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Paffenbarger Award Finalists

P1. Experimental Self-Adhesive Composites for Bulk-Fill Applications. **P.P.A.C Albuquerque*[1]**, V.E. Salgado[2], C.E. Francci[1], A.C. Nishida[1], L.M. Cavalcante [2,3], L.F. Schneider[3,4] ([1] University of São Paulo, Department of Dentistry, São Paulo, Brazil; [2] Salgado De Oliveira University, Niteroi, Rio De Janeiro Brazil; [3] Federal Fluminense University, Niteroi, Rio De Janeiro, Brazil; [4] Veiga De Almeida University, Rio De Janeiro, Brazil).

P2. Effect of Photoinitiator System on Polymerization of Methacrylamides. **L.M. Barcelos[1*]**, M.G. Borges[1], C.J. Soares[1], M.S. Menezes[1], A.P.P. Fugolin[2], A. Dobson[2], V. Huynh[2], C.S. Pfeifer[2] ([1] Federal University of Uberlandia, Brazil; [2] Oregon Health and Science University, USA).

P3. Thio-Urethane Addition effect on Sol-Gel Composition of Bis-GMA/TEGDMA Networks. **M.G. Borges[1*]**, L. Barcelos[1], M.S. Menezes[1], C.J. Soares[1], A.P.P. Fugolin[2], O. Navarro[2], V. Huynh[2], C.S. Pfeifer[2] ([1] Federal University of Uberlândia, Br, [2] Oregon Health and Science University, USA).

P4. Novel Super-Speed Sintered Zirconia by Microwave Technology. **N.C. Ramos [1,2*]**, M.R. Kaizer [1], J.N. Luz [2], L.C. Anami [3], V.P. Thompson [1], G.S.F.A. Saavedra [2], Y. Zhang [1] ([1] New York University College of Dentistry, USA; [2] Sao Paulo State University - Sao Jose Dos Campos, Brazil; [3] Santo Amaro University, Brazil).

P5. Non-Agglomerated Ionic Liquid-Stabilized Titania Quantum Dots in Adhesive Resin. **I.M. Garcia*[1]**, V.S. Souza [2], C. Hellriegel [3], J.D. Scholten [2], F.M. Collares [1] ([1] Federal Department of Conservative Dentistry, University of Rio Grande Do Sul, Porto Alegre, Brazil, [2] Institute of Chemistry, Federal University of Rio Grande Do Sul, Porto Alegre, Brazil, [3] Carl Zeiss Microscopy GmbH, Jena, Germany).

P6. Effect of Zinc/Copper Nanoparticles on Bonding to Artificially Caries-Affected Dentin. **M.F. Gutiérrez*[1,2]**, L. Mendez-Bauer [1], L.F. Alegría-Acevedo [1], A. Dávila-Sánchez [1,3], J. Bermudez [1], A. Nuñez [1], A. Reis [1], A.D. Loguercio [1], P.V. Farago [4], E. Fernandez [2,5] ([1] School of Dentistry, State University of Ponta Grossa, Brazil; [2] Dentistry, University of Chile, Chile; [3] Department of Restorative Dentistry and Biomaterials, San Francisco De Quito University, Ecuador; [4] Department of Pharmaceutical Sciences, State University of Ponta Grossa, Brazil; 5 Instituto De Ciencias Biomédicas, Universidad Autónoma De Chile, Chile).

P7. Chemical and Structural Characterizations of an Experimental Silica/Y-TZP Glass-Ceramic. **V. Mosquim*[1]**, B.M. Ferrairo [1], C. A. Fortulan [1], P.N. Lisboa-Filho [2], A.G. Magdalena [2], F.M.L. Pontes [2], E.A. Bonfante [1], P.F. Cesar [1], A.F.S. Borges [1] ([1] University of São Paulo, Brazil, [2] São Paulo State University, Brazil).

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M2. Novel Strong Graded High-Translucency Zirconias for Broader Clinical Applications. **M.R. Kaizer***, Y. Zhang (Department of Biomaterials and Biomimetics - New York University College of Dentistry, New York, USA).

M3. Damage Tolerance in CAD/CAM Restorative Materials. **C.B. Tanaka*[1]**, Y. Zhang [2], J.J. Kruzic [1] ([1] School of Mechanical and Manufacturing Engineering, University of New South Wales, Sydney, Australia; 2 Department of Biomaterials and Biomimetics, New York University, New York, USA).

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1. Fracture Load of Fully Stabilized Zirconia with Different Thicknesses. **G.L. Adabo***[1], D. Longhini[1], C.O.M Rocha[1], L.T. Oliveira[1], N.G. Olenscki[1], E.A. Bonfante[2] ([1]Sao Paulo State University, Brazil,[2]University of Sao Paulo, Brazil).

2. Porosity Analysis of Endodontic Cements after Phosphate Buffer Solution Storage. **N. Aguiar***, GB Leoni, AFS Barbosa, IR Oliveira, YTC Silva-Sousa, LMS Castro-Raucci, W. Raucci-Neto, (Odontology, University of Ribeirão Preto, Ribeirão Preto, Brazil).

3. Discrepancies of Zirconia Crowns under Different Preparations and Sintering Techniques. **W. Ahmed***, A. Mccullagh, C. Wyatt, T. Troczynski, R. Carvalho (University of British Columbia, Canada).

4. Clinical Performance of Bulk-Fill and Incremental Restorations in Endodontically-Treated Molars. R.A.S. Pereira, C.J. Soares, L.R.S. Oliveira, S.S.L. Braga, L.M. Barcelos, **R.A. Deus*** (Federal University of Uberlândia, Uberlândia, Brazil).

5. Subsurface Microhardness of Affected Dentin after Biomidification with Phosphorylated Chitosan. G.S. Tanta[1], **F.A. Curylofo-Zotti***[1], A.B. Reis[2], A.P. Macedo[1], A.E. Souza-Gabriel[1], S.A.M. Corona[1] ([1]University of São Paulo, Brazil, [2] Federal University of Vale Do Jequitinhonha and Mucuri, Brazil).

6. Strength and Reliability of Leucite versus Lithium Disilicate Glass ceramics. **A.A. Alonso*[1,2]**, R. Belli[2], U. Lohbauer[2] ([1]São Paulo State University (Unesp), Institute of Science and Technology, São José Dos Campos, Brazil, [2] University of Erlangen-Nuremberg, Research Laboratory for Dental Biomaterials, Erlangen, Germany).

7. Wear of Zirconium-Reinforced Lithium Silicate Ceramic against Several Restorative Materials. **L.M.M. Alves*[1]**, L.P.C. Contreras[1], T.M.B. Campos[2], M.A. Bottino[1], L.F. Valandro[3], R.M. Melo[1] ([1]São Paulo State University, Br, [2] Aeronautics Technological Institute, Br,[3] Federal University of Santa Maria, Br).

8. Mechanical Performance of CAD/CAM Materials Adhesively Bonded to NG10. I.S.S.L. Weitzel[1], M.P. Perim[1], J.H.R. Rangel[1], L.R. Silva-Concílio[1], A.L.S. Borges[2], R.M. Melo[2], **M. Amaral***[1] ([1]University of Taubate, Br, [2]Sao Paulo State University/SJC, Br).

9. Dentin Pre-Treatment with EGCG SOLUTION: Long-Term Nanoleakage and Bond Strength. M.P.N. Fialho[1], R.P. Nogueira[2], F.G.M. França[1], C.P. Turssi[1], R.T. Basting[1], V. Hass[3], **F.L.B. Amaral***[1] ([1]São Leopoldo Mandic Dental School and Research Center, Brazil, [2]Florence Institute, Brazil,[3]Ceuma University, Brazil).

10. Gap Evaluation of Milled Chrome-Cobalt Full-Arch Implant-Supported Frameworks. J.D.M. Silva, A. Callegari, A.C.Pimentel, **L.C. Anami*** (Santo Amaro University (Unisa), Brazil).

11. Anti-Caries Agents Incorporation Effects on Color Shade of Composites. **C.B. Andre***[1], P.L. Rosalen[1], J.L. Ferracane[2], M. Giannini[1] ([1]Piracicaba Dental School - State University of Campinas, Br, [2]Oregon Health and Sciences University, USA).

12. MMP Gene Expression and Bond Strength to Proanthocyanidin-Biomodified Air-Dried Dentin. **G Anovazzi*[1]**, D.L.S. Scheffel[1], D.G. Soares[2], E.A.F. Bordini[1], C.A. De-Souza-Costa[1], J. Hebling[1] ([1]School of Dentistry at Araraquara, Unesp- Univ Estadual Paulista, Araraquara, Brazil; [2] Bauru School of Dentistry, University of São Paulo, Bauru, Brazil).

13. Bond Strength of Y-TZP to Resin Cements: Surface Treatment Effects. **L. L. Arashiro*[1]**, Y. P. Correa[1], Q.C. Nguyen[2], P. F. Cesar[1], S. M. Salazar-Marocho[2] ([1]Departament of Biomaterials and Oral Biology, University of São Paulo, São Paulo, Br, [2] Department of Biomedical Materials Science, University of Mississippi Medical Center, USA).

14. TT-Farnesol-Containing Ionomeric Cement: Chemical Mechanical Characterization and S.Mutans Virulence. **I.J.S. Araújo*[1]**, A.R.F. De Castilho[1], I.L. Kitagawa[2], P.N. Lisboa Filho[2], R.N. Stipp[1], P.L. Rosalen[1], R.M. Puppin-Rontani[1] ([1] Piracicaba Dental School - State University of Campinas, Piracicaba, Brazil, [2]São Paulo State University, Department of Physics, Bauru, Brazil).

15. Fatigue Testing Machine Design for Dental Ceramics: A Validation Study. **P. Baldissara*[1]** , C. Parisi[1], C. Castelletti[1], R. Scotti[1], V.F. Wandscher[2], R. Garcia Fonseca[3], L. Ciocca[1] ([1]University of Bologna, Italy, [2]Franciscan University of Santa Maria, Brazil,[3] Araraquara Dental School, Araraquara, Sao Paulo, Brazil).

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18. Effect of Thermocycling on Bond Strength of Restorative Composites. **I.M. Barros*[1]**, L.M.M. Alves[1], L.T. Yamamoto[2], R.N. Tango[1] ([1]São Paulo State University, Br, [2]Santo Amaro University, Br).

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37. Correlation between Fluoride Release and Acid Erosion of Glass-Ionomer Cements. **L.S. Bueno***[1], R.S. Menezes[1], A.P. Magalhães[2], M.F.L. Navarro[1], R.C. Pascotto[3], S.C. Leal[4], M.A.R. Buzalaf[1], A.F.S. Borges[1] ([1] São Paulo University, Br,[2] University From São Paulo (Unip), Br,[3] State University of Maringá (Uem), Br,[4] University of Brasília (Unb)).

38. Strength Behavior of Veneered Zirconia after Different Surface Treatments. **S. Butler***[1], B. Linke[2], J.A. Nychka[2] ([1] Western University, London, Canada,[2] University of Alberta, Edmonton, Canada).

39. Can a Multi-Mode Adhesive Substitute Silicatization+Silanization in Zirconia Ceramics? A.M.M. Araújo[1], A.B.N. Januário[1], D.M.D. Moura[1], **P.S. Calderon***[1], J.P.M. Tribst[2], M. Özcan[3], R.O.A. Souza[1] ([1] Federal University of Rio Grande Do Norte, Brazil,[2] São Paulo State University, Brazil,[3] University of Zurich, Switzerland).

40. Antimicrobial Properties and Cytotoxicity of a Modified Polymer. **K.P.L. Campos***[1], M.B. Portela[2], R. Hirata Jr[3], L.M.A. Cavalcante[2], D.M. Telles[1] ([1] School of Dentistry, Rio De Janeiro State University - Uerj, Rio De Janeiro, Brazil,[2] School of Dentistry, Federal Fluminense University - Uff, Niterói, Brazil,[3] School of Medical Sciences, Rio De Janeiro State University - Uerj, Rio De Janeiro, Brazil).

41. Influence of Preheating in Microhardness of Bulk Fill Composite Resins. **PG Warmling***, FS Wolff, L Guerra, SB Silva, RG Machado (School of Dentistry, Federal University of Santa Catarina, Florianópolis, Br).

42. Antimicrobial Effect of TiO^2 Nanotubes Coating for Dental Implant. **P. Capellato**[1*], A. P. R. A. Claro[2], G. Silva[3], C. A. C. Zavaglia ([1,3] Unifei- Federal University of Itajubá, Brazil,[2] UNESP- Univ. Estadual Paulista, Brazil,[4] Unicamp- State Uni. of Campinas, Brazil).

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44. Evaluation of Bromelain as a New Dentin Pre Treatment. **C.L. Capillé***, J. Cuccinelo, K. Martins, E.M. Silva, M.B. Portela (Federal Fluminense University).

45. Effect of a Proanthocyanidin Mouthrinse on Dentin Erosion. **F. Cardoso***[1], A. P. Boteon[1], T. A. P. Da Silva[1], T. L. Bueno[1], A. Prakki[2], L. Wang[1], H. M. Honório[1] ([1] Bauru School of Dentistry, University of São Paulo, Bauru, Brazil,[2] Faculty of Dentistry, University of Toronto, Toronto, Canada).

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50. Effect of Toothbrushing with Fluoride-Containing Dentifrices on Ceramic Optical Properties. F. Bidoli[1], **E. Castro***[1], V.L.B. Azevedo[1], G. Nima[1], O.S. De Andrade[2], M. Giannini[1] ([1] State University of Campinas, Piracicaba, Brazil,[2] National Service of Commercial Learning (Senac), São Paulo, Brazil).

51. Thiourethane-Functionalized Fillers: Characterization in Model Composite Materials. A.B.Ramos[1], D.C.Silva[2], G.G.Alves[2], R.Hirata-Júnior[3], L.F.J Schneider[4], C.S. Pfeifer 5, **L.M.Cavalcante***[4],**6** ([1] Federal Fluminense University - Uff, Niterói, Brazil[2] Institute of Biology, Federal Fluminense University - Uff, Niterói, Brazil[3] Faculdade De Ciências Médicas, Universidade Do Estado Do Rio De Janeiro , Rio De Janeiro, Brazil.[4] Federal Fluminense University - Uff, Niterói, Brazil, 5 Biomaterials and Biomechanics, Oregon Health and Science University, Oregon, USA, 6 Brazil and Nucleus for Dental Biomaterials Research, Veiga De Almeida University - Uva, Rio De Janeiro, Brazil).

52. Violet Led Bleaching: Efficacy and Enamel Surface Morphology Analysis. M.Kury[1], B. Rezende[1], B.C. Mendonça[1], E.F. De Castro[1], F. A.Rueggeberg[2], M. Giannini[1], **V. Cavalli**[1]* ([1] University of Campinas, Piracicaba Dental School, Br;[2] Augusta University, USA).

53. Ca(OH)[2] Sustained Release From a Cactus Extract Vehicle. **B.I. Cerda-Cristerna***, J.L Suárez-Franco, A. Tlaxcala-Tlaxcala, M.V. Hernández-Mixteco (Universidad Veracruzana Región Orizaba-Córdoba, México).

54. Effect of Oxidizing Agents on Bond of New Self-Adhesive Cement. **L. Chen***, J. Yang, B.I. Suh (Bisco Inc, USA).

55. Development of a Phosphoric Acid Containing Proanthocyanidin as Cross-Linker Agent. **Y.C. Del Rey***[1], L.M.R. Roselino[1], R. França[2], C. Fiuza[2], A.C.B.C.J. Fernandes[2] , R.G. Palma-Dibb[1] ([1] University of Sao Paulo, Department of Restorative Dentistry, Ribeirão Preto, Brazil,[2] University of Manitoba, Department of Restorative Dentistry, Winnipeg, Canada).

56. Does a Self-Etch-Glass-Ceramic-Primer Etch Feldspathic Ceramic? A FE-SEM Analysis. **B. Chrispim***[1], Dr Consoni[1], Cl Baratieri[1], J Perdigão[2], GC Lopes[1] ([1] Federal University of Santa Catarina, Br,[2] University of Minnesota, USA).

57. Does MDP-Based Adhesive Associated with Chloerhexidine affect Bonding to Dentin? **M.C. Giacomini***[1], P.M.C. Scaffa[1], R.S. Gonçalves[1], G.S. Zabeu[1], M.A.S. Agulhari[1], J.C. Jacomine[1], C.M.P. Vidal[2], M.R.O. Carrilho[3], H.M. Honório[1], L. Wang[1]. ([1] Bauru School of Dentistry, University of São Paulo, Bauru, Brazil;[2] College of Dentistry, University of Iowa, Iowa City, USA;[3] Research Faculty College of Dental Medicine – Illinois, Midwestern University, USA).

58. Antibacterial Activity of Dental Composite: Four Months Evaluation. L.T.S. Silva[1], K. Cogo-Muller[2], L.C. Anami[1], L.M.P. Campos[3], D. Parra[3], **L.C.C. Boaro**[1]* ([1]- Universidade Santo Amaro, Brasil;[2]-Unicamp, Brasil;[3]-Ipen/USP, Brasil).

59. CAD/CAM or Conventional Ceramic Restorations Longevity: Systematic Review and Meta-Analysis. **J.A.D. Coelho***, S.B. Rodrigues, P. Franken, R.K. Celeste, V.C.B. Leitune, F.M. Collares (Federal University of Rio Grande Do Sul).

60. Carbodiimide effect on MMPs and Hybrid-Layer Micro-Hardness in Radicular Dentine. **A. Comba***[1], T. Maravic[1], A. Mazzoni[1], L. Breschi[1] , G. Serino[2], A. Audenino[2], M Cadenaro[3], M. Alovisi[4], N. Scotti[4] ([1] University of Bologna, Dibinem;[2] Politecnico Di Torino, Department of Mechanical and Aerospace Engineering;[3] University of Trieste;[4] University of Turin, Department of Surgical Sciences).

61. Influence of Occlusal Splint on Implant-Supported Fixed Dental Prosthesis (FEA). **L.R. Silva-Concilio***[1], M.N. Henrique[1], R.A. Caldas[2], M. Amaral[1], R.P. Vitti[1] ([1] University of Taubaté, Br -[2] State University of Campinas, Br).

62. Bioglass Air-Abrasion Influences Bonding and Conversion of an Etch-And-Rinse Adhesive. **K.E. Moura**[1]*, T.O. Rifane[1], L.K. Solheiro[1], F. Silvestre[1], A.M.P. Ponte[1], M.M. Moreira[1], M.T. Souza[2], E.D. Zanotto[2], S. Sauro[3], V.P. Feitosa[1] ([1] School of Dentistry, Paulo Picanço Fortaleza, Brazil,[2] Department of Materials Engineering, Federal University of São Carlos, São Carlos, Brazil,[3] Dental Biomaterials, Preventive & Minimally Invasive Dentistry, Ceu Cardenal Herrera University, Valencia, Spain).

63. Flexural Strength and Flexural Modulus of Urethane Resin-Based Resin Composites. **A.B. Correr***, J.P. Curtulo, M.A.C. Sinhoreti, L. Correr-Sobrinho (Piracicaba Dental School, University of Campinas, Piracicaba, Br).

64. Effect of Resin-Cements Containing Thio-Urethane on Bond Strength after Aging. **L. Correr-Sobrinho***[1], A.R. Costa[1], A.P. Fugolin[2], L.P.S. Borges[1], J.L. Ferracane[2], C.S. Pfeifer[2] ([1] Restorative Dentistry, State University of Campinas, Piracicaba, Br,[2] Restorative Dentistry, Oregon Health & Science University, Portland, USA).

65. Cleaning Methods and Contamination with Saliva/Blood Affects Ceramic Bond Strengths. **A.R. Costa***[1], R. Araújo Jr.[1], D. Sundfeld Neto[2], J Puppin-Rontani[1], A.B. Correr[1], L. Correr-Sobrinho[1] ([1] Restorative Dentistry, State University of Campinas, Piracicaba, Br,[2] Centro Universitário Ingá, Dentística E Prótese, Maringá, Br).

66. Two-Year Clinical Evaluation of Proanthocyanidins Added to an Adhesive System. **D.A. Cunha**[*1], N.S. Rodrigues[1], L.C. Souza[1], V.P. Feitosa[1], S.L.Santiago[1], A.Reis[2], A.D.Loguercio[2], J.Perdigão[3] V. Saboia[1] ([1] Federal University of Ceará, Br,[2] State University of Ponta Grossa, Br,[3] University of Minnesota, USA).

67. Enzymatic Activity of the Hybrid Layer of Irradiated Teeth. **SR Cunha**[*1,2], T Maravic[1], AA Comba[1], AC Aranha[2], ER Fregnani[3], G Tetti[1], L Breschi[1] A Mazzoni[1] ([1]University of Bologna, Italy;[2]University of Sao Paulo, Brazil;[3]Hospital Sírio Libanês, Brazil).

68. Drug-Delivery at Endodontic Materials: In Vitro and In Vivo Behavior. **M. Cuppini**[*1], K.C. Zatta[2], L.B. Mestieri[1], F.S. Grecca[1], V.C.B. Leitune[1], S.S. Guterres[2] and F.M. Collares[1]. ([1] School of Dentistry, Universidade Federal Do Rio Grande Do Sul, Porto Alegre, Brazil;[2] School of Pharmaceutical Sciences, Universidade Federal Do Rio Grande Do Sul, Porto Alegre, Brazil).

69. Physical and Adhesion Properties of Bulk-Fill Composites. **B. C. Mendonça**[*1], F. Rueggeberg[2], R. R. Braga[3], J. Soto[1], M. Sebold[1], G. M. B. Ambrosano[4], M. Giannini[1] ([1]Department of Restorative Dentistry, University of Campinas, Piracicaba, Brazil,[2]Department of Restorative Sciences, Dental College of Georgia, Augusta University, USA,[3]Department of Biomaterials and Oral Biology, University of Sao Paulo, Sao Paulo, Brazil,[4]Department of Social Dentistry, University of Campinas, Piracicaba, Brazil).

70. Universal Adhesive System and Resin-Based Fissure Sealant Sorption and Solubility. G. Botton, **L.S. Da Rosa***, F.M.Z. Soares, R.O. Rocha (Federal University of Santa Maria, Br).

71. Bond Strength of Recycled Metallic Brackets after Different Surface Treatments. R. G. Viana[1], N. F. Piller[1], L. M. Campaner[1], F. A. Maeda[1], T. Triviño[1], P. F. Cesar[2], **L. H. Silva**[*1] ([1] Universidade Cidade De São Paulo, Brazil,[2] Universidade De São Paulo, Brazil).

72. Anti-Proteolytic Agents on Shear Bond Strength: Systematic Review and Meta-Analysis. **F.S. Camim***, M. Vertuan, D.C. Santin, R.F.L. Mondelli, L. Wang, H.M. Honório (Bauru School of Dentistry, University of São Paulo, Bauru, Brazil).

73. Translucent Zirconia: Mechanical Reliability, Fatigue Strength, Survival and Phase Analysis. G.K.R. Pereira[1,2], L.F. Guilardi[2,3], **K.S. Dapieve**[*2], C.J. Kleverlaan[3], M.P. Rippe[2], L.F. Valandro[2] ([1] Meridional Faculty, Imed, Passo Fundo, Brazil[2] Faculty of Odontology, Federal University of Santa Maria, Santa Maria, Brazil[3] Academic Centre for Dentistry Amsterdam (Acta), Universiteit Van Amsterdam and Vrije Universiteit, Amsterdam, the Netherlands).

74. Antimicrobial Potential of Resin Matrices with Coffee Compounds. **S De Almeida**[*1], L Poskus[1], J Ferracane[2], J Noronha[1], A Mushashe[3], J Merritt[2], R Velloso[1] ([1] Universidade Federal Fluminense, Br,[2] Oregon Health & Science University,[3] Universidade Positivo, Br).

75. Effect of Removal of Temporary Cement on Zirconia-Dentin Bond Strength. **G.M. Araújo**[1*], D.M.D. Moura[1], T.E.L. Vila-Nova[1], I.H.G. Carvalho[1], A.H. Veríssimo[1], A.B.N. Januário[1], S.E.G. Silva[1], K.B. Souza[1], A.M.O. Dal Piva[2], R.O.A. Souza[1]. ([1] Federal University of Rio Grande Do Norte, Natal, Brazil;[2] State University of São Paulo, São Paulo, Brazil).

76. Niobium Silicate as Filler Particle on Experimental Photopolymerizable Resin Cement. **E.Z. Figueiredo***, G.S.Balbinot, F.M. Collares, V.C.B. Leitune, S.W. Samuel. (School of Dentistry, Federal University of Rio Grande do Sul, Porto Alegre, Brasil).

77. Long-Term Effectiveness of CAD/CAM Materials Provided by Self-Etching Silane Primer. **M. De Goes**[1*], F. Murillo-Gómez[2] ([1]Piracicaba Dental School, University of Campinas, Brazil;[2] School of Dentistr, University of Costa Rica, San José, Costa Rica).

78. Can Protease Inhibitors Stabilize the Adhesive Interface after Cariogenic Challenge? **R.V. De Paiva***, J.C. Dos Santos, A.V. Dos Reis, G.B. Santos, E.M. Da Silva, M.B. Portela (Federal Fluminense University, Niteroi, Br).

79. Clinical Evaluation of Restorations in Cervical Lesions with Copper-Containing Adhesive. **T.P. Matos**[*1], T.A. Hanzen[1], M.F. Gutiérrez[1,2], P. Malaquias[1], A.M. De Paula[1], A. Serrano[1], J.J De Souza[1], V. Hass[3,4], A.D Loguercio[1] ([1] School of Dentistry, State University of Ponta Grossa, Ponta Grossa, Brazil,[2] Faculty of Dentistry, University of Chile, Santiago, Chile,[3] University Ceuma, São Luís, Brazil,[4] State University of West Paraná, Cascavel, Brazil).

80. Pre-Treatment Using Natural Collagen Cross-Linkers on Dentin Bonding and Biomodification. **D.M. De Paula**[1,2*]; A.M.P. Da Ponte[1], M.P. De Lima[1], D. Lomonaco[3], S.E. Mazzetto[3], V.P. Feitosa[1,2] ([1] Paulo Picanço School of Dentistry, Fortaleza, Brazil;[2] Dental School, Federal University of Ceará, Fortaleza, Brazil;[3] Department of Organic and Inorganic Chemistry, Federal University of Ceará, Fortaleza, Brazil).

81. Retention Rates of Cervical Restorations: A Systematic Review and Meta-Analysis. **A.M Paula**[*1], T.F. Boing[2], L.M. Wambier[3], T.A. Hansen[1], A.D. Loguercio[1], A. Reis[1] ([1] State University of Ponta Grossa, Br,[2] Guairacá College, Br,[3] Positivo University, Br).

82. Dentin Bimodification with EGCG: Two-Year Clinical Evaluation. **A.M.B. De Souza**[*1,2], C.A.G.A. Costa[1,2], N.L.A. Guimarães[1,3], A.L.M. Mota[1], J.S. Mendonça[1], A.D. Loguercio[4], V.P.A. Sabóia[1], S.L. Santiago[1] ([1] Federal University of Ceará, Br,[2] University of Fortaleza, Br,[3] University Center of Christus, Br[4] State University of Ponta Grossa, Br).

83. Synthesis of Sol-Gel Derived Calcium Silicate with Calcium Tungstate Addition. **GS Balbinot***, BV Cezimbra, VCB Leitune, FM Collares (Universidade Federal do Rio Grande do Sul, Porto Alegre, Br).

84. Remineralization of Early Caries Lesion by Application of Different Materials. **A. N. S. Rastelli**[*1], A. C. P. Barros[1], M. T. Souza[2], O. Peitl[2], E. D. Zanotto[2] ([1] School of Dentistry, University of São Paulo State Araraquara, Araraquara, Brazil,[2] Materials Engineering Department, Federal University of São Carlos - Ufscar, São Carlos, Brazil).

85. The Effect of Ionizing Radiation on Monolithic Zirconia. A.A. Alshamrani, **G.M. De Souza*** (Faculty of Dentistry, University of Toronto, Canada).

86. Effect of Bromelain Gel on Demineralized Dentin Bond Strength. **G.D.T.B. Ferreira**[*1], E.F. Martinez[2], R.T. Basting[3] ([1] University of Amazon State, Brazil;[2] São Leopoldo Mandic Institute College, Brazil).

87. Optical Coherence Tomography in Evaluation of Veneer's Cementation Layer. **T.J.C. Dias**[*1], C.C.B.O. Mota[2], L.O. Fernandes[1], P.F.C.Silva[1], S.L.Campelo 5, L.S.A. Melo[1], N.S.M. Pires[1], A.S.L. Gomes[1] ([1] Universidade Federal De Pernambuco, Brazil,[2] Faculty of Dentistry Centro Universitário Tabosa De Almeida, Brazil).

88. Bonding of Silanes to a Glass-Ceramic with and without Etching. **M.Dimitriadi***, M. Zafeiropoulou, G.Eliades (National and Kapodistrian University of Athens, School of Dentistry, Greece).

89. TiO^2 Nanotubes Incorporation in Y-TZP Surface: Synthesis, Characterization and Biocompatibility. **A.F. Santos***[1], F.S. Lucena[1], A.Y. Furuse[1], P.N. Lisboa-Filho[2], A.F.S. Borges[1] ([1] Bauru School of Dentistry, University of São Paulo, Bauru, Br;[2] School of Sciences, São Paulo State University, Department of Physics, Bauru, Br).

90. Color Stability and Roughness of Cover Materials over Composite Resin. **L.S. Cortopassi***, S.J.C. Bezerra, C.A.K. Shimokawa, M.A.P. Sobral (Department of Restorative Dentistry, University of São Paulo, São Paulo, Brasil).

91. Influence of Protease Inhibitors on Sound, Sclerotic and Caries-Affected Dentin. **P.H. Dos Santos***[1], B. Oliveira-Reis[1], A.T. Maluly-Proni[1], H.B.S. Sahyon[1], G. Vasconcelos[2], E. Bresciani[1], A. Prakki[3], A.L.F. Briso[1], T.C. Fagundes[1] ([1] São Paulo State University, Brazil,[2] Institute of Advanced Studies of São José Dos Campos, Brazil,[3] University of Toronto, Canada).

92. Diphenyl-Iodonium Modulating Properties of Resins with Low Concentrations of Camphorquinone. **D. Dressano***[1], M. Hadis[2], L. S. Gonçalves[3], D. C. Watts[4], W. M. Palin[2], G. M. Marchi[1], A. F. Lima 5 ([1] Department of Restorative Dentistry, State University of Campinas, Brazil,[2] College of Medical and Dental Sciences, Institute of Clinical Studies, University of Birmingham, UK,[3] Department of Conservative Dentistry, Federal University of Rio Grande Do Sul, Brazil,[4] School of Medical Sciences and Photon Science Institute, University of Manchester, Manchester, UK, 5 Dental Research Division, Paulista University, Sao Paulo, Brazil).

93. Repair of Resin Nanoceramic: Effect of Aging and Surface Treatments. **D.M.D. Moura***[1], A.B.N. Januário[1], A.H. Veríssimo[1], A.M.O. Dal Piva[2], G.M. Araújo[1], T.E. L. Vila-Nova[1], S.E.G.Silva[1], I.H.G. Carvalho[1], K.B. De Souza[1], R.O.A. Souza[1] ([1] Department of Dentistry, Federal University of Rio Grande Do Norte (Ufrn), Natal, Brazil;[2] Institute of Science and Technology, São Paulo State University (Unesp), São José Dos Campos, São Paulo, Brazil).

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94. Aesthetic and Biological Analysis of an Experimental Tooth-Bleaching Gel. **CCO Duque***[1], DG Soares[2], MLAS Leite[1], G Anovazzi[1], UO Zuta[1], EAF Bordini[1], J Hebling[1], CA De Souza Costa[1] ([1] University of the State of São Paulo – Unesp, Araraquara, Brazil,[2] University of São Paulo - Usp, Bauru, Brazil).

95. Polymerization of Dual Resin Cements Light-Cured Through Different Ceramic Materials. **L. Fanfoni***[1], G. Marchesi[1], F. Baccarini[1], G. Turco[1], L. Breschi[2], M. Cadenaro[1] ([1] University of Trieste, Italy,[2] University of Bologna, Italy).

96. Water Sorption, Solubility and Dentin Bonding of Experimental Self-Adhesive Composites. **VP Feitosa**[1,2*], BM Costa[1], DM De Paula[1], FM Milan[2], S Sauro[3] ([1] Restorative dentistry Department, Federal University of Ceará, Fortaleza, Brazil,[2] Research Division, Paulo Picanço School of Dentistry, Fortaleza, Brazil,[3] Department of Dental Biomaterials and Minimally Invasive Dentistry, University Ceu-Cardenal Herrera, Valencia, Spain).

97. Nanoparticulation and Characterization of Natural Hydroxyapatite Originated From Bovine Bone. **B.M. Ferrairo***[1], V. Mosquim[1], L.A. Pires[1], PF Cesar[2]; C. A. Fortulan[3]; P.N. Lisboa-Filho[3]; A.G. Magdalena[4]; F.M.L. Pontes[4]; A.F.S. Borges[1]; J.H. Rubo[1]. ([1] Bauru School of Dentistry, University of São Paulo, Bauru, Brazil;[2] School of Dentistry, University of São Paulo, , São Paulo, Brazil;[3] São Carlos School of Engineering, University of São Paulo, São Carlos, Brazil;[4] School of Science, São Paulo State University, Bauru, Brazil).

98. Failure Load of Fatigued CAD/CAM Endocrowns: Material And Thickness Effect. **C.F.L. Madruga***, J.P.M. Tribst, A.M.O. Dal Piva, E. Bresciani, M.A. Bottino, R.M. Melo (Institute of Science and Technology, São Paulo State University (Unesp), São José Dos Campos, Brazil).

99. Phase, Roughness And Young's Modulus Of Y-TZP Ceramic after Grinding. **L. Fiorin***, I.C.M. Moris, A.C.L. Faria, R.F. Ribeiro, R.C.S. Rodrigues (Ribeirão Preto Dental School, University of Sao Paulo, Br).

100. Contemporary Composites SEM Polishing Quality and Surface Porosity Level. **N.F. Coelho***, R.Q. Ramos, R.M. Gondo, D.R. Consoni, G.C. Lopes (Federal University of Santa Catarina, Brazil).

101. Chlorhexidine-Containing Phosphoric Acid Compromises Bonding Stability of Universal Adhesive. L.S. Da Rosa, **A.C. Follak***, T.L. Lenzi, R.O. Rocha, F.Z.M. Soares (Department of Restorative Dentistry, Federal University of Santa Maria, Santa Maria, Brazil).

102. Bonding Effectiveness of Multi-Mode Adhesive to Pre-Etched Dentine. C.T.P. Araújo[1], **J.F.B. Fonseca***[1], K.C. Santos[1], G. Abuna[2], A.B Meirelles[1], S.P.A. Guimarães[1], L.T. Prieto[2], A.C. Dayrell[1] ([1] Federal University of Jequitinhonha and Mucuri Valley, Brazil,[2] State University of Campinas, Brazil).

103. Ferrule Thickness on Fracture Resistance of Teeth Restored with Posts. **P.E. Fontana***[1], T.C. Bohrer[1], V.F. Wandscher[2], L.F. Valandro[1], I.F. Limberger[1], O.B. Kaizer[1] ([1] Federal University of Santa Maria, Santa Maria, Brazil,[2] Franciscan University, Santa Maria, Brazil).

104. Influence of Bulkfill Composite Viscosity on Microhardness and Fracture Resistance. **F.M.G. França***, I.P. Broglio, L.E.J. Paiva, R.T. Basting, C.P. Turssi, F.L.B. Amaral (São Leopoldo Mandic Institute and Dental Research Center).

105. Mechanical Characterization of Lithium-Disilicate Glass-Ceramics by Nanoindentation. CT Fiuza, M Aramfard[2], C Deng[2], **R França*** (University of Manitoba, Winnipeg, Manitoba, Canada).

106. Effect of Bioactive Glasses for Controlling Enamel Erosion. **A. Freire***[1,2], B.P. Nyland[2], C.P. Pereira[2], P. Soares[2], D.S.L. Weiss[2], W.L. Mikos[3], J.A. Brancher[2], S. Vieira[2] ([1] Universidade Federal De Mato Grosso Do Sul, Br;[2] Pontifícia Universidade Católica Do Paraná, Br;[3] Universidade Tecnológica Federal Do Paraná, Br).

107. Effect of Brushes Cleanliness with Different Substances on Composite Resins. **M.S. Freitas***, R.V. Monteiro, V.C. Ruschel, J.K. Bernardon, S.Jr. Monteiro (Department of Dentistry, Federal University of Santa Catarina, Florianópolis, Brazil).

108. Refractive Index Matching Effect on Depth of Cure Of Composites. **B.M. Fronza***[1], S. Lewis[2], P. Shah[2], M. Giannini[1], J. Stansbury[2] ([1] University of Campinas, Br,[2] University of Colorado, USA).

109. Adhesive Performance of Universal Adhesives Containing Zinc-Oxide and Copper Nanoparticles. Gutiérrez MF[1,2], Alegría-Acevedo LF[1], Mendez-Bauer L[1], Bermudez J[1], Dávila-Sánchez A[1,3], Reis A[1], Loguercio AD[1], Farago PV[4], **Fernandez E*2,5** ([1] School of Dentistry, State University of Ponta Grossa, Ponta Grossa, Br;[2] Faculty of Dentistry, University of Chile, Santiago, Chile;[3] Department of Restorative Dentistry and Biomaterials, San Francisco De Quito University[4] Department of Pharmaceutical Sciences, State University of Ponta Grossa, Ponta Grossa, Br; 5 Instituto De Ciencias Biomédicas, Universidad Autónoma De Chile, Chile).

110. The effect of Air Stream Flow on Ceramic/Resin Bond Strength. **G. A. Galhano***, B.C.T Silva, L. V. S Cota, L. M. S Alves, R.L Prado, L. S. A. Matuda (University of Western Sao Paulo, Br).

111. Guanidine Solution as a New Fungicidal for Heat-Polymerized Acrylic Resins. **M.E.R. Gama***, I.M. Garcia, S.B. Rodrigues, V.C.B. Leitune, F.M. Collares (UFRGS, Porto Alegre, Br).

112. Virtual Articulator Accuracy in Determination of Occlusal Contacts. **I García[1]***, K Zurita[1], L Bohner[2], D Gamba[2], C Pannuti[2], K Roberta[2], D Marques[2], PT Neto[2] ([1] Universidad Central Del Ecuador, Ecuador,[2] Universidade De São Paulo, Brazil).

113. Influence of Infiltrant Application Time on Caries Lesions Opaqueness. **G.G. De Carvalho*[1]**, A.C. Pires[2], F.B. De Sousa[3] ([1] São Paulo State University, Araraquara, Br;[2] Paraíba State University, Campina Grande, Br;[3] Federal Unirsity of Paraíba, João Pessoa, Br).

114. Effects of Light-Activation Time on Flexural Strength of Bulk-Fill Composites. B.C. Mendonça[1], F.A. Rueggeberg[2], E.F. Castro[1], M. Kury[1], V. Cavalli[1], **M. Giannini*[1]** ([1] University of Campinas, Brazil,[2] Augusta University, USA).

115. Bond Strength of Water-Free Adhesive Systems to Cross-Linked, Air-Dried Dentin. **L.N. Gomes***, M. Citta, G. Anovazzi, C.A. De Souza Costa, J. Hebling (Araraquara School of Denstry, São Paulo State University, Araraquara, Br).

116. BioGran® Funtionalized with PTH(1-^{34}) on Peri-Implant Defect in Orchiectomized Rats. **PHS Gomes-Ferreira*[1]**, AC Silva[2], O Bim-Júnior[2], Fr De Souza-Batista[1], D Oliveira[1], IR Garcia-Junior[1], PR Botacin[1], PN Lisboa-Filho[2], R Okamoto[1] ([1] São Paulo State University, Araçatuba Dental School, Araçatuba, Brazil;[2] São Paulo State University, School of Sciences, Bauru, Brazil).

117. Evaluation of Conversion and Cytotoxicity of New Bioactive Composites. D.P. Lopes[1], M.S.A. Moreira[1], L.H. Catalani[2], R.R. Braga[3], **F. Gonçalves*[1]** ([1]- University Ibirapuera, São Paulo, Brazil;[2] Institute of Chemistry,University of São Paulo, São Paulo, Brazil;[3] School of Dentistry, University of São Paulo, São Paulo, Brazil).

118. Surface Properties of Soft Relining Material Incorporated with Plant Extract. **B.L.C. Gondim*[1]**, L.R.C Castellano[2], R.A. Tibau[2], E.S. De Medeiros[2], A.U.D. Batista[2], A.C.D. De Medeiros[1] ([1] State University of Paraíba, Campina Grande, Brazil,[2] Federal University of Paraíba, João Pessoa, Brazil).

119. Translucency of Dental Ceramics for Monolithic Restorations. C.M.A. Carneiro, B.P. Gugelmin, R.C. Hintz, G.M. Correr, L.F. Cunha, **C.C. Gonzaga*** (Graduate Program In Dentistry, Universidade Positivo, Brazil).

120. Fracture Resistance of Restored Teeth with Differents Resins Composites. **L. Guerra*[1]**, S.Jr. Monteiro[1], S.S. Favero[2], Cesar P.F[2], J.K. Bernardon[1]. ([1] Federal University of Santa Catarina, Dentistry, Florianópolis, Brazil,[2] University of São Paulo, Dental Materials, Brazil).

121. Cytocompatibility, Bioactivity, and Antimicrobial Activity of Experimental Calcium-Silicate Sealer. **J.M. Guerreiro-Tanomaru***, C.L. Zordan-Bronzel, E.M. Rodrigues, G.M. Chávez-Andrade, G. Faria, M. Tanomaru-Filho (Restorative Dentistry, São Paulo State University, Araraquara, Brazil).

122. Effect of Copper-Containing Universal Adhesive Bonding in Different Substrates. **T.A. Hanzen*[1]**, T.P. Matos[1], A.M. Paula[1], M.F. Gutiérrez[1,2], P. Malaquias[1], F.S.F. Siqueira[3], A.F.M. Cardenas[3], J. Bermudez[1], A.D. Loguercio[1] ([1] School of Dentistry, State University of Ponta Grossa, Ponta Grossa, Brazil;[2] - Institute for Research In Dental Sciences, Faculty of Dentistry, University of Chile, Santiago, Chile.[3] - Undergraduate and Post-Graduate Department, University Ceuma, São Luís, Brazil).

123. Novel Self-Adhesive Composites: Chemical and Microstructural Comparisons to Commercial Materials. **A.H.S. Delgado***, A. Almusa, Y. Eshmawi, W. Xia, P. Ashley, A. Young (Eastman Dental Institute, University College London, UK).

124. Surface Treatments of Y-TZP: Effects on Optical Properties after Staining. **B.D. Ilha***, C.P. Zucuni, L.B. Jacques[1], F.Z.M. Soares, L.G. May (Federal University of Santa Maria, Santa Maria, Brazil).

125. Anticariogenic Potential and Quantification Mineral the Enamel Around Restorative Materials. **IF Leão***, JFS Bombonatti[1], NA Oliveira[1], NA Bastos[1], FK Rhoden[2], QN Sonza[2], MFA Freitas[2] ([1] Department of Operative Dentistry, University of São Paulo, Bauru, Brazil,[2] Department of Operative Dentistry, Fasurgs, Passo Fundo, Brazil).

126. Ceramics Glossiness by Different Polishing Methods. **A. Ishikawa*** (General Dentistry, The Nippon Dental University Hospital, Tokyo, Japan).

127. MDP-Based Bonding System and Interactions with Demineralized Dentin Substrate. **J.C. Jacomine***, M.C. Giacomini, M.A.S. Agulhari, G.E. Zabeu, P.M.C. Scaffa, L. Wang (Bauru School of Dentistry, University of São Paulo, Bauru, Brazil).

128. Zirconia-Ceramic versus Metal-Ceramic: Thermal Expansion Mismatch and Residual Stresses. **A.N. Jikihara*[1]**, C.B. Tanaka[2], R.Y. Ballester[1], J.B.C. Meira[1] ([1] Department of Biomaterials and Biological Oral, University of São Paulo, São Paulo, Br,[2] School of Mechanical and Manufacturing Engineering, University of New South Wales, Sydney, Au).

129. Challenges in Measuring Fracture Toughness of Dental Ceramics: SEPB Method. **K.S. Jodha***, S.M. Salazar Marocho, J.A. Griggs (University of Mississippi Medical Center, Department of Biomedical Materials Science, Jackson, USA).

130. Newly Identified Peptides against Candida Biofilm Formed on Acrylic Resin. **J.H. Jorge*[1]**, C.V.G. Pellissari[1], W. L. Siqueira[2] ([1] São Paulo State University, Brazil,[2] University of Western Ontario, Canada).

131. Physical-Mechanical Characterization of Nanotechnology into Conventional GIC. **K.R. Kantovitz*[1,2]**, F.P. Fernandes[1], O.P. Gomes[3], I.L. Kitagawa[3], I.V. Feitosa[1], I.A.P.S. Silva[1], F.H, Nociti-Jr[2], R.T.Basting[1], R.M. Puppin-Rontani[2], P.N. Lisboa-Filho[3] ([1] São

Leopoldo Mandic Institute and Dental Research Center, Br,[2] University of Campinas, Br,[3] State University of São Paulo, Br).

132. Bond Strength of Experimental Adhesives with[1]0-MDP and Diphenyl-Iodonium Salt. **C. Kintopp***, G.R. Kinder, L.F. Cunha, G.M. Correr, C.C. Gonzaga (Graduate Program in Dentistry, Universidade Positivo, Brazil).

133. Reinforcement of Fast-Prototyping Resin by Nb_2O_5 Nanoparticles for Dental Application. **C.K. Scotti**[1]*, M.M.A.C. Velo[1], T.R.L. Nascimento[2], T.P.M. Ferreira[2], F.A.P. Rizzante[3], A.S.M. Ferreira[2], V. Silva[2], R.F.L. Mondelli[1], J.F.S. Bombonatti[1]. ([1] Bauru School of Dentistry, University of São Paulo, Bauru, Brazil;[2] Federal University of Paraíba, João Pessoa, Brazil;[3] College of Medicine, Case Western University, Cleveland, Ohio).

134. Influence of Veneering Technique on the Fit of Metal-Ceramic Crowns. **P. Kunz***, A.B.F. Fernandes, L.F. Cunha, G.M. Correr, C.C. Gonzaga (Graduate Program In Dentistry, Universidade Positivo, Brazil).

135. Color Alteration Promoted by Violet Led for In-Office Bleaching. **M. Kury***, C. Perches, B. Fronza, M. Giannini, V. Cavalli (Piracicaba Dental School, University of Campinas, Piracicaba, Br).

136. Use of Recycled Zirconia for Thermoactivated PMMA Reinforcement. **RS Leão***[1], SLD Moraes[1], BGS Casado[1], Jr Souto-Maior[1], BCE Vasconcelos[1], MAJR Montes[1], KAS Aquino[2], EP Pellizzer[3], JML Gomes[3], TE Vila-Nova[4] ([1] University of Pernambuco, Brazil,[2] Federal University of Pernambuco, Brazil,[3] São Paulo State University (Unesp), Brazil,[4] Federal University of Rio Grande Do Norte, Brazil).

137. Biological Properties of Experimental Poly (E-Caprolactone) Nanofibers Scaffolds. **M.L.A.S. Leite***[1], D.G. Soares[2], E.A.F. Bordini[1], J. Hebling[3]1, C.A. De Souza Costa[1] ([1] Araraquara School of Dentistry, São Paulo State University, Araraquara, Br;[2] Bauru School of Dentistry, University of São Paulo, Bauru, Br).

138. Y-TZP Ceramic Flexural Strength: Extrinsic Pigmentation and Surface Treatments Influence. Leite, **F.P.P***[1], De Faria, J.C.B[1], Bittar, B.F[1], Braga, L. De C[1], Leite, A.P.P[1], Carvalho, R.L.A[2], Miranda, J.S De[3], Kimpara, E.T[3], Souza, R.O[4]([1] Federal University of Juiz De Fora, Br,[2] Braz Cubas University, Br,[3] Paulista State University, Br,[4] Federal University of Rio Grande Do Norte, Br).

139. Influence of Novel Plant-Derived Monomers on Bonding to Dentin. **M.V.S. Lemos***[1], T.A.D.Mendes[1], A.L.M. Mota[1], V.G. Araújo-Neto[2], D. Lomonaco[3], S.E. Mazzetto[3], V.P. Feitosa[1], S.L. Santiago[1] ([1] Federal University of Ceará, Fortaleza, Ceará, Brazil,[2] Catholic University Center of Quixadá, Quixadá, Ceará, Brazil,[3] Department of Organic and Inorganic Chemistry, Federal University of Ceará, Fortaleza, Ceará, Brazil).

140. Bis(p-tolyl)Iodonium Hexafluorophosphate as Co-Initiator for Light Curing Resins. **A.F. Lima***[1], K.C. Verzola[1], D. Dressano[2], M. Hadis[3], L.S. Gonçalves[4], D.C. Watts 5, W.M. Palin[3] ([1] Dental Research Division, Paulista University, Brazil,[2] Department of Restorative Dentistry, State University of Campinas, Brazil,[3] College of Medical and Dental Sciences, Institute of Clinical Studies, University of Birmingham, UK,[4] Department of Conservative Dentistry, Federal University of Rio Grande Do Sul, Brazil, 5 School of Medical Sciences and Photon Science Institute, University of Manchester, UK).

141. Effectiveness of Silane- And MDP-Based Primers Bond to Zirconia. **R.B.W. Lima***[1], S.C. Barreto[1], N.M.Alfrisany[2], T.S. Porto[3], G.M. De Souza[2], M.F. Goes[1] ([1] Piracicaba Dental School, University of Campinas, Piracicaba, Brazil,[2] Faculty of Dentistry, University of Toronto, Toronto, Canada,[3] Case Western Reserve University, Department of Comprehensive Care, Cleveland, USA).

142. Processing Variables Influence Strength and Reliability of a Lithiumsilicate Glass ceramic. **U. Lohbauer***[1], A.A. Alonso[2], R. Belli[1] ([1] Research Laboratory for Dental Biomaterials, Erlangen, University of Erlangen-Nuernberg, Germany;[2] Institute of Science and Technology, São Paulo State University (Unesp), São José Dos Campos, Brazil).

143. Effect of Dentin Moisture Protocols on Cementation of Fiber Post. **R. Lopes-Rocha***[1], C.T.P. Araújo[1], M.L.P. Pinheiro[1], A.C. Dayrell, M.O.A. Dourado[1], J.M. Ferreira (.

144. Experimental Adhesives Containing DPHIF/10-MDP: Degree of Conversion and Biocompatibility. **F.S. Lucena***, M.H. Narimatsu, S.R. Conceição, A.Y. Furuse (Bauru School of Dentistry, University of São Paulo, Brazil).

145. Antimicrobial Properties of Experimental Endodontic Sealers Containing Vegetable Extracts. D.C. Dos Santos[1], C.E.C. Suárez[1], L.R. Schneider[1], A.S. Barboza[1], M.F. Damian[1], E. Piva[1], A.D. Campos[2], **R.G. Lund**[1]* ([1] Federal University of Pelotas, Brazil,[2] Brazilian Agricultural Research Corporation, Brazil).

146. Wettability of Monolithic Y-TZP Ceramic Submitted to Different Surface Treatment. **F.A. Maeda***[1], G.S. Coltro[1], K.N. Monteiro[2], F.C. Torres[1], L.H. Da Silva[1], P.F. Cesar[2]. ([1] University of Sao Paulo City (Unicid), Sao Paulo, Brazil,[2] Biomaterials and Oral Biology Department, University of Sao Paulo, Sao Paulo, Brazil).

147. Is it Necessary to Photoactivate Bonding Agents inside Ceramic Crowns? **A.T. Maluly-Proni***[1], B. Oliveira-Reis[1], T.Y.U. Suzuki[2], G. Vasconcelos[3], W.G. Assunção[1], P.H. Dos Santos[1] ([1] Sao Paulo State University, Brasil,[2] Federal University of Minas Gerais, Brasil,[3] Aeronautics Institute of Technology, Brasil).

148. Y-TZP Reinforced with Reduced Graphene Oxide: Evaluation of Processing Conditions. **D.S. Manarão*** [1], G.L. Cordeiro[2], A.J.O. Tertuliano[3], I.F. Machado[3], D.R.R. Lazar [2], V. Ussui[2], P.F.Cesar [1] ([1] Fo-University of São Paulo, Br;[2] Ipen-University of São Paulo, Br;[3] Poli-University of São Paulo).

149. A Network Meta-Analysis of Different Ligh-Activation to Dental Bleaching. **B.M. Maran***[1], P.K. Ziegelmann[2], A. Burey[1], T.P. Matos[1], A.D. Loguercio[1], A. Reis[1] ([1] State University of Ponta Grossa, Br[2] Federal University of Rio Grande Do Sul, Br).

150. File-Splitting Multilayer vs Y-TZP: Fatigue Strength and Finite Element Analysis. **A.M.E. Marchionatti***[1], L.G. May[2], V.F. Wandscher[3], I.L. Aurélio[4], C.D. Bergoli 5 ([1] Santo Ângelo Cnec Faculty, Br,[2] Federal University of Santa Maria, Br,[3] Franciscan University, Br,[4] Fsg Faculty, Br, 5 Federal University of Pelotas, Br).

151. Zinc Phosphate with Red Propolis Antimicrobial effect and Tensile Strength. **E.L.B. Marroquim***[1], F.L.B. Amaral[2], R.T. Basting[2], C.P. Turssi[2], I.C.C.M. Porto[1], T.G. Nascimento[1], J.M.S. Oliveira[1], F.M.G. França[2] ([1] Universidade Federal De Alagoas, Maceio, Brazil,[2] São Leopoldo Mandic Institute and Dental Research Center, Campinas, São Paulo, Brazil).

152. Biological Properties of Universal Adhesives Containing Zinc-Oxide and Copper Nanoparticles. MF Gutiérrez[1,2], J Bermudez[1], A Dávila-Sánchez[1,3], LF Alegría-Acevedo[1], L Mendez[1], AD Loguercio[1], S Buvinic[2], N Hernández-Moya[2], **J Martin***[2], E Fernandez[2,4] ([1] School of Dentistry, State University of Ponta Grossa, Ponta Grossa, Brazil,[2] Faculty of Dentistry, University of Chile, Santiago, Chile,[3] Department of Restorative Dentistry and Biomaterials, San Francisco De Quito University,[4]Instituto De Ciencias Biomédicas, Universidad Autónoma De Chile, Chile).

153. Phytic Acid as a Conditioning Dentin Agent. **B.C. Martins***, T.A.D. Mendes, E.J.A.Filho, S.C.D.Pascual, S.L.Santiago, J.S.Mendonça (Universidade Federal Do Ceará, Br).

154. Clinical Evaluation of Violet Led ([4]05-[4]10 nm) Bleaching: Preliminary Results. **E Mayer-Santos***[1], CV Twiaschor[1], AP Brugnera[2], F Zanin[2], ABrugnera-Junior[2], PM Freitas[1] ([1] University of São Paulo, Br;[2] Brugnera and Zanin Institute, Br).

155. Effect of Benzalkonium-Chloride (BAC) on Dentin Bond-Strength and MMPs Activity. **A Mazzoni***[1], L Valente[1], A Comba[1], T Maravic[1], S Chuna[2], M Cadenaro[3], L Breschi[1] ([1]University of Bologna, Italy,[2] University of San Paulo, Brasil,[3] University of Trieste, Italy).

156. Etch-And-Rinse Adhesive Containing Silver Nanoparticles: Preliminary Study of Antibacterial Effects. J.D. Aguiar[1], I.B. Suffredini[2], S.H. Toma[1], K. Araki[1], M. Dutra-Correa[2], **I.S. Medeiros***[1] ([1] University of São Paulo, Br,[2] Paulista University, Br).

157. Simulation of Bone Resorption around Implants by Finite Element Analysis. **J.B.C. Meira***, A.A. Gomes, G.M.A. Galasse, R.C. Santana, N. Sesma, R.Y. Ballester (University of São Paulo, São Paulo, Brazil).

158. Failure Probability and Stress Distribution of Silica-Infiltrated Bioinspired Zirconia Crowns. G.F. Ramos[1], L.M.M. Alves[1], N.C. Ramos[1], T.M.B. Campos[2], M.R. Kaizer[3], A.L.S. Borges[1], **R.M. Melo***[1] ([1] Institute of Science and Technology, São Paulo State University (Unesp), São José Dos Campos, Brazil;[2] Aeronautics Technological Institute (Ita), Brazil;[3] New York University, USA).

159. Ethanol-Wet-Bonding and Collagen Cross-Linkings: Physico-Chemical Properties on Bonding to Dentin. **T.A.D. Mendes***, M.V.S Lemos, S.L. Santiago, B.C. Martins, S.C.D. Pascoal,P.R.P. Motoyama, J.S. Mendonça (Federal University of Ceara, Br).

160. Tribological Characterization of[3]Y-TZP Ceramics Sintered at Different Conditions. **A.M. Mendes***[1], A.E. Martinelli[1], J.R.C. Queiroz[2], E.S. Santos[3], M.R.D. Bomio[1] ([1] Materials Science and Engineering Department, Federal University of Rio Grande Do Norte, Natal, Brazil,[2] Biotechnology Department, Potiguar University, Natal, Brazil,[3] Chemical Engineering Department, Federal University of Rio Grande Do Norte, Natal, Brazil).

161. Effect of Different Pistons on Resistance and Damage of Ceramics. **J.S. Miranda***, R.L.A. De Carvalho, R.F. De Carvalho, A.L.S. Borges, R.O.A. Souza, R.M.M. Marinho (Institute of Science and Technology - UNESP of São José dos Campos, São José dos Campos, Br).

162. Crystallized e-max CAD Response to Several Surface Modifications. **G.L.P.Miranda***[1], V.Boyes[2], N.R.F.A.Silva[3], V.P.Thompson[2] (Unicentro Newton Paiva, Br,[2] King's College of London, UK,[3] Federal University of Minas Gerais, Br).

163. Phosphoric Acid Concentration Affects Dentinal MMPs Activity. **A. Moraes Devito***[1,2], C. Francci[1], C. Vidal[3], P. Scaffa[4], D. Nesadal[1], L. Yamasaki[2], J. Nicolau[1], F. Nascimento 5, D. Pashley 6, M. Carrilho 7 ([1] University of São Paulo (Usp), São Paulo, Brazil,[2] University Nove De Julho (Uninove), São Paulo, Brazil,[3] University of Iowa, Iowa, USA,[4] University of São Paulo (Usp), Bauru, Brazil , 5 University of Mogi Das Cruzes (Umc), Mogi Das Cruzes, Brazil, 6 Georgia Health Sciences University, Augusta, USA, 7 Midwestern University, College of Dental Medicine, USA).

164. Eficacy of Desensitizing Agents in the Treatment of Dentinal Hypersensitivity. **J.M. Moreira***, V.C. Ruschel, A.S. Bandeira, G.B. Raube, J.K. Bernardon (Universidade Federal De Santa Catarina, Odontologia, Florianópolis, Brasil).

165. Influence of TiO[2] Nanosctructures on Properties of Flowable Resin. **G.M.F. Guimarães***[1], E.S.B. Uhle[2], P.N. Lisboa-Filho[2], A.Y. Furuse[1] ([1] Bauru School of Dentistry, University of São Paulo, Bauru, Brazil,[2] School of Sciences, São Paulo State University, Bauru, Brazil).

166. Effect of Different Ceramic-Primers and Silanization-Protocols on Glass-Ceramic Bond Strength. **M.B.P. Moreno***[1], F. Murillo-Gómez[2], M. De Goes[1] ([1] Piracicaba Dental School, State University of Campinas, Piracicaba, Brazil,[2] Dental School, University of Costa Rica, San Jose, Costa Rica).

167. Monolithic Zirconia Prosthesis vs Bilayer Prosthesis: A Systematic Review. J.M.L. Moreno*, W.G. Assunção, P.H. Dos Santos, E.P. Rocha, D. Oliveira, A.R. Barion, C.A. De Sousa, H.B.S Sahyon, A.O. Da Silva (São Paulo State University (Unesp), School of Dentistry, Araçatuba, Brazil).

168. Effect of Propolis on Removal of Biofilm of Maxillofacial Elastomers. **A. Moreno***[1], I.B.S. Lopes[1], D.G. Calefi[2], J.A.A. Arruda[1], S.G. Santos[2], P.P. Magalhães[2], L.M. Farias[2], Mesquita R.A.[1] ([1] School of Dentistry, Federal University of Minas Gerais, Belo Horizonte, Brazil,[2] Institute of Biological Sciences, Federal University of Minas Gerais, Belo Horizonte, Brazil).

169. Clinical Performance of 168 Screw Free Implants: Prosthetic Complications. **C.S. Morsch***, M.C. Lisboa, J. Silva, C.F. Rafael, R.C. Cecato, R.S. Magini, C.A.M. Benfatti (Federal University of Santa Catarina, Dentistry, Florianópolis, Brazil).

170. Evaluation of Dentinal Conditioning with Natural Acids in Dentin-Resin Interface. **A.L.M Mota***, F.A.A Macedo, M.V.S Lemos, T.A.D Mendes, G.A. Lourenço, N.L.G Albuquerque, V.P Feitosa, S.L Santiago (Federal University of Ceará, Brazil).

171. Development and Study of Cytotoxicity of Calcium Oxide Nanocrystals. GL Souza[1], TR Silva[1], MS Vieira[1], NO Dantas[2], ACA Silva[2], **CCG Moura***[1] ([1] Universidade Federal De Uberlândia, Br;[2] Universidade Federal De Alagoas, Br).

172. Adhesiveness Analysis of Sealer Plus and AH Plus Endodontic Sealers. V.H. Nunes, L.P. Papa, **F. Muranaka***, F.A.S. Mello, T.M. Ponce, L.M. Silva, J.E.P. Silveira, L.S. Girotto, E.G.Corrêa (Southwestern College of São Paulo, Br).

173. Evaluation of Biofilm Removal and Antimicrobial Action of Denture Cleansers. **C.N.F. Arruda***, M.M. Salles, V.C. Oliveira, A.P. Macedo, C.H. Silva-Lovato, H.F.O. Paranhos (School of Dentistry of Ribeirão Preto, University of Sao Paulo, Br).

174. Zn+[2] Containing Glass Ionomer Cement Inhibits Root Dentin Demineralization. **Y. Nagano***, D. Mori, T. Kumagai (GC Corporation, Research & Development, Tokyo, Japan).

175. Evaluation of Surface Roughness of Alginate Impression Materials. **Y.Nakashima***, N.Niizeki, D.Usuki, T.Ueno, T.Kumagai (GC Corporation R&D Center, Tokyo, Japan).

176. Effect of Toothbrushing on the Surface of Esthetic Restorative Materials. **G. Nima***[1], J.G. Lugo[2], R.G. Palma-Dibb[3], J.J. Faraoni[3], A. Correa[2] , M. Giannini[1] ([1] Piracicaba Dental School, University of Campinas, Brazil,[2] Scientific University of the South, Peru,[3] School of Dentistry of Ribeirão Preto, São Paulo University, Brazil).

177. Double-Blind Clinical Trial of Satisfaction in Patients Undergoing Dental Bleaching. **AC Nishida***, TG Carnaval, C Francci, PP Albuquerque, EC Rodrigues, CR Kiyohara (Faculty of Dentistry, University of São Paulo, São Paulo, Brazil).

178. Ultimate Fracture Load of CAD-CAM Crowns with Different Thicknesses. **M.S. Noronha***[1], P.F. Cesar[2], V.L.B. Azevedo[1], O.S. Andrade[3], A.O. Carvalho[4], S.S. Favero[2], M. Giannini[1] (University of Campinas, Br;[2] University of São Paulo, Br;[3] Senac University, Br,[4] State University of Southern Bahia, Br).

179. Influence of Increment Thickness on Microhardness of Bulk-Fill Resin. **A.T. Obeid***, C.K. Scotti, L.E. Pacheco, A.Y. Furuse, R.F.L. Mondelli, J.F.S. Bombonatti (Bauru School of Dentistry, University of São Paulo , Bauru, Brazil).

180. Compression Strength and Fractographic Analyses between two Indirect Veneers Materials. **NA Oliveira***, RF Rodrigues, IBL Soares-Rusu, CA Espinoza-Villavicencio, E Bonfante, PAS Francisconi, AFS Borges (Bauru School of Dentistry, University of São Paulo, Bauru, Brazil).

181. Influence of Laminate Veneers on Behavior of Gingival Margin. **D. Oliveira***[1], N.S. Araújo[1], M.T. Caixeta[1], J.M.L. Moreno[1], P.H.S. Gomes-Ferreira[2], F.I. De-Souza[1], E.P. Rocha[1]. ([1] Department of Dental Materials and Prosthodontics, São Paulo State University, Araçatuba, Brazil;[2] Department of Surgery and Integrated Clinic, São Paulo State University, Araçatuba, Brazil).

182. Resin-Cement Adhesion to Zirconia: Effect of Adhesion Technique and Aging. **M. Özcan***[1], N. Al-Haj Husain[2], L. Chen[3] ([1] Division of Dental Materials, University of Zurich, Zurich, Switzerland,[2] School of Dental Medicine, University of Bern, Switzerland,[3] Bisco, Director of R&D, USA).

183. Effect of Silver-Coated Silica Nanoparticles Associated to PMMA. **T.J.A. Paes-Junior***, S.C.M. Sacorague, Gonçalves F.C.P, B.C. Lucatto (São Paulo State University (Unesp), Brazil).Polymerization Shrinkage of Bulk Fill Composite through Optical Coherence Tomography. **P.T.S.S. Palmeira***[1], A.F. Souza[2], A.S.L. Gomes[3], D.L.B. Faria[2], W.V. Maciel[2], M.H.C.V. Catão[1], C.C.B.O. Mota[2] ([1] Dentistry Department, Universidade Estadual Da Paraíba (Uepb), Campina Grande, Brazil,[2] Faculty of Dentistry, Centro Universitário Tabosa De Almeida (Asces-Unita), Caruaru, Brazil,[3] Physics Department, Universidade Federal De Pernambuco (Ufpe), Recife, Brazil).

184. Analysis of Voids using Different Restorative Techniques. **C. Pardo Díaz***, CAK Shimokawa, AZ Freitas, ML Turbino (Department of Restorative Dentistry, University of São Paulo, Brazil).

185. Bond Strength of Different Resin-Cements to Dentin. A Preliminary Study. **C. Parisi***[1], P. Baldissara[1], T. Greischberger[1], A. Casamenti[1], L.F. Valandro[2], C. Monaco[1] ([1] University of Bologna, Italy,[2] Federal University of Santa Maria, Brazil).

186. Marginal Adaptation of Ceramic Fragments Reconstructing the Canines tip. **R.P. Pereira***[1], L.A. Linhares[1], L.F. Pottmaier[1], R.C.R. Silveira[1], P.F. Cesar[2], L.N. Baratieri[1] ([1] Federal University of Santa Catarina, Br,[2] University of Sao Paulo, Br).

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187. Effects of Graft Biomaterials and Topical Glucocorticoid on Preosteoblastic Cells. **C.N.B. Pereira***[1], A.F.A. Silva[1], I.M.A. Diniz[2], C.S. Magalhães[2], A.N. Moreira[2], K.L.M. Maltos[2], E.G. Zenóbio[1] ([1] Dentistry Department of Pontifícia Universidade Católica De Minas Gerais, Belo Horizonte, Br,[2] Faculty of Dentistry, Universidade Federal De Minas Gerais, Br).

188. Dental Bleaching Techniques: Clinical Parameters and Enamel Mineral Content. **A. Pinto***, NR. Carlos, FLB Amaral., FMG França, CP Turssi, RT Basting (São Leopoldo Mandic University, São Paulo, Campinas, Brasil).

189. Effects of Exposure to Grape Juice during Bleaching: Clinical Study. L.F. Pottmaier[1], L.A. Linhares[1], **G. Bruzi***[2], L.N. Baratieri[1], G.C. Lopes[1] ([1] Operative Dentistry, Federal University Os Santa Catarina, Florianópolis, Brazil,[2] Operative Dentistry, Federal University of Alfenas, Alfenas, Brazil).

190. Effect of Glass-Ceramic Associated to Natural Primers on Dentin-Adhesive Interface. **F.C.P. Pires-De-Souza***[1], R. Geng-Vivanco[1], R. Tonani-Torrieri[1], A.B.S. Sousa[2], F. Marquele-Oliveira[3] ([1] Ribeirao Preto School of Dentistry, University of Sao Paulo, Brazil,[2] University of Ribeirao Preto, Brazil,[3] Laboratory of Research, Development and Innovation, Apis-Flora, Brazil).

191. Self-Adhesive Pit and Fissure Sealant Modified with Metallic Monomers. **E. Piva***[1], A.R. Cocco[1], C.E.C. Suarez[1], Wlo Da Rosa[1], F.S. Rondan[2], A.F. Silva[1], , M.F. Mesko[2], R.G. Lund[1] ([1] School of Dentistry, Federal University of Pelotas, Pelotas, Brazil,[2] Center of Chemical, Pharmaceutical and Food Sciences, Federal University of Pelotas, Capão Do Leão, Brazil).

192. Physicochemical Properties of Dental Adhesives Doped with Zinc Compounds. **C. Pomacóndor-Hernández***[1], A. Catelan[2], V.P. Feitosa[3], S. Consani[4] ([1] John Paul II Private University, Lima, Peru,[2] University of Western Sao Paulo, Presidente Prudente, Brazil,[3] Paulo Picanço School of Dentistry, Fortaleza, Brazil,[4] University of Campinas, Piracicaba, Brazil).

193. Influence of Etching Procedures on Surface Wettability of CAD/CAM Materials. **T.S. Porto***[1], F.A.P. Rizzante[1], I.G.M. Silva[1], R.C. Roperto[1], S.T. Porto-Neto[2], E.A. Campos[2], F.F. Faddoul[1], S.T. Teich[1] ([1] Case Western Reserve University, USA,[2] Sao Paulo State University, Brazil).

194. Cyclic Load-to-Failure of Hydrofluoric Acid Etched Lithium Disilicate Restorations. **C. Prochnow***[1], A.B. Venturini[1], L.F. Guilardi[1], M.P. Rippe[1], C.J. Kleverlaan[2], M.C. Bottino[3], G.K.R. Pereira[4], L.F. Valandro[1] ([1] Federal University of Santa Maria, Br,[2] University of Amsterdam and Vu University Amsterdam, Nl,[3] University of Michigan School of Dentistry, USA,[4] Meridional Faculty, Br).

195. Correlation of Calcium-Phosphate, Laser and Adhesive on Dentin-Permeability and Bond-Strength. P.L. Benitez Sellan, A.C. Bellam, D.S. Andrade, C.R.G. Torres, **C.R. Pucci*** (Department of Restorative Dentistry, São Paulo State University Unesp São Jose Dos Campos, São Paulo, Brazil).

196. Effect of a Nanochitosan Solution on Tooth Color. **J.R.C. Queiroz***[1], A.A. Barbosa[2], G.T. Furtado[3], M.V.L. Fook[3] ([1] Universidade Estadual Da Paraiba, Brazil,[2] Universidade Potiguar, Brazil,[3] Universidade Federal De Campina Grande, Brazil).

197. Can Low Temperature Degradation Influence Conventional and Monolithic Zirconia Crowns? M Del Piñal,[1,2], **CFRafael***[1]; JF Bartolomé[2], MJ Suarez[2], CAM Volpato[1], ([1]Department of Dentistry, Federal University of Santa Catarina, Florianópolis, Brazil;[2] Faculty of Odontology, University Complutense, Madrid, Spain).

198. Bioactive Glasses Improve Dentin Adhesion and Conversion of Experimental Adhesives. **T.O. Rifane***[1], L.K. Solheiro[1], K.E. Moura[1], F. Silvestre[1], M.M. Moreira[1], M.T. Souza[2], E.D. Zanotto[2], S. Sauro[3], V.P. Feitosa[1] ([1] Paulo Picanço School of Dentistry, Fortaleza, Brazil,[2] Department of Materials Engineering, Federal University of São Carlos, São Carlos, Brazil,[3] Departamento De Odontologia, Ceu Cardenal Herrera University, Valencia, Spain).

199. Survival Rate of Restored Premolars: Evaluation of Inlay Fabrication Methods. **M.P. Rippe***[1], C. Monaco[2], T. Missau[1], V.F. Wandscher[1], L. Volpe[2], R. Scotti[2], M.A. Bottino[3], L.F. Valandro[1] ([1] Federal University of Santa Maria, Br,[2] Alma Mater Studiorum University of Bologna, It,[3] São Paulo State University, Br).

200. Staining Susceptibility of Resin Infiltrated White Spot Lesions after Bleaching. **C.R.G. Torres***, D.S. Andrade, A.M.O. Correia, T.R. Mesquita, A.B. Borges (Sao Paulo State University – Unesp, Brazil).

201. Fatigue of Lithium-Disilicate Crowns: Processing Technique and Surface Treatment Effects. R. Schestatsky; Cp. Zucuni; Lf. Valandro; **Gk. Rocha Pereira*** (Meridional Faculty – IMED, Passo Fundo, Br).

202. Biogenic Synthesis and Characterization of Silver Nanoparticles Coated with Silica. **M.C. Rodrigues***[1], W.R. Rolim[2], M.M. Viana[1], T.S. Rodrigues[1], V. Arana-Chaves[3], B.B. Silva[4], A.B. Seabra[2] ([1] Cruzeiro Do Sul University, Br,[2] Federal University of ABC, Br,[3] University of São Paulo, Br,[4] Guarulhos University, Br).

203. Glaze Firings on Veneered Zirconia: Residual Stresses and Optical Aspects. **C.S. Rodrigues***[1], I.L. Aurélio[2], S. Fraga[3], L.G. May[1] ([1] Federal University of Santa Maria, Brazil,[2] University Center of Serra Gaúcha, Brazil,[3] Franciscan University, Brazil).

204. Adhesion and Strength Properties of Air-Abraded Y-TZP: Distinct Silica-Coating Concentrations. **A.C.C. Rodrigues**[1*], C. Prochnow[1], J.S. Oliveira[2], S.L. Jahn[2], E.L. Foletto[2], M.P. Rippe[1], G.K.R. Pereira[3], L.F. Valandro[1] ([1] Prosthodontics Units, Federal University of Santa Maria, Santa Maria, Brazil;[2] Department of Chemical Engineering, Federal University of Santa Maria, Santa Maria, Brazil;[3] School of Dentistry, Meridional Faculty, Passo Fundo, Brazil).

205. Brushite Particles Synthesis: Effect of Temperature and Concentration of Reagents. **L.R. Brasil***[1], M.C. Rodrigues[1], F.M. Vicchi[2], V.E. Arana-Chavez[1], R.R. Braga[1] ([1] Department of Biomaterials and Oral Biology, University of São Paulo, São Paulo, Brazil,[2] Institute of Chemistry, University of São Paulo, São Paulo, Brazil).

206. Characterization of Dental Ceramics. **G.R. Rocha***[1], E.J. Florez Salamanca[1], J.P.B. Machado[2], M.I. Klein[1], F.Z. Trincade[1] ([1] University of State São Paulo - Unesp, Br;[2] National Institute of Space Research - Inpe, Br).

207. Reproducing the Occlusal Anatomy of Temporary Crowns in Zirconiumoxide Crowns. S. Mohan, **JF Roulet***, N Abdulhameed, M Rocha, E O'Neill (Restorative Dental Sciences, University of Florida, Florida, USA).

208. Microtensile Bond Strength of Zirconia after Surface Treatments and Aging. **E. Ruales-Carrera***[1], P.F. Cesar[2], B. Henriques[1], M.C. Fredel[1], M. Özcan[3], C.A.M. Volpato[1] ([1] Department of Dentistry, Federal University of Santa Catarina, Florianópolis, Brazil;[2] Department of Dental Materials and Oral Biology, São Paulo University, São Paulo, Brazil;[3] Dental Materials Unit, Center for Dental and Oral Medicine, University of Zurich, Zurich, Switzerland).

209. Postoperative Sensitivity of Composite Replacement of Amalgam Restoration. **V.P. A. Saboia***[1], N.S.Rodrigues[1], D.A.Cunha[1]; L.C.De Souza[1], N.O.Souza[1], P.G.B.Silva[1], S.L.Santiago[1], A.D.Loguércio[2] ([1] Federal University of Ceará, Br,[2] State University of Ponta Grossa, Br).

210. Evaluation of Chemically Synthetic Carbonate Apatite Bone Substitute. **Y. Sakaguchi***, K. Yamanaka, Y. Shigemitsu K. Yamamoto, and T. Kumagai (GC Corporation, Research & Development Department, Tokyo, Japan).

211. Evaluation of Bond Strength of[2]-Step Type Adhesives. **T. Sakai***, A. Arita, T. Kumagai (GC Corporation, Research & Development, Tokyo, Japan).

212. Characterizing Laser Irradiation through an YSZ Ceramic for Debonding Purposes. D. Hutto[1], L. Stringer[2], S. Malley[1], J.A. Griggs[1], **S.M. Salazar Marocho**[1*] ([1] University of Mississippi Medical Center, Jackson, USA;[2] Millsaps College, Jackson, USA).

213. Sorption and Solubility of Dental Cements after Acid Etching. **L.A. Salvio**[1*], T.P. Pereira[1], M. B. Lopes[2] ([1] Federal University of Juiz De Fora, Juiz De Fora, Brazil,[2] State University Londrina, Londrina, Brazil).

214. Three-Year Clinical Study of Universal Adhesives in Non-Carious Cervical Lesions. **AM San Martins***[1], VC Ruschel[1]; SC Stolf[1]; S. Shibata[2]; Y Chung[3]; LW Boushell[4]; R. Walter[4]; R. Gondo[1] ([1] Departamento De Odontologia, Federal University of Santa Catarina, Florianópolis, Brazil;[2] Avantis University, Balneário Camboriú, Brazil;[3]Fred Hutchinson Cancer Research Center, Seattle, USA;[4] Department of Operative Dentistry, University of North Carolina, Chapel Hill, USA).

215. Influence of Volume on Polymerization Contraction Force of Bulk-Fill-Composites. **D.C. Santin***, M.M.A.C. Velo, F.S. Camim, H.M. Honório, R.F.L. Mondelli (Bauru School of Dentistry, University of São Paulo, Bauru, Brazil).

216. Microtensile Bond Strength of a Novel Resin-Modified Glass Ionomer Adhesive. **I.C. Santos***[1], T.B. Salgueiro[1], J.J. Mendes[1,2], A. Delgado[1], J. Brito[1,2], A.C. Azul[1,2], M. Polido[1,2] ([1] Instituto Universitário Egas Moniz, Caparica, Portugal,[2] Centro De Investigação Interdisciplinar Egas Moniz, Caparica, Portugal).

217. Assessment of S-PRG Fillers' effect on Enamel Demineralization using SS-OCT. **A.C. Sá-Pinto***[1], K. Matin[2], N. Hiraishi[2], Y. Zhou[2], M.L. Ramos-Jorge1, S.G.D. Oliveira[1], T. Nikaido[2], J. Tagami[2] ([1] Federal University of Valleys of Jequitinhonha and Mucuri, Br;[2] Tokyo Medical and Dental University, Tokyo, Japan).

218. Fractographic Analysis In-Vivo Failed Molar Resin Composite Restorations. **CM Saratti***, GT Rocca, I Krejci, SS Scherrer (School of Dentistry, University of Geneva, Geneva, Sui).

219. Bulkfill can Decrease Conversion at the Bottom of deep Preparations. **L.F. Schneider**[12*], B.T. Vasconcellos[2], B.S. Veiga[2], L.M. Cavalcante[12] ([1] Federal Fluminense University, Brazil,[2] Veiga De Almeida University, Brazil).

220. Evaporation Time: Aging Adhesive Properties of Universal Adhesives to Dentin. **M Schroeder***[1], Thalita P. Matos[2], T.A. Hanzen[2], M. F. Gutierrez[2], A. Reis[2], and A.D. Loguercio[2], ([1]Universidade Estadual De Ponta Grossa, Ponta Grossa, Brazil).

221. Wear and Marginal Gap of Direct Composites on Endodontically-Treated Teeth. **N. Scotti***[1], A. Comba[2], R. Michelotto Tempesta[1], A. Baldi[1], E.A. Vergano[1], C. Foglia[1], M. Alovisi[1], D. Pasqualini[1], E. Berutti[1]. ([1]University of Torino, Italy;[2] University of Bologna, Italy).

222. Shear Bond Strength of Brackets under Exposure to Cigarette Smoke. **N.J.C. Sena***[1], B.K. Lima[1], V.P.Feitosa[2], V.P.A Saboia[1] ([1] Universidade Federal Do Ceará, Ufc, Br;[2] Faculdade Paulo Picanço, Br).

223. Surface Properties and Wear Resistance of Conventional and Bulk-Fill Composites. **C.A.K. Shimokawa***[1], M. Giannini[2], C.B. André[2], B.O. Sahadi[2], J.J. Faraoni[3], R.G. Palma-Dibb[3], C.J. Soares[4], M.L. Turbino[1], R.B. Price 5 ([1] Department of Restorative Dentistry, University of São Paulo, São Paulo, Brazil,[2] Department of Restorative Dentistry, University of Campinas, Piracicaba, Brazil,[3] Department of Restorative Dentistry, University of São Paulo, Ribeirão Preto, Brazil,[4] Department of Operative Dentistry and Dental Materials, Federal University of Uberlândia, Uberlândia, Brazil, 5 Clinical Dental Sciences, Dalhousie University, Halifax, Canada).

224. Mechanical Properties of Methyl-Methacrylate Resins including Metronidazole or Chlorhexidine. **U.P.C. Silva***[1], R.C.F. Grassia-Jr.[2], N.C.A.Alves[2], L.C.C. Boaro[2], W.C. Brandt[2]. ([1] University São Leopoldo Mandic, Campinas, Brasil,[2] University Santo Amaro, Unisa São Paulo, Brasil).

225. Color Stability of Repairs on Bis-Acrylic Resin after Colorants Immersion. **J. Silva***[1], S.L. Grass[1], M.C.S. Lisboa[1], E.A.R. Carrera[1], C.F. Rafael[1], R.C. Cecato[1], P.C. Vaz[2], C.A.M. Volpato[1] ([1] Department of Dentistry, Federal University of Santa Catarina, Florianópolis, Brazil,[2] Dental Medicine Faculty, University of Porto, Porto, Portugal).

226. Flexure Strength of a Glass Ceramic: Effect of Cementation Protocols. **S.E.G. Silva***[1], G.M. Araújo[1], T.E.L. Vila-Nova[1], K.B. Souza[1], D.M.D. Moura[1], I.H.G. Carvalho[1], A.H. Veríssimo[1], A.B.N. Januário[1], A.M.O. Dal Piva[2], R.O.A. Souza[1]. ([1] Departament of Dentistry, Federal University of Rio Grande Do Norte, Brazil,[2] Departament of Dental Materials and Prosthodontics, State University of São Paulo, São José Dos Campos, Brazil).

227. Cytotoxicity and Physical Properties of new Composites for Pulp Capping. **J.C. Silva**[1*], V.P.A. Saboia[1], A.P.N. Nunes Alves[1], M.R.L. Mota[1], P.B.A. Fechine[2], R.J. Miron[3], E.V. Carvalho[2], A.E.C. Ferreira-Júnior[1], P.G.B. Silva[1], V.P. Feitosa[1,4]. ([1] Dental School, Federal University of Ceará, Fortaleza, Brazil;[2] Department of Physical-Chemistry, Federal University of Ceará, Fortaleza, Brazil,[3] Department of Periodontology, Nova Southeastern University, Fort Lauderdale, USA,[4] Research Division, Paulo Picanço School of Dentistry, Fortaleza, Brazil).

228. Evaluation of Polymerization Stress of Bulk Fill Composites. **F.C.F.A. Silva***[1], L. G. Barreto[1], N.S. Rodrigues[2], D.A. Cunha[2], L.C. Souza[2], N.O. Souza[2], E.C.R. Júnior[3], V.P. Saboia[2] ([1] Christus University Center, Unichristus, Br,[2] Federal University of Ceará, Br,[3] State University of São Paulo, Br).

229. MDP-Based Systems Profile when combined with Chlorhexidine/Hydroxyapatite. **M.A.S. Agulhari***[1], N.L. Froio[1], G.S. Zabeu[1], L.F.F. Brianezzi[1], M.C. Giacomini[1], J.C. Jacomine[1], M.R.O. Carrilho[2], H.M. Honório[1], L. Wang[1] (Bauru School of Dentistry, University of São Paulo, Bauru, Br;[2] Research Faculty College of Dental Medicine – Illinois, Midwestern University, Downers Grove, USA).

230. Intracanal Bonding with Therapeutic Adhesives and new Dentin Conditioners. **F.A. Silvestre***[1], L.K. Solheiro[1], K.E. Moura[1], T.O. Rifane[1], R.S. Sousa[1], C.P. Isolan[3], G.S. Lima[3], S. Sauro[4], V.P. Feitosa[1,2] ([1] Paulo Picanço School of Dentistry, Fortaleza, Brazil,[2] Department of Restorative Dentistry, Federal University of Ceará, Fortaleza, Brazil,[3] Dental Materials, Federal University of Pelotas, Pelotas, Brazil,[4] Dental Biomaterials, Preventive & Minimally Invasive Dentistry, Departamento De Odontologia, Ceu Cardenal Herrera University, Valencia, Spain).

231. Mechanical, Chemical and Bond Strength Properties of Bisphenol-A Free Composites. **M. Sinhoreti***[1], R.F. De Oliveira[1], D.C.R.S. De Oliveira[1], M.G. Rocha[1], J.F. Roulet[2], S. Geraldeli[2] ([1] Piracicaba Dental School, Unicamp, Piracicaba, Brazil;[2] College of Dentistry, University of Florida, Gainesville, USA).

232. Mouthguard Biomechanics for Protecting Dental Implants from Impact. **P.B.F. Soares***[1], V.F. Carvalho[1], C. Veríssimo[2], R.S. Pessoa[1], A. Versluis[3], C.J.[1] ([1] Federal University of Uberlândia, Brazil,[2] Federal University of Goias, Brazil,[3] University of Tennessee, USA).

233. Flexural-Strength and Translucency of Feldspar-Ceramic: Specimen's Number-Position in Furnace Effect. **P.S. Machado***, J.G. Camponogara, C.S. Rodrigues, L.B. Jacques, L.F. Valandro, M.P.Rippe (Prosthodontics Units, Federal University of Santa Maria, Santa Maria, Brazil).

234. Composite Restoration of Endodontically-Treated Molars: Bite-Force and Specific FE-Analysis. **C.J. Soares***[1], M.P.Rodrigues[1], P.B.F. Soares[1], M.A.B. Gomes[1], R.A. Pereira[1], D. Tantbirojn[2], A.Versluis[2] ([1] Federal University of Uberlândia, Brazil,[2] University of Tennessee Health Science Center, USA).

235. Clinical Evaluation of Lithium Disilicate Veneers Manufactured by CAD/CAM. **IBL Soares-Rusu***, CA Villavicencio-Espinoza, NA Oliveira, L Wang, HM Honório, JH Rubo, AFS Borges (Bauru School of Dentistry, University of São Paulo, Bauru, Brazil).

236. Gap Evaluation of Class II Resin-Filling Techniques–MCT and SEM Analysis. **CS Sampaio***, GA Garces, N Kolakarnprasert, PJ Atria, R Hirata (Department of Biomaterials, Universidad de los Andes, Santiago, Chile).

237. Bioactive Glasses May Interfere on Dentin Adhesion of Experimental Composites. **L.K. Solheiro***[1], K.E. Moura[1], T.O. Rifane[1], F. Silvestre[1], M.M. Moreira[1], M.T. Souza[2], E.D. Zanotto[2], N. Silikas[3], V.P. Feitosa[1] ([1] Paulo Picanço School of Dentistry, Fortaleza, Brazil,[2] Department of Materials Engineering, Federal University of São Carlos, São Carlos, Brazil,[3] School of Medical Sciences, University of Manchester, Manchester, UK).

238. Sorption and Solubility of Different Resin Cements. **Q.N. Sonza***, C.D. Bertol, A. Dela Bona, M. Borba (School of Dentistry, Univerity of Passo Fundo, Passo Fundo, Br).

239. Use of Violet Light on Tooth Color Change In-Office Bleaching. **J.R. Soutomaior***[1], B.M. Angelim[1], M.Pontes[1], C.H.V.Silva[2], M.A.J.R. Montes[1], S.L.D. Moraes[1] ([1] Pernambuco University, Brazil;[2] Federal Pernambuco University, Brazil).

240. Efficacy of Plant-Derived Crosslinkers on Fiber-Post Bonding to Radicular Dentin. **N.O Souza***[1], R.S Sousa[1], N.S. Rodrigues[1], C. Isolan[2], R.R. Moraes[2], D.M. Paula[1,3], V. P. Saboia[1], D. Lomanaco[4], S.E. Mazetto[4], V.P. Feitosa[1,3]. ([1] Restorative Dentistry Department, Federal University of Ceará, Fortaleza, Brazil;[2] Dental Materials, Federal University of Pelotas, Pelotas, Brazil;[3] Paulo Picanço School of Dentistry, Fortaleza, Brazil;[4] Department of Organic and Inorganic Chemistry, Federal University of Ceará, Fortaleza, Brazil).

241. Effect of Hydrofluoric Acid on Resin-Bond Strength to Glass Ceramics. **K.B. Souza***[1], D.M.D. Moura[1], A.H. Veríssimo[1], J.P.M Tribst[2], T.E.L Vila-Nova[1], G.M. Araújo[1], A.B.N Januário[1], I.H.G Carvalho[1], S.E.G Silva[1], R.O.A. Souza[1]. ([1] Department of Dentistry, Federal University of Rio Grande Do Norte (Ufrn), Brazil;[2] Institute of Science and Technology, São Paulo State University (Unesp), Brazil).

242. Push-Out Bond Strength of Semi-Direct Composite to Dentin. **R.O.A. Souza***[1], M.F.T.P. Campos[1], D.M.D. Moura[1], I.V. Assunção[1], M.R.G.R Caldas[1], B.C.D Borges[1], J.A. Platt[2] ([1] Department of Dentistry, Federal University of Rio Grande Do Norte, Brazil;[2] Indiana University School of Dentistry, Indianapolis, USA).

243. Effect of Bleaching Interval on Color Change of Discolored Teeth. **I. S. Vardasca***, T.R. Dias, A.S. Martorano, S.R.C. Da Silva, D.C.F. Messias (Odontology, University of Ribeirão Preto, Ribeirão Preto, Br).

244. Computational Analysis of Amine Activators in Amine-Peroxide Redox Polymerization. K. Kim[1], N. Singstock[2], K. Childress[2], C. Musgrave[2], **J Stansbury***[2,3] ([1] Chemistry and Biochemistry, University of Colorado, Boulder, USA;[2] Chemical and Biological Engineering, University of Colorado, Boulder, USA;[3] School of Dental Medicine, University of Colorado, Aurora, USA).

245. Marginal Chipping of Lithium Disilicate Crowns Produced by CAD-CAM Systems. **S.S.F. Strelhow***[1], B.M. Ferrairo[1], F.F Lima[2], F.F. Piras[1], A.F.S. Borges[1], J.H. Rubo[1], A.L. Valle[1] ([1] Bauru School of Dentistry, University of São Paulo, Bauru, Brazil;[2] Department of Dentistry, Ingá University Centre, Maringá, Brazil).

246. Biological Characterization of Dental Pulp Stromal Cells onto PMMA Scaffolds. **J.L. Suárez-Franco**[1*], B.I. Cerda-Cristerna[1], L. Tejeda-Jácome[1], G. Suárez-Franco[2], J Romero-Ricavar[1], M.A. Álvarez-Pérez[3]. ([1] Universidad Veracruzana Región Orizaba-Córdoba, México,[2] Universidad Veracruzana Región Veracruz, México,[3] Laboratorio De Bioingeniería De Tejidos, Facultad De Odontología U.N.A.M.).

247. Temporary Denture Liners Modified by Medicinal Plants on Candidal Biofilm. **C.Y.C. Sugio***, C.R. Garcia, T.Y. Ueda, R.A. Silva, L.A.S. Coelho, V.S Lara, K.H. Neppelenbroek (Bauru School of Dentistry, University of São Paulo, Bauru, Brazil).

248. Microshear Bond Strengths of Nine CAD/CAM Restoratives Materials. **E. Sutil***[1], L. N Kunstmann[2], M. F Gutiérrez[13], P. Malaquias[1], A. Reis[1], J. Perdigão[4], A. Loguercio[1] ([1] School of Dentistry, State University of Ponta Grossa, Ponta Grossa, Brazil,[2] School of Dentistry, University of Concepción, Concepción, Chile,[3] Faculty of Dentistry, University of Chile, Santiago, Chile,[4] School of Dentistry, University of Minnesota, Minneapolis, USA).

249. Influence of Silver Nanoparticle on Mechanical Properties of Adhesive Interface. **T.Y.U. Suzuki***[1,2], A.T. Maluly-Proni[1], B. Oliveira-Reis[1], W.G. Assunção[1], A.L.F. Briso[1], P.H. Dos Santos[1] ([1] School of Dentistry, Sao Paulo State University, Araçatuba, Brazil,[2] Department of Restorative Dentistry, Federal University of Minas Gerais, Belo Horizonte, Brazil).

250. Tricalcium Silicate Repair Materials Doped with Fluorine and Radiopacifiers. **M. Tanomaru-Filho***[1], L.B. Campi[1], F. Rubio[1], F.F.E. Torres[1], J. Camilleri[2], J.M. Guerreiro-Tanomaru[1] ([1] Restorative Dentistry, Unesp, São Paulo State University, Araraquara, Brazil,[2] Restorative Dentistry, University of Birmingham, UK).

251. Novel Lignan and Stilbenoid Mixtures Inhibit Cathepsin-K Activity in Dentin. **A Tezvergil-Mutluay***, R Seseogullari-Dirihan, E Yatkin, MM Mutluay (Institute of Dentistry, Univ of Turku, Turku, Finland).

252. Multidisciplinary Approach for the Treatment of External Cervical Root Resorption. **P. Thanyakoop***, P. Jiradechochai, T. Sripontong (Khon Kaen University, Thailand).

253. Evaluation of Initial Bacterial Adhesion on Zirconia using Artificial-Intelligence (AI). **J. Tsoi***, H. Ding, J.Y. Yang, J.P. Matinlinna (University of Hong Kong, Dental Materials Science, Pokfulam, Hong Kong).

254. Interface Created by Self-Adhesive Resin and Sound or Caries-Affected Dentin. **Ml Turbino***, PMA Carneiro, CAK Shimokawa (Faculty of Dentistry, University of São Paulo Sao Paulo, Br).

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1

Fracture load of fully stabilized zirconia with different thicknesses

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Purpose/aim: The aim of this study was to assess a fully stabilized zirconia (FSZ), a partially stabilized zirconia (PSZ) and a lithium di-silicate (LD), through microstructural and mechanical characterization, and to investigate the effect of thickness of the ceramic cemented on an epoxy-resin subtract.

Materials and methods: Microstructure was analyzed by scanning electron microscope (SEM), and crystal phases by X-ray diffraction (XRD) and Rietveld Refinement. For Biaxial Flexural Strength testing (BFS), disk-shaped specimens (12 mm in diameter and 1.2 mm thick) were prepared with FSZ (Prettau Anterior: Zirkonzahn), PSZ (Prettau: Zirkonzahn), and LD (IPS e.max CAD: Ivoclar Vivadent) (control group). BFS testing was performed according to ISO 6872:2015. For the fracture load static test (FLST) and Weibull statistics, disk-shaped specimens with thicknesses of 0.5 mm, 1 mm, and 1.5 mm were cemented on an 3 mm thickness epoxy-resin substrate (G10: Epoxyglas) ($n = 30$). The zirconia specimens were airborne particle-abraded with 100 μm Al_2O_3 and LD specimens were etched by 10% hydrofluoric acid for 20 s. Single Bond Universal (3M ESPE) was applied for 20 s, and cementation made with RelyX Ultimate Adhesive Resin Cement (3M ESPE). Fracture load was measured in a material testing system (MTS 810), and the load was applied by a piston with a diameter of 1.4 mm at the center of the specimens.

Results: SEM of LD showed typical needle-like crystal structure, while polycrystal FSZ showed remarkably larger grains PSZ. RDX analysis for LD showed primarily lithium di-silicate crystals, while FSZ showed 64% cubic and 38% tetragonal phases, and PSZ showed 17% cubic and 83% tetragonal phases. BFS (MPa) results were: PSZ: 683.0 ± 70.23; FSZ: 438.6 ± 64.1; and LD: 248.6 ± 37.3. One-way ANOVA for BFS was significant ($p < 0.001$), and Tukey's test showed differences among all ceramics. Two-way ANOVA for FLST was significant for ceramic, thickness, and interaction. There was no difference among all ceramics with 0.5 mm thickness. PSZ with 1.0 and 1.5 mm was significantly higher. LD with 1.5 mm exhibited higher mean than FSZ, and there was no difference between then at 1.0 mm. There is no significant difference in Weibull modulus among all ceramics and thicknesses, except that PSZ 0.5 (the lowest value).

Conclusions: Overall, PSZ showed better mechanical performance in higher thickness. Despite the lower BFS, LD had a fracture load equivalent or superior to FSZ when cemented in the epoxy substrate. In terms of reliability, in general, the ceramics behaved similarly.

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2

Porosity analysis of endodontic cements after phosphate buffer solution storage

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Purpose/aim: The aim of the present study was to evaluate the effect of phosphate buffer solution (PBS) on porosity, calcium release (Ca^{+2}) and pH change of mineral trioxide aggregate (MTA); calcium aluminate cement (CAC); CAC + 1%

chitosan (CACq); CAC + 4% zirconia (CACz); CAC + 4% hydroxyapatite (CACh).

Materials and methods: Fifteen samples (1.5 × 2 cm), prepared according to the manufacturer's instructions, were divided into five groups according to the composition of the materials used ($n = 10$). Twenty-four hours after its preparation, the samples were scanned through a micro computed tomography (micro-CT) for porosity (%) analysis. All samples were storage in 7.5 mL of PBS for 14 days, the solution being renewed every 3 days. The solutions were used for pH and Ca^{+2} release analysis by atomic absorption spectrometry (AAS). The final scanning of the samples was performed and the porosity (%) quantified.

Results: Porosity data were analyzed by Kruskal-Wallis and SNK tests ($\alpha = 0.05$). Ca^{+2} and pH data were analyzed by two-way ANOVA and Tukey tests ($\alpha = 0.05$). The 3D images analyzed qualitatively. CACq (63.90) and CACh (58.42) total porosity reduction were similar to each other ($p > 0.05$) and higher than MTA (23.44), CAC (22.82) and CACz (33.77) ($p < 0.05$). In 3 days, MTA (11.45) and CAC (10.92) presented higher pH than the other cements ($p < 0.05$). In 3 days MTA, CAC and CACq presented similar Ca^{+2} concentrations ($p > 0.05$) and higher than CACz and CACh ($p < 0.05$). In 6 days CACq presented higher concentration of Ca^{+2} than the others groups ($p < 0.05$).

Conclusions: It was observed pore formation and irregular surface for all cements. It can be concluded that the PBS significantly reduce the materials porosity, and CAC with chitosan and hydroxyapatite additives had significantly lower porosity than MTA and CAC. Also all the cements tested showed Ca^{+2} release and pH change of the storage medium.

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3

Discrepancies of zirconia crowns under different preparations and sintering techniques

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Purpose/aim: The precise marginal fit is an essential component for the clinical success of dental restorations. The purpose of this study is to investigate the influence of different finish line widths and crown thicknesses on the marginal fit of zirconia crowns using the manufacturer recommended standard and fast sintering protocols.

Materials and methods: Six Atlantis core file titanium abutments mimicking mandibular molar crown preparations were used to fabricate six master abutments for monolithic zirconia crowns. Crowns were designed virtually and milled using partially sintered zirconia blocks (emax ZirCAD, Ivoclar Vivadent) into 12 groups ($n = 10$). Crowns were sintered from group 1 to 6 by standard sintering (SS) and from group 7 to 12 by fast sintering (FS) protocols using one conventional sintering furnace. Experimental groups were as follow; G1/G7: 0.5 mm chamfer, 0.8 mm thickness, G2/G8: 0.5 mm chamfer width, 1.5 mm thickness, G3/G9: 1.0 mm chamfer, 0.8 mm thickness, G4/10: 1.0 mm chamfer width, 1.5 mm thickness, G5/G11: 1.2 mm chamfer, 0.8 mm thickness, G6/G12: 1.2 mm chamfer width, 1.5 mm thickness. The marginal gaps were assessed using a Leica microscope coupled with a digital camera at 40× magnification and calibrated with a single focal point calibration slide. Vertical marginal gaps were determined using 8 predetermined measuring points (mid-buccal, mid-lingual, mid-mesial, mid-distal) and four line angles (MB, ML, DB, DL). Photographs were taken, and the images were processed with image analysis software (Image J software 1.32; U.S. National Institutes of Health). All measurements were made perpendicular to the crown.

Results: A linear mixed effect model showed significant differences (<0.001) between the pairs of the groups (1,2), (3,4), (5,6) that used ST protocol. Within FS groups, group 8 showed the highest marginal gap, while groups 7, 11 and 12 were similar to each other and different from 9 and 10 that were similar to each other. L surface showed the highest marginal gaps in both sintering protocols.

Conclusions: This study showed that preparation designs have great influence in monolithic zirconia marginal discrepancy while no obvious differences between the two sintering protocols have been observed.

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4

Clinical performance of bulk-fill and incremental restorations in endodontically-treated molars

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Purpose/aim: This randomized clinical trial aimed to evaluate the clinical performance of complex restorations placed with bulk-fill and conventional resin composite in endodontically-treated molars after a follow-up period that ranged between 1 and 2 years.

Materials and methods: A total of seventy-two molars in 55 young patients (between 10 and 18 years old) were endodontically treated and immediately restored by incremental technique using one of both restorative protocols: composite resin (Filtek Z350, 3M-ESPE) associated with glass ionomer cement into the pulp chamber (Vitremer, 3M-ESPE) or bulk-fill composite (Posterior, 3M-ESPE) in two increments of no more than 5.0 mm. All restorations were made using universal adhesive system (Single Bond, 3M-ESPE); all the materials were light cured using Optilight Max light curing unit (Gnatus), that presented irradiance of 2500 mW/cm^2. The restorations were evaluated immediately and after 12 months by two calibrated examiners using the USPHS (United States Public Health Service) criteria.

Results: The recall rate was 96%. The clinical performance of both groups was similar after 1 year. The followed parameters had score C per restorative protocol: marginal integrity: Incr-40%; Bulk-31%; anatomic contour: Incr-36%; Bulk-21%; color stability: Inc-24%; Bulk-12%.

Conclusions: Large bulk-fill composite resin (Posterior, 3M-ESPE) restorations in endodontically-treated molars of young patients presented similar clinical performance when compared to composite resin restorations placed with incremental filling after 12 months.

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5

Subsurface microhardness of affected dentin after biomodification with phosphorylated chitosan

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Purpose/aim: To evaluate the effect of phosphorylated chitosan on subsurface microhardness of caries-affected dentin.

Materials and methods: Thirty dentin specimens with the dimension of $7.0 \times 7.0 \times 2.5$ mm were submitted to pH-cycling method. To create artificial lesions, each specimen was immersed in demineralizing solution for 8 h followed by remineralizing solution for 16 h during 14 days. Selective removal of carious lesion was performed with spherical carbide drill at low speed using an automatic custom-designed device. Dentin specimens were acid etched and subdivided according to dentin biomodification: no biomodification (control) and phosphorylated chitosan (p-chi). Specimens were immediately restored using Single Bond Universal (3M) and composite resin (Z250-3M). The Knoop microhardness analysis ($n = 10$) was performed with distance of 30 μm from tooth surface at four times: sound dentin, caries-affected dentin, after the selective removal of caries (remaining caries-affected dentin) and after dentin restoration. Data were analyzed with the Friedman's test followed by post-hoc Wilcoxon test ($\alpha = 0.05$).

Results: After artificial caries induction, the subsurface microhardness of dentin decreased ($p < 0.001$). However, after selective removal of carious lesions, the values of remaining caries-affected dentin were increased ($p < 0.001$). The biomodification with p-chi did not alter the subsurface microhardness of caries-affected dentin compared to control ($p = 0.141$).

Conclusions: The phosphorylated chitosan did not influence the subsurface microhardness of caries-affected dentin.

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6

Strength and reliability of leucite versus lithium disilicate glass ceramics

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Purpose/aim: This study aimed to compare leucite-based and lithium disilicate glassceramics regarding biaxial flexural strength.

Materials and methods: A leucite-based material for CAD/CAM application (LRF Block, GC InitialTM, GC, Tokyo, Japan) and a lithium disilicate glassceramic for injection-molding (LiSi Press, GC InitialTM, GC) were selected. LRF blocks were ground to 12×12 mm^2 cross-section, and further into slices of 1.5 mm thickness. Acrylic plates of $12 \times 12 \times 1.5$ mm^3 served as templates for the specimens of the pressable material. One side of the specimens were finished with highly polished surfaces using a series of SiC papers in water (P800 to P4000) to a final thickness of 1.1 ± 0.05 mm. Etched samples were analyzed in a scanning electron microscope for microstructural characterization. Plate specimens were tested in a universal testing machine (Zwick Roell, Germany) at 1.5 mm/min using the Balls-on-3-Balls biaxial flexure set-up. The data were analyzed using Weibull statistics.

Results: The characteristic strength ($\sigma 0$) and Weibull modulus (m) were, respectively: LRF ($\sigma 0 = 216.67$ MPa, $m = 9.72$) and LiSi ($\sigma 0 = 455.19$ MPa, $m = 3.71$). A statistically significant difference between both materials was obtained for both parameters.

Conclusions: Within the limitations of this study, the following conclusions are taken: (i) the lithium disilicate material shows a higher flexural strength than the leucite-based glassceramic; (ii) the defect population in the CAD/CAM material (leucite) has been shown to be more homogeneous than that in specimens fabricated by injection-molding (lithium disilicate).

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7

Wear of zirconium-reinforced lithium silicate ceramic against several restorative materials

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Purpose/aim: This study investigated the performance of lithium silicate ceramic reinforced with zirconium dioxide after wear with several material pairs (zirconia, steatite, and acrylic resin).

Materials and methods: Thirty discs of Suprinity (10 mm in diameter and 2 mm in thickness) were made and divided into three groups according to the antagonist. Ten cylinders of each antagonist material (15 mm in height and 4 mm in diameter, flat) were also made. The parameters for the simulation of wear were: 30 N, horizontal movement of 6 mm, and 1.7 Hz, totaling 300,000 cycles in water. Wear measurements on the ZLS specimens and on the antagonists were performed. Roughness, hardness, and digital optical profilometry measurements were also performed. The means of wear, roughness, and hardness were subjected to one-way ANOVA and Tukey's test (95%).

Results: The results were not statistically significantly different for roughness ($p = 0.08$), but differed for hardness ($p = 0.000$). With the profilometry images, it was possible to observe the different wear patterns depending on the antagonist and quantify the volumes worn with steatite and zirconia, which were statistically significantly different ($p = 0.001$). CAD-waxx promoted a superficial wear that could not be quantified. After the statistics for the wear of the antagonists were gathered, it was observed that there were differences in wear among all groups ($p = 0.000$).

Conclusions: It can be concluded that zirconia promoted marked wear of ZLS. Steatite caused intermediate wear, and resin/CAD-waxx caused no wear of ZLS.

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8

Mechanical performance of CAD/CAM materials adhesively bonded to NG10

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Purpose/aim: To evaluate the hardness, fracture toughness, load to failure, fatigue and stress distribution with finite element analysis (FEA) of lithium disilicate (LD), feldspathic ceramic (FC), resin matrix ceramic (RM) and nanohybrid composite (NC) when adhesively cemented to a dentin-like substrate (NG10).

Materials and methods: Disc shaped samples were manufactured from each material ($N = 45$), which were polished. Hardness was measured in a microhardness tester (19.61 N, 12 s, Knoop indenter, $n = 5$). Indented samples were subjected to biaxial flexural strength, and the fracture origin defect was measure under microscopy for determination of fracture toughness. Remaining discs were adhesively cemented to NG10. Twenty samples were subjected to load-to-failure test, and other 20 samples were subjected to cyclic fatigue (400 N, 1,000,000 cycles), samples were checked every 200 K cycles for verification of catastrophic failure. A 3D model of the cemented discs was constructed in design software and imported to finite element analysis software, were the elastic properties of the materials were inserted and a mesh was generated. A 100 N load, normal to surface, was applied to the restoration surface and stress distribution was evaluated. Data were subjected to statistical analysis (ANOVA and Tukey's test, $\alpha = 0.05$) and Weibull analysis.

Results: LD presented the highest hardness and fracture toughness values and the highest stress concentration values in FEA at the disc cementation surface. The NC presented to lowest values of hardness and stress concentration, and the FC presented the lowest values of fracture toughness. One sample of LD and one of NC fractured during fatigue test, but there was no variation of failure rate along time for evaluated materials ($\beta = 1$). LD and RM presented high rate of samples with internal cracks after fatigue (55% and 75% respectively). The FC presented the lowest debonding rate on load-to-failure test and absent of catastrophic fractures or cracks during fatigue.

Conclusions: Materials tested presented different mechanical behaviors according to the test performed.

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Dentin pre-treatment with EGCG solution: Long-term nanoleakage and bond strength

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Purpose/aim: This study evaluated the effect of dentin pre-treatment with EGCG at different concentrations on long-term bond strength (μTBS) and nanoleakage (NL) of etch-and-rinse adhesive system to caries affected dentin (CAD).

Materials and methods: Dentin fragments of 40 human molars were submitted to a microbiological caries induction protocol for 14 d. After caries removal, fragments containing CAD surfaces were randomly divided into 5 groups ($n = 8$), according to dentin pre-treatment performed after acid etching for 15 s: 0.02% EGCG; 0.2% EGCG; 0.5% EGCG; 2% Chlorhexidine [CHX] and without treatment as a control group – [C]. The etch-and-rinse adhesive system (Adper Single Bond 2, 3M ESPE) was applied according to the manufacturer's instructions and composite resin restorations were built on CAD. After 24 h, the teeth were sectioned in order to obtain "sticks" (1 mm^2) that were randomly subdivided into two groups according to the moment they were submitted to μTBS and NL testings: immediately or after 1 year of storage in distilled water.

Results: The data were statistically analysed by two-way ANOVA and Tukey's test ($\alpha = 0.05$). The application of EGCG, at different concentrations, and CHX did not affect immediate μTBS ($p > 0.05$). After 1Y, there was significant decrease in μTBS for all experimental groups ($p < 0.05$). For NL, groups that received dentin pre-treatments showed reduced NL in comparison to C group, regardless of water storage period ($p < 0.001$). CHX group showed lower NL but with no significant difference from 0.02% and 0.5% EGCG groups ($p < 0.001$).

Regardless of dentin pre-treatment, NL increased after 1Y of storage in water ($p < 0.001$).

Conclusions: It can be concluded that although dentin pre-treatment with EGCG at 0.02% and 0.5% concentrations and CHX promoted a decrease in nanoleakage, they were not able to prevent decrease of bond strength to caries-affected dentin over time.

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Gap evaluation of milled chrome-cobalt full-arch implant-supported frameworks

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Purpose/aim: Complete-arch implant-supported fixed prostheses provide the patient with function and aesthetic recovery, but may have their success reduced in the absence of passive adaptation of framework. The aim of this study was to compare the vertical marginal gap of computer numeric controlled (CNC)-milled chrome-cobalt frameworks after different scanning techniques.

Materials and methods: Five analogous of microunit abutments (conical 4.1, Neodent, Curitiba, Brazil) were installed in an aluminum cylinder (45 mm height, 60 mm diameter). Abutments were symmetrically distributed from the median line following a 112.5° arch and were named A/B/C/D/E from left to right. A scan body (Neodent, Curitiba, Brazil) was installed over each abutment and were scanned (Dental Wings 7 series, Montreal, Canada) by two techniques suggested by the manufacturer, which consisted in a single scanning of all abutments at the same time ("unique" group) or a detailed scanning of each abutment followed by images overlap performed by the software ("detailed" group). After scanning, a virtual model was obtained and 4 frameworks were designed from each scanning technique. 8 frameworks were CNC-milled (Ultrasonic 10 Suaer, DMG, Tokyo, Japan) from CrCo disks. The measurements of the vertical marginal gap were performed at "E" screw position using a stereomicroscope considering two screw tightening positions ("A" or "C"). Means of mismatch were obtained from 4 measurements per point in each experimental condition. Data were analyzed by 2-way ANOVA (scanning technique versus screw position) and Tukey's test ($\alpha = 5\%$).

Results: Scanning technique influenced the misfit of frameworks ($p < 0.0001$), but the tightening position of the screw did not ($p = 0.7958$). Reduced mean vertical gap was found for "unique" scanning.

Conclusions: Frameworks scanned by the single image method showed less vertical marginal gap compared to the detailed image technique.

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Anti-caries agents incorporation effects on color shade of composites

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Purpose/aim: This study aimed to analyze the effect of the addition of two anti-caries agents on the color shade of resin composites and resin cements.

Materials and methods: Two compounds isolated from Brazilian propolis, Apigenin (Api) and tt-Farnesol (Far), were added in a concentration of 5 mM. These compounds were incorporated alone, combined or combined with fluoride (250 ppm of NaF^- F) to resin composites and resin cements. Five composites disks (10 mm × 2 mm) were obtained of each group and the color shade, L*, a* and b* were analyzed using VITA Easyshade.

Results: Regarding the color assessment following the VITA shade guide, all groups having Api shifted the color from B1 to B2 (Table 1). L* decreased for all groups having Api or Far, compared to the control group, for both materials. Groups having Api presented higher b* values compared to the control group. Far presented lower a* and b* values when added to the resin composite.

Conclusions: The addition of Far promoted a slightly decreased in yellowish when added to resin composite, while the addition of Api promoted an increase in yellowish for both materials tested.

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Table 1 – Resin composite and resin cement color shade.

	Resin composite				Resin cement			
	Color shade	L	a	b	Color shade	L	a	b
Control	B1	95.9 (0.4) a	−2.4 (0.2) a	11.1 (0.6) b	B1	96.0 (0.5) a	−2.8 (0.2) a	9.4 (0.6) c
Api	B2	90.3 (0.5) c	−2.2 (0.2) a	23.7 (0.6) a	B2	90.3 (0.6) c	−2.7 (0.2) a	23.8 (1.7) a
Far	B1	93.7 (0.5) b	−0.6 (0.2) c	8.9 (0.6) c	B1	94.7 (0.5) b	−2.4 (0.5) ab	10.1 (1.4) c
Api + Far	B2	91.3 (0.5) c	−1.9 (0.2) ab	23.4 (0.6) a	B2	89.8 (0.8) c	−2.1 (0.2) b	20.6 (1.3) b
Api + Far + F	B2/A1	91.3 (0.5) c	−2.1 (0.2) a	21.8 (0.6) a	B2/A1	90.1 (0.6) c	−2.1 (0.3) b	20.8 (1.7) b

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MMP gene expression and bond strength to proanthocyanidin-biomodified air-dried dentin

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Purpose/aim: To evaluate the effect of physical dehydration of proanthocyanidin-biomodified dentin on immediate bond strength, cell viability and MMP-2 and MMP-9 gene expression in immortalized odontoblast-like cells.

Materials and methods: Flat dentin surfaces ($n = 120$) were etched with phosphoric acid and treated with 5% proanthocianydin (PA) dissolved in water, in 5% or 90% ethanol or acetone, or only water, ethanol or acetone ($n = 6$). The solutions were passively applied for 60 s followed by rinsing with deionized water. Then, the teeth were subdivided according to the hydration condition of dentin, wet or dry. Dry dentin was achieved by continuously air drying the conditioned dentin for 60 s. Wet and dry dentin that received only water as treatment was considered the positive and negative controls, respectively. Optibond S was applied, and composite resin blocks were built up. After 24 h, the teeth were cut to produce beam-like specimens (0.81 mm^2) for the microtensile test. In the next phase thirty-two 0.4mm-thick dentin discs were separated into 4 groups ($n = 8$). The discs were adapted in artificial pulp chambers which were inserted in culture plates containing DMEM. MDPC-23 cells (5 × 105 cell/well) were seeded on the pulpal side of the dentin discs and the occlusal surface was etched with phosphoric acid and treated with water, 5% PA in 5% ethanol or in 5% acetone. The culture plates were incubated for 24 h, followed by the analysis of cell viability (Alamar Blue) and MMP-2 and -9 gene expression (RT-qPCR). Data were submitted to one-way ANOVA and Tukey tests ($p = 0.05$).

Results: For both solvents and concentrations, there was no difference between the positive control and treatments when the conditioned dentin was kept moist. For the dry dentin, all treatments showed higher μTBS in comparison to the dry dentin negative control, and similar values when compared to the positive control. The highest μTBS values were observed for 5% PA in 5% acetone or in 5% ethanol. There was no difference in cell viability and MMP-2 and -9 gene expression among all groups. However, the expression levels of the gene encoding MMP-2 was considerably higher than the levels seen for MMP-9.

Conclusions: Dentin biomodification with PA, especially in 5% acetone or ethanol, allowed air drying the conditioned dentin without any detrimental effect on the immediate bond strength and odontoblast-like cells viability.

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Bond strength of Y-TZP to resin cements: Surface treatment effects

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Purpose/aim: The aim of this study was to evaluate the shear bond strength between a Y-TZP ceramic and resin cement as a function of the ceramic surface treatment.

Materials and methods: Y-TZP cylinder-shaped specimens (~3.0 × 4.0 mm) were fabricated and cemented to resin composite blocks. The experimental groups were divided according to the surface treatment. The control group (a) did not receive any surface treatment. Groups (b) to (e) received SC with silica-modified alumina particles with different sizes either before or after final sintering, as follows (particle size/SC moment): (b) 30 μm/before sintering; (c) 110 μm/before sintering; (d) 30 μm/after sintering; and (e) 110 μm/after sintering. All groups were stored in distilled water at 37 °C and tested 24 h after the cementation. All specimens were subjected to the shear bond strength test. Data were analyzed using two-way ANOVA and Tukey's test. Fractography analysis was performed.

Results: Results are shown in Table 1. After TC, the bond strength values of all groups were similar, except for the group 110 μm/before sintering that showed significantly lower mean values. Adhesive failures were predominant (50–60%) when no surface treatment was performed and when silica coating was applied after sintering using 30-μm silica-modified Al_2O_3 particles. Mixed failures (adhesive fracture and cohesive fracture of the resin cement) occurred in all studied specimens. Cohesive failure of the Y-TZP ceramic was observed when 110-μm silica-modified Al2O3 particles were used before final sintering.

Conclusions: The surface treatment affected the bond strength of the Y-TZP to the resin cement. The most detrimental effect was observed for specimens sandblasted with larger Al_2O_3 particles (110 μm) before sintering which showed detachment of the zirconia grains (cohesive failure of Y-TZP).

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Table 1 – Mean shear bond strength values with SD.

SC protocol	Control/ after sintering	30 μm/ after sintering	110 μm/ after sintering	30 μm/ before sintering	110 μm/ before sintering
Shear bond strength	13.03[b] (2.36)	19.25[a] (3.58)	11.07[b] (3.42)	14.52[b] (1.50)	6.82[c] (1.37)

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TT-farnesol-containing ionomeric cement: Chemical mechanical characterization and S. mutans virulence

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Purpose/aim: The aim of this study was to characterize chemical and mechanical properties of an experimental tt-farnesol-containing glass ionomer cement (GIC) as well as their molecular effects on S. mutans biofilm.

Materials and methods: Standard round-shaped specimens (5 mm × 2 mm) of a GIC (Fuji IX GP®) containing or not tt-farnesol were prepared according to the manufacturer's instructions, using silicon matrix, at 23 °C, and 50% relative humidity. After setting reactions, specimens were polished and submitted to each test. Raman spectroscopy was performed with spectra scanned between (100–3000 cm^{-1}) and wavelength 785 nm with five accumulations to confirm the presence or not of the tt-farnesol ($n = 5$). Roughness analysis ($n = 15$) was performed using 3 measurements in a perfilometer at a constant speed (0.5 mm/s). Knoop microhardness (KHN) was assessed by 3 indentations with 25 g/15s using 15 specimens per group. Compressive ($n = 30$) and diametral tensile strength ($n = 30$) were assessed in a universal testing machine at a crosshead speed of 1 mm/min and 0.5 mm/min, respectively. Finally, tt-farnesol/GIC effect on gene expression of S. mutans UA159 biofilms, were analyzed by RT-qPCR. Afterwards, biofilms formed on specimens were collected and centrifuged to pellet precipitation ($n = 6$). Total RNA was purified and then converted in cDNA. RT-qPCR reactions were made with specific primers to following genes: gtfB, gtfC, gtfD, gbpB, vicR, and covR. Gene expression values were normalized by 16S reference gene. Data homogeneity was confirmed (Levene's test) and statistical analysis were made using t-test for all experiments performed ($\alpha = 0.05$).

Results: Raman spectroscopy bands showed intensity modifications to tt-farnesol/GIC compared to conventional GIC. No statistical difference was evidenced to roughness between tt-farnesol/GIC (0.8 μm ± 0.1) and conventional GIC (0.7 μm ± 0.2). KHN was significantly increased by tt-farnesol/GIC (72.4 ± 6.5) compared to conventional GIC (44.2 ± 8.0). Compressive strength presented similar values for tt-farnesol/GIC (28.5 MPa ± 8.3) and conventional GIC (24.0 MPa ± 8.9) as diametral tensile strength to tt-farnesol/GIC (14.0 MPa ± 3.1) and conventional (18.0 MPa ± 5.5) materials. No statistical differences were evidenced between tt-farnesol/GIC and conventional GIC for all S. mutans genes analyzed in this study.

Conclusions: The tt-farnesol was capable to enhance KHN of GIC, and exhibited similar values for roughness, compressive strength and diametral tensile strength and did not modify S. mutans biofilms at molecular level.

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Fatigue testing machine design for dental ceramics: A validation study

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Purpose/aim: Fatigue resistance is a crucial factor for the clinical long-term survival of prosthetic restorations. High strength full-contour ceramics combined with CAD/CAM technology showed promising clinical outcomes and lower costs; however, their fatigue resistance was seldom compared to natural teeth. Aim of this study was to validate a fatigue testing machine concept comparing the fatigue survival and the wear patterns of monolithic ceramic crowns to those of sound human teeth. The null hypothesis was that the fatigue resistance and the wear pattern induced by the machine did not differ among the tested groups ($\alpha = 0.05$)

Materials and methods: Five groups ($n = 20$) of monolithic crowns of different thickness (1.0 mm Y-TZP HT, 1.0 mm cubic-zirconia UT, 1.5 mm cubic-ziconia UT, 1.0 mm cubic-zirconia ST, all from Kuraray-Noritake, and 1.5 mm lithium-disilicate, L-DIS, from Ivoclar Vivadent) and 20 human sound third molars have been collected and mounted in epoxy-resin cylinders, then subjected to impact fatigue cycles (Ball-Mill). The specimens were analyzed after 10, 20, 30 and 60 min cycling, then analyzed every hour until a total time of 480 min cycling. Wear and damage analysis was carried out using a stereomicroscope. The material losses (mm^3) were calculated (Rhinoceros software) by comparing the digital impressions (Carestream CS3500 scanner) of each specimen at the different time intervals. Gehan-Breslow-Wilcoxon test and Kruskal-Wallis with post-hoc Dunn's test were applied to survival and volume loss data ($\alpha = 0.05$).

Results: After 480 min 1.0 mm Y-TZP HT showed the highest fatigue resistance, similar ($p > 0.05$) to 1.5 mm UT cubic-zirconia and 1.5 mm L-DIS. 1.0 mm UT cubic-zirconia showed the highest failure rate ($p < 0.001$). At 60 min fatigue cycling, natural teeth showed significantly higher volume loss (mean 59.92 mm^3, $p < 0.05$) than all ceramic crown groups, that ranged from <0.01 mm^3 (1.0 mm Y-TZP HT) to 18 mm^3 (1.5 mm L-DIS). Morphological characterization of natural teeth showed neatly exposed dentin after 60 min cycling. Digital and CAD analysis of tissue loss pattern occurred on natural teeth was related to clinical functional time through Miles classification of occlusal wear during life. A correspondence of 18 years of clinical function for 60 min cycling for the Ball-Mill machine was suggested.

Conclusions: Fracture growth can be induced by Ball-Mill fatigue machine on ceramics and dental tissues causing wear

patterns similar to those clinically observed. The response to fatigue of ceramic crowns are in accordance with the literature data and with the expected behavior drawn from their different mechanical properties; thus, the results suggest that the Ball-Mill machine could be a fast and cost-effective method to foresee the clinical behavior of different all-ceramic crowns.

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Effect of ceramic bars geometry on flexural strength

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Purpose/aim: The aim of this study was to evaluate the behavior of a lithium disilicate based ceramic, IPS emax CAD, using bar shaped specimens for the three-point bending test with different types of edge geometries.

Materials and methods: These edge geometries were: right-angle (90°), rounded and 45° chamfer. Theoretical and laboratorial tests were conducted. For the theoretical test, Rhinoceros 4.0 program was used to design the bar samples (3D) which were evaluated using finite element analysis to examine if the geometry of these edges influenced the stress distribution within the samples during three-point bending tests. Maximum principal stress was used because of the fragility of ceramics after a coherence and mesh convergence (10%) test. For the laboratorial test, 10 bars from each chosen group were prepared and bent using the three-point bending test.

Results: In the theorical test, all groups were tested under the same mechanical conditions, where stress concentration was on the bottom side of the bar, in the tensile stress area. In the laboratorial test, there was no statistical difference between groups ($p = 0.075$). A similar behavior was observed for both groups during flexural resistance test and fractographic analysis, validating the mathematical model presented.

Conclusions: Thus, the edge shape of bars has no influence on resistance values of three-point bending tests.

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Effect of sandblasting particle size on mechanical properties of zirconia

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Purpose/aim: This study aimed to evaluate the effect of sandblasting particle size on bond strength (μSBS) between zirconia and resin cement.

Materials and methods: 60 Y-TZP (Yttria-tetragonal zirconia polycrystalline) samples were randomly assigned to 3 groups according to the treatment: Control or sandblasting (standoff distance 10 mm, 90° angle, 2.5 bar, 15s) with Al_2O_3 particles (45 μm or 150 μm). Surface topography (surface profilometry and atomic force microscopy – AFM) and contact angle (Fringe Projection Phase Shifting – FPPS) were characterized. Micro-shear bond strength (μSBS) was analyzed after 24 h or 6 months water storage and mode of failure was classified. The data were subjected to two-way ANOVA ($\alpha = 0.05$) and Tukey's test.

Results: Sandblasting had no significant effect on contact angle ($\rho = 0.76$). There was a positive correlation between sandblasting particle size and surface roughness. Sandblasting significantly affected μSBS values, but storage time did not ($\rho = 0.1753$). After 24 h of storage, μSBS of samples sandblasted with 150 μm Al_2O_3 particles (15.09 MPa) was significantly higher than μSBS of control group (7.11 MPa). Six months water storage significantly affected μSBS of 150 μm-blasted samples (9.51 MPa). Particle size significantly affected bond strength results after 24 h of storage time, but not after 6 months. Storage time significantly affected bond strength irrespective of surface treatment.

Conclusions: Sandblasting with Al_2O_3 particles increases the roughness on Y-TZP surface and the μSBS between zirconia and resin cement. This bond strength was reduced in presence of water, thus, the unstable gain in bond strength does not compensate for the possibility of surface damage.

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Effect of thermocycling on bond strength of restorative composites

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Purpose/aim: The purpose of this study was to evaluate the thermal effect on the adhesive interface between the human dentin and the indirect restorative material (hybrid ceramic), by microtensile test.

Materials and methods: Ten teeth were sanded until exposure of dentin, and then were submitted to conditioning with 37% phosphoric acid and adhesive system. The indirect restorative material (Enamic, Vita Zahnfabrik) was cut to 4 mm of thickness and submitted to 10% fluoridric acid etching and then silane was applied, following a manufacturer's recommendation. After that, the restorative material was cemented to dental structure with resin cement (Bifix QM, Voco). For this, a load of 500 g was applied, the excesses were removed and was cured during 120 s. The assembly were immersed in distilled water at 37 °C, during 24 h, after this, they were sectioned in a cutting machine to obtain the sticks specimens (1 mm x 1 mm). All specimens were divided into five groups, where three were thermocycled with different protocols: T1 (55°-5 °C), T2 (60°-4 °C), T3 (60°-37°-12 °C). As negative controls, 2 groups were considered, stored in: water (L1) and mineral oil (L2) in an oven at 37 °C, during 5 d. The groups T1, T2 and T3 were submitted to thermal cycling in water (6.000 cycles). All groups were then subjected to microtensile testing. The fracture resistance data (MPa) were submitted to statistical analysis. The fractures were analyzed in stereomicroscope and classified as adhesive, cohesive and mixed.

Results: The thermocyclic groups showed lower values of tensile strength compared to L2 group. L1 group presented intermediate values, with no statistical difference compared to the others.

Conclusions: Thus, it was possible to conclude that, the temperature variations used did not influence the tensile strength values.

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Flexural strength and reliability of CAD/CAM materials for dental applications

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Purpose/aim: The aim of this study was to investigate the biaxial flexural strength and reliability of modern CAD/CAM dental materials.

Materials and methods: Disc-shaped specimens (□ = 12 mm, thickness = 1.0 mm) were divided into three groups according to the testing materials: a particle-filled composite (Lava Ultimate, 3 M ESPE), an interpenetrating phase composite (VITA Enamic®, VITA Zahnfabrik), and a machinable lithium dissilicate ceramic (IPS e.max® CAD, Ivoclar-Vivadent). The fracture strength of the materials was evaluated by a biaxial strength test. The fracture strength data were analyzed according to the characteristic strength and the Weibull modulus. For reliability analysis, the specimens were fatigued via step-stress method based on the mean flexural strength values according to three profiles (mild, moderate and aggressive) until failure. The step-stress failure/survival data were analyzed with reliability software Alta Pro 7. Use level probability Weibull curves (probability of failure vs cycles) and reliability were calculated (90% confidence bound) for comparison among groups.

Results: The data from biaxial strength test (MPa) were compared by ANOVA and Tukey test ($\alpha = 0.05$). The mean strength value for Lava Ultimate (219.8 MPa) was statistically higher than the values obtained for emax CAD (191.4 MPa) and Enamic (126.7 MPa), respectively. The probability of failure varied over a very wide range, ranging from 2.6% (Lava Ultimate estimated for 1×106 cycles at 20 MPa) to 100% (Enamic estimated for 1×107 cycles at 50 MPa).

Conclusions: A remarkable effect of fatigue mechanisms on the flexural strength was demonstrated for all dental CAD/CAM materials. The Lava Ultimate showed significantly better performance than the others evaluated restorative systems in terms of fracture strength and fatigue behavior.

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Physical properties of adhesive system incorporated with polyphenol-enriched extract

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Purpose/aim: The aim of this study was to evaluate the physical properties (degree of conversion, pH and extract release) of a three-step total-etch adhesive system (Scotchbond Multipurpose/3M ESPE) incorporated with polyphenol-enriched extract of Arrabidaea chica (AC).

Materials and methods: The degree of conversion of 2.5% AC incorporated into the primer of the adhesive system was evaluated by Fourier transform infrared spectroscopy (FTIR) ($n = 5$). The pH values of the adhesive system incorporated or left unincorporated with AC were measured with a pH meter in triplicate. Adhesive system discs ($n = 10$) incorporated or left unincorporated with AC were prepared using rubber molds (12 mm in diameter and 0.8 mm thick). The discs were weighed and kept immersed in distilled water at 37 °C during the entire

experimental study. The AC concentration released was determined by UV–Vis spectrophotometry with a wavelength of 278 nm, at 1, 3, 7, 14, 28 and 36 days storage. The discs were weighed again at the 36th day.

Results: Generalized linear models were applied to show that the discs mass was lower at the 36th day ($p < 0.0001$), and when AC was not incorporated ($p = 0.0041$). AC release was higher at 3 and 7 days, compared with the group without AC, but was lower at the 36th day for both groups ($p = 0.0162$). The t-student tests showed that the cumulative AC concentration released was higher for the adhesive incorporated with AC ($p = 0.0116$) at the 7th day, but no differences between the groups were observed at other time points ($p > 0.05$). The t-student test showed no differences in degree of conversion between adhesives incorporated or left unincorporated with AC ($p = 0.2242$). The pH of the adhesive system primer was 3.74, but rose to 4.28 in the AC-incorporated group.

Conclusions: The three-step total-etch adhesive system released the AC extract over time, with a higher release at the 3rd and 7th days. The AC release was accompanied by material mass loss. The incorporation of AC into the adhesive system did not affect the degree of conversion, but did increase the pH of the adhesive system primer.

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Can ferrule effect reduce failures in fiber post-retained restorations? Meta-analysis

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Purpose/aim: The survival/success of post-retained restorations is influenced by numerous factors, among them the amount of residual coronal structure, known as ferrule effect. The aim of this systematic review and meta-analysis was to evaluate whether the absence or presence of ferrule influences the failure rate in fiber-reinforced composite (FRC) post-core restorations

Materials and methods: The methods of this study were recorded on the PROSPERO (International Prospective Register of Systematic Reviews) platform under the number CRD42018092904. A comprehensive review of the literature was conducted in the PubMed/Medline, Embase, Scopus and Cochrane Library databases until May 2018. The risk ratio with 95% confidence interval (CI) was estimated using the Mantel-Haenszel method. Of the 380 studies found, four were included in this meta-analysis, filling the pre-established selection inclusion criteria. 297 teeth were evaluated, being 157 teeth with ferrule and 140 teeth without ferrule.

Results: The mean survival rate was 88.35% in the ferrule groups and 78.05% in the non-ferrule group. There was no statistically significant difference in the general failure analysis (RR: 0.71, 95% CI: 0.47–1.06, $p = 0.09$), although a higher number of failures occurred for non-ferrule restorations.

Conclusions: This meta-analysis of the limited studies available suggested that ferrule effect does not significantly reduce the failure rate in FRC post-core restorations when compared in the absence of this effect.

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Effect of aging on the optical properties of ZTA composites

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Purpose/aim: The aim of the study was to synthesize a ZTA composite by including 30% of translucent Y-TZP in a 70% Al_2O_3 matrix (ZTA-Zpex) and to characterize its optical properties before and after aging, with a translucent Y-TZP (Zpex) as control group.

Materials and methods: Fifteen discs with 12 mm of diameter and 1 mm thick were prepared for each group by uniaxial and isostatic pressing. After sintering, polishing of the two flat surfaces was done with diamond discs and diamond suspensions. The optical characterization was performed by means of reflectance tests over white and black background to determine the contrast ratio (CR) and the translucency parameter (TP). X-Ray Diffraction (XRD) test was performed to study the Y-TZP and Al_2O_3 crystalline phases. Aging was performed in autoclave for 20 h at 134 °C and 2.2 bars. Obtained data was statistically analyzed with One-way ANOVA and Tukey tests.

Results: A significantly lower opacity was found in Zpex (RC = 0.77) ($p < 0.0001$) when compared with ZTA-Zpex composite (RC = 1.00). A high masking ability was found for ZTA-Zpex ($\Delta E = 0.22$), being statistically different from Zpex ($p < 0.0001$), which presented higher translucency and poor masking ability ($\Delta E = 10.19$). After aging, Zpex CR significantly decreased (CR = 0.6811) while TP increased ($\Delta E = 15.5110$) when compared with immediately tested Zpex ($p < 0.0001$). ZTA-Zpex optical properties remained stable after aging (RC = 0.9971 and TP = 0.4241) without significant differences when immediately tested ($p = 0.991$). XRD showed that zirconia patterns were preserved in the ZTA composite. After aging, higher monoclinic

peaks were identified in Zpex while ZTA-Zpex exhibited a more stable crystalline structure.

Conclusions: ZTA-Zpex composite exhibited significantly higher opacity values, and their optical properties did not vary after aging when compared to Zpex group.

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Adhesion and marginal integrity of bioactive restorative materials

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Purpose/aim: To investigate adhesion and marginal adaptation of claimed bioactive restorative materials (ACTIVA BioACTIVE Restorative, Pulpdent; Fuji II LC, GC) to human teeth.

Materials and methods: Shear bond strength of the restorative materials to enamel and dentine was assessed. Marginal adaptation of these materials to hemispherical cavities (Ø 3 mm) with margins located in enamel and dentine were assessed (n = 10). The hard tissues were either previously etched (using phosphoric or polyacrylic acid) or restored directly with the bioactive materials, with no pretreatment. For ACTIVA BioACTIVE Restorative, the effect of applying a self-etch adhesive (Xeno Select, Dentsply Sirona) was also investigated. A group restored with the self-etch adhesive and resin composite (Ceram X Mono, Dentsply Sirona) was used as control. The specimens were subjected to 6000 thermal cycles and then stored in phosphate-buffered saline solution at 37 °C for 28 days. Shear bond strength test was conducted at a crosshead speed of 1 mm/min. The marginal adaptation to the cavities was assessed under 500× magnification; the size of gaps was registered and wall-to-wall contraction was calculated. Data was analysed using non-parametric tests ($\alpha = 0.05$).

Results: Significant differences in bond strength and wall-to-wall contraction were observed among the investigated materials, both in enamel and dentine ($p < 0.05$). Good bonding of the bioactive materials to enamel resulted from previous enamel etching. On the contrary, adequate bond strength of ACTIVA BioACTIVE Restorative to dentine was obtained only when using the adhesive. Etching alone (with phosphoric acid) resulted in insufficient adhesion of ACTIVA BioACTIVE Restorative; the restorations were lost and no measurements could be performed (Table 1). Fuji II LC resulted in the best marginal adaptation to enamel and dentine, with or without previous etching.

Conclusions: For the bioactive materials, previous etching or the use of an adhesive was essential to provide adequate bond strength to enamel. In dentine, the best bond strength outcome for Fuji II LC was seen when dentine was previously etched with polyacrylic acid; for ACTIVA BioACTIVE Restorative, when the adhesive was used prior to restoration. The self-adhesive property of ACTIVA BioACTIVE Restorative is poor and the possible clinical implications of this finding are not to be overlooked.

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Table 1 – Median (interquartile range) wall-to-wall contraction (%) to cavities with margins in enamel and dentine. Median (interquartile range) bond strength (MPa) to enamel and dentine.

Pretreatment	Agent & application time	Restorative material & manufacturer	Bond strength (MPa) Enamel	Bond strength (MPa) Dentine	Wall-to-wall contraction (%) Enamel	Wall-to-wall contraction (%) Dentine
No pretreatment	–	ACTIVA BioACTIVE Restorative, Pulpdent	**	**	0.16 (0.06)^{b} $p = 0.198$	**
	–	Fuji II LC, G.C.	13.91 (8.32)^{c} $p = 0.028$	7.17 (9.90)^{c} $p = 0.002$	0.04 (0.12)^{ab} $p = 0.05$	0.00 (0.11)^{a} $p = 0.314$
Etching	Phosphoric acid: 10 s	ACTIVA BioACTIVE Restorative, Pulpdent	30.94 (9.27)^{a} $p = 0.001$	**	0.13 (0.05)^{b} $p = 0.436$	0.26 (0.11)^{b} $p = 0.000$
	Polyacrylic acid: 10 s	Fuji II LC, G.C.	24.03 (3.94)^{a} $p = 0.013$	12.88 (7.12)^{b} $p = 0.004$	0.00 (0.02)^{a} $p = 0.002$	0.04 (0.11)^{a} $p = 0.286$
Bonding	Self-etch adhesive: 20 s (Xeno Select, Dentsply Sirona)	ACTIVA BioACTIVE Restorative, Pulpdent	19.33 (6.10)^{b} $p = 1.000$	23.68 (17.76)^{a} $p = 0.657$	0.19 (0.09)^{c} $p = 0.033$	0.05 (0.04)^{a} $p = 0.379$
	Self-etch adhesive: 20 s (Xeno Select, Dentsply Sirona)	Ceram X Mono, Dentsply (control)	18.14 (7.41)^{b}	18.96 (8.23)^{a}	0.13 (0.10)^{b}	0.07 (0.03)^{a}

Superscript small case letters indicate significant differences among the groups within each column. Significance (p values, 2-tailed) in the table results from Mann–Whitney U comparisons of each group with the control group (Ceram X Mono bonded with self-etch adhesive Xeno Select).

** Not possible to measure due to loss of restorations.

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Wear behavior of glass-ceramic systems after different finishing procedures

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Purpose/aim: To evaluate the fatigue wear behavior of zirconia-reinforced lithium silicate and lithium disilicate glass-ceramic systems after different surface finishing procedures.

Materials and methods: Disc-shaped specimens of zirconia-reinforced lithium silicate (ZLS) and lithium disilicate (LD) were milled (12 × 1.4 mm) and then divided into two groups according to surface finishing protocol: polishing (P) and polishing + glazing (G) ($n = 8$/group). Wear test was performed on ceramic discs by sliding a steatite indenter ($r = 3$ mm) applying a 200 N load at 2 Hz for 106 cycles in distilled water. Wear-induced surface morphology changes for both materials and finishing procedures was evaluated using scanning electron microscope (SEM). Wear volume on the ceramic surface was quantified using SEM images superimposition through MeX software. Steatite antagonists were scanned using micro-computed tomography and 3D reconstructed using Amira software to measure the wear depth (WD) and area (WA). Wear data were analyzed by two-way ANOVA (material and finishing) and Tukey test. Normal data is presented as mean and 95% confidence interval.

Results: Contact-induced scars were observed in all specimens with the extent associated with finishing procedures. Overall, similar ceramic volume loss was demonstrated for ZLS and LD specimens ($p = 0.518$). ZLS polished discs showed (Fig. 1) significantly lower volume loss (0.03 ± 0.02 mm^3) than glazed discs (0.06 ± 0.02 mm^3) ($p = 0.037$); whereas, LD polished samples (0.029 ± 0.02 mm^3) presented similar wear volume relative to glazed samples (0.049 ± 0.02 mm^3) ($p = 0.187$). Concerning to the antagonist wear, ZLS discs were less abrasive than LD (data collapsed over finishing procedure) ($p < 0.021$). ZLS glazed samples caused less wear on the antagonist (WD: 0.07 ± 0.04 mm/WA: 1.9 ± 1.4 mm^2) compared to polished samples (WD: 0.12 ± 0.04 mm/WA: 3.8 ± 1.4 mm^2) ($p < 0.05$). In contrast, similar antagonist wear was observed for LD polished (WD: 0.16 ± 0.05 mm/WA: 4.5 ± 1.7 mm^2) and glazed discs (WD: 0.14 ± 0.04 mm/WA: 3.6 ± 1.5 mm^2) ($p > 0.461$).

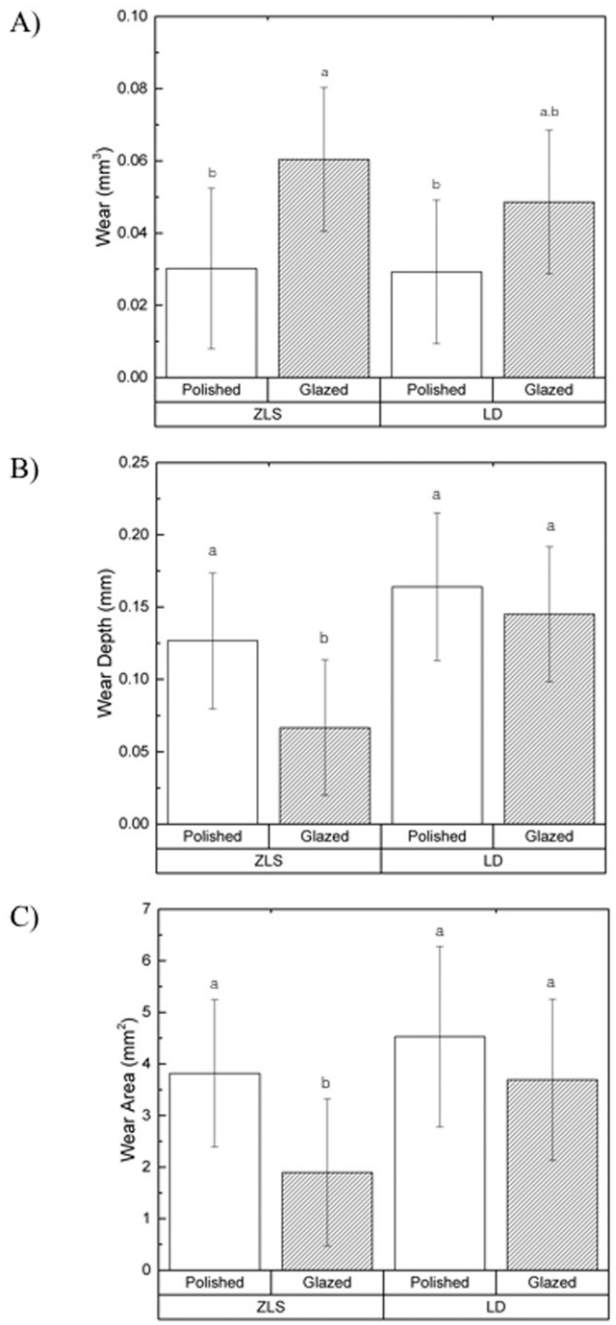

Fig. 1 – Volume loss of zirconia-reinforced lithium silicate (ZLS) and lithium disilicate (LD) after different finishing procedures (A). Steatite antagonist wear depth (B) and area (C).

Conclusions: Ceramic volume loss and antagonist wear behavior were within clinical acceptable levels for both materials and finishing procedures, however, ZLS glazed discs were significantly less abrasive to the antagonist.

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Influence of surface treatment on shear-bond strength of zirconia ceramic

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Purpose/aim: This study aimed to evaluate the influence of different surface treatment protocols on yttria-stabilized polycrystalline tetragonal zirconia on shear bond strength (SBS).

Materials and methods: A hundred zirconia cylinders (4 mm × 5 mm) were made using CAD/CAM system. The specimens were divided into 10 groups, according to the surface treatment: G1 (C) Control – No treatment; G2 (CCP) – Clearfil Ceramic Primer; G3 (SU) – Scotchbond Universal; G4 (CCP/SU) – Clearfil Ceramic Primer + Scotchbond Universal; G5 (HF/SU) – 50% fluoridric acid + Scotchbond Universal; G6 (SB) – Sandblasting (50 μm-Al_2O_3); G7 (SB/CCP) – Sandblasting + Clearfil Ceramic Primer; G8 (SB/SU) – Sandblasting + Scotchbond Universal; G9 (SB/CCP/SU) – Sandblasting + Clearfil CeramicPrimer + Scotchbond Universal; G10(SB/HF/SU)–Sandblasting + 50% fluoridric acid + Scotchbond Universal. All specimens were cemented with Panavia F 2.0, stored in distilled water (37 °C/60 d) and then thermocycled (5000 cycles; 5 °C to 55 °C). The shear bond strength test was performed in a universal testing machine (1 mm/min). Fractographic and surface zirconia analysis were done with a stereo microscope, SEM and WDS. Data were analyzed using Pearson's chi-square test, Fisher exact test and the Kruskal–Wallis test ($\alpha = 0.05$).

Results: The highest shear bond strength (SBS) values were observed in G10(AS/HF/SU) with 14.09 MPa, followed by G5 (HF/SU) groups with 12.65 MPa, G8 (SB/SU) with 11.02 MPa and G9 (SB/CCP/SU) with 9.72 MPa. The lowest averages were observed in the groups G1 (C), G3 (SU) and G2 (CCP) with values of 4.12, 4.69 and 5.87 respectively. All groups had pre-test failures, except groups conditioned with 50% hydrofluoric acid. The pre-potency failure mode was adhesive. In G4 (CCP/SU), all specimens had pre-test failures.

Conclusions: The 50% hydrofluoric acid associated with the Single Bond Universal adhesive offers higher values of shear bond strength to the zirconia, regardless of the use of sandblasting.

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Surface treatments to improve repairs of acrylic and bis-acryl materials

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Purpose/aim: Surface treatments and bonding agents have been analyzed to improve the repair of acrylic and bis-acryl provisional materials, but studies evaluating specific primers are scarce. Thus, the effects of the Composite Primer (GC) and different surface treatments on the shear bond strength (SBS) of acrylic and bis-acryl repairs with composite resin (CR) were analyzed in this in vitro laboratory study.

Materials and methods: Acrylic (Alike; GC Dental Products Corporation) and bis-acryl (Protemp 4; 3M ESPE) blocks were prepared. Surface roughness was standardized (0.16 μm) and grit blasting was applied to half of the sample. Blocks were divided randomly into groups according to surface treatment [methyl methacrylate monomer (MMA) for 180 s or bonding agents (Composite Primer (GC) and Scotchbond Multi-Purpose (3 M ESPE)), applied alone or following MMA]. Two consistencies of composite resins (CR) [regular (Filtek Z350XT (3 M ESPE) and Solare Composite (GC)) or flowable (Filtek Z350XT flowable (3M ESPE) and G-aenial Flowable Composite (GC))] were used to test bond repair. Cylinders (2-mm diameter) of each CR ($n = 10$/group) were attached to the block surface, and SBS was measured using a universal testing machine at 0.5 mm/min. Failure (adhesive, cohesive or mixed) was assessed under 3.5× magnification. SBS data were analyzed using factorial Analysis of Variance (ANOVA), followed by Tukey post-hoc, and Weibull moduli estimation ($\alpha = 0.05$).

Results: The highest SBS, Weibull modulus (m) and scale parameter (σ0) were found in combined use of MMA and bonding agents ($P < 0.001$), regardless the substrate, CR consistency or brand. The use of the Composite Primer (GC) and flowable CR also increased SBS ($P < 0.001$). Significant interaction between surface treatment and CR consistency was observed for the PMMA substrate ($P < 0.001$). Sandblasting did not influence SBS ($P > 0.05$). Adhesive failure was most prevalent (93.5%) and SBS values were significantly higher in mixed fractures (19.2 ± 3.8 MPa) in comparison to the adhesive ones (9.7 ± 6.0 MPa) ($P < 0.001$). No cohesive fracture was observed.

Conclusions: Composite Primer (GC) improves the adhesion of acrylic and bis-acryl repairs, especially when a flowable CR is used. When such product is not available, the combined use of MMA and a bonding agent is necessary, increasing the number of clinical steps, cost, and time required.

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Mechanical properties of universal adhesives containing zinc-oxide and copper nanoparticles

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Purpose/aim: To evaluate the effect of addition of zinc oxide and copper nanoparticles (ZnO/Cu Np) at different concentrations into two universal adhesive systems, on mechanical properties (ultimate tensile strength, microhardness, water sorption and solubility), degree of conversion and zinc/copper release.

Materials and methods: Six universal adhesives were formulated according to the addition of ZnO/Cu Np (0% [control]; 5/0.1 and 5/0.2 wt%) in Ambar Universal (AMU; FGM) and Prime&Bond Active (PBA; DentsplySirona). For ultimate tensile strength (UTS) and microhardness (MH), specimens were tested after 24 h and 28 d. For water sorption (WS) and solubility (SO), specimens were stored in water for 28 d. For degree of conversion (DC), specimens were constructed and tested after 24 h for FTIR and micro-Raman spectroscopy. For zinc/copper release (ZCR), specimens were stored in 2% nitric acid solution for 28 d.

Results: For UTS and MH, in AMU, the incorporation of ZnO/Cu Np in all concentrations, improved the mechanical properties in both evaluated times ($p < 0.05$). For PBA, no significant differences were observed when ZnO/Cu Np was added ($p > 0.05$). For the 28-d cumulative water sorption, significant higher values of all zinc oxide/copper concentrations when compared with control, were detected in PBA. On the other hand, no significant difference among ZnO/Cu Np concentrations and control was detected in AMU ($p > 0.05$). However, all experimental zinc oxide/copper-containing adhesives showed significantly lower solubility than control, in both adhesives tested ($p < 0.05$). For DC, no significant differences were observed between experimental groups and control, in both universal adhesive systems ($p > 0.05$). For ZCR, the analytical curve with linear regression between absorbance values and zinc oxide and copper concentrations had a correlation coefficient of $r = 0.99$, making it suitable for determining of zinc oxide and copper release. We fitted the release profiles to mathematical models to select the best model in light of the correlation coefficient (r), the selection criteria (MSC), and graphic adjustment: In this specific case the biexponential equation model fitted best. Significant difference was observed in the overall cumulative release of zinc and copper (% and ppm) after 28 d. All the evaluated concentrations showed Fickian's diffusion release mechanism.

Conclusions: The addition of ZnO/Cu Np in the tested concentrations in universal adhesive systems may be an alternative to preserve or even improve adhesives' mechanical properties.

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Endodontic sealers affect the resistance adhesive of fiber posts

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Purpose/aim: The aim of this study was to evaluate the effect of two endodontic sealers on push-out bond strength between fiber posts and root canal wall after different storage times. In addition, verify the influence of the two endodontic sealers (eugenol-based and epoxy resin-based) on the degree of conversion of two resin cements.

Materials and methods: A total of 180 bovine teeth were endodontically treated using two endodontic sealers (Endofill or AH Plus). Subsequently, the specimens were stored in 100% relative humidity at 37 °C for 24 h, 6 months, or 12 months. After the respective storage times, the root canals were prepared for fiber post cementation using two resins cements, RelyX U200 or Multilink Automix. The push-out test and the analysis of failures were performed. For the degree of conversion analysis, samples were prepared using only resin cement or resin cement and endodontic sealer. The degree of conversion was estimated by comparison of relative heights of the C=C and C–C stretching peaks in the vibrational spectra. Vibrational spectra for all samples in the region between 1500 and 2630 cm^{-1} were collected with a Raman microscope as the radiation source, using a 785 nm laser-line at 25 mW of power with an exposure time of 10 s. The best spectra were collected with a 20× objective. The non-polymerized cements were analyzed and used as references for the calculations. For the groups containing polymerized resin cements, the samples were placed on a mirror to perform the focus and had standardization of the area of analysis in all samples. Finally, the push-out data were subjected to statistical analysis and the percentages of degree of conversion were calculated.

Results: The AH Plus sealer obtained the highest values of push-out bond strength at 24 h and 6 months. There was no difference between the values of AH Plus and Endofill sealer at 1 year ($p < 0.05$). The degree of conversion was affected

by the Endofill sealer. Furthermore, the degree of conversion depended on the distance from the point of contact between resin cement and the sealer–a lower conversion was observed when the cement was closer to the endodontic sealer, with the conversion increasing as the distance became larger.

Conclusions: The use of a eugenol-based sealer is not recommended because it affects the push-out strength of fiber posts. The AH Plus sealer and the post-endodontic waiting time of 24 h is recommended.

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Damage tolerance of translucent zirconia after chewing simulation

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Purpose/aim: To evaluate the damage tolerance of zirconia-based polycrystalline ceramics subjected to a mouth-motion simulation.

Materials and methods: Two types of ceramics were investigated: a translucent 5 mol.% yttria-partially-stabilized-zirconia (5Y-PSZ, Zpex Smile, Tosoh Corporation) and a control 3 mol.% yttria-stabilized tetragonal zirconia (3Y-TZP, Zpex, Tosoh Corporation). Forty-six zirconia discs were prepared for each material by cutting pre-sintered CAD-CAM blocks, sintering and polishing (1 μm finish) to achieve a final dimension of 1.2 mm thickness and 13.9 mm diameter. Ten discs of each group were tested with piston-on-three-balls using a universal testing machine (1 mm/min) to obtain the initial flexural strength. The remaining specimens were bonded onto a dentin-like composite substrate (G10) with resin cement (Panavia F 2.0, Kuraray). The bonded specimens were subjected to a sliding-contact mouth-motion fatigue test in distilled water with 2 Hz frequency. A 200 N off-axis (30°) load was applied onto the center of the ceramic disc through a zirconia spherical antagonist ($r = 3.15$ mm) using an electrodynamic fatigue testing machine for different lifetimes (2 cycles up to 1 million cycles). After the fatigue test, ceramic specimens were removed from the G10 substrate and tested for biaxial flexural strength (with the damaged surface loaded in tension) to access the damage tolerance. Fracture surfaces were analyzed using fractography. Surface and cross-sectional images were also obtained to characterize surface and sub-surface damage.

Results: The strength of both ceramics underwent significant degradation after the mouth-motion simulation (Fig. 1). The flexural strength of 3Y-TZP decreased from 860 MPa (initial) to 410 MPa (~50%) after 50 cycles. For 5Y-PSZ, the strength degradation occurred with a lower number of cycles. Ten cycles resulted in 60% strength degradation for most 5Y-PSZ specimens tested (reducing from 661 MPa to, approximately, 260 MPa). Further increasing the number of loading cycles (up to 1 million) had no additional effect on the flexural strength of both ceramics even though an increase in the surface and sub-surface damage was observed. Herringbone cracks emerged

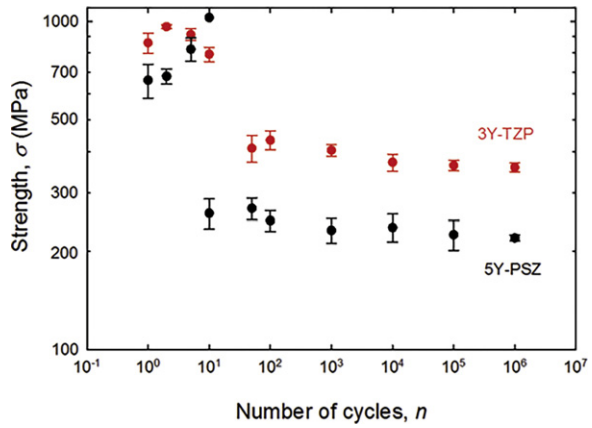

Fig. 1

on 3Y-TZP and 5Y-PSZ surfaces after 50 and 10 cycles, respectively.

Conclusions: Zirconia-based polycrystalline ceramics have low damage tolerance. Surface flaws produced during the chewing simulation were capable of a significant strength degradation even after a small number of cycles. 5Y-PSZ translucent zirconia has lower flexural strength and resistance to damage than conventional 3Y-TZP.

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Abutment's screw design influences the reliability of implant-supported restorations

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Purpose/aim: To evaluate the influence of abutment's screw design on the reliability and failure mode of external and internal hexagonal connection implant-supported anterior crowns.

Materials and methods: External (EH) and internal (IH) hexagonal connection implants were divided into five groups based on abutment's screw design: (i) control (Ø = 2.0 mm + standard threads) (C), (ii) upper threads (UT), (iii) threads until neck (TN), (iv) narrow screw (Ø = 1.51 mm + standard threads) (NS), and (v) narrow upper threads (NUT) ($n = 21$/group). The respective abutments were torqued to the implants (30.0 Ncm) and standardized maxillary incisor crowns were cemented following manufacturer instructions. Samples were subjected to step-stress accelerated life fatigue testing (SSALT) in water. The use-level probability Weibull curves (probability of failure vs. number of cycles) and reliability for a set mission of 50,000 cycles at 1000, 1500, 2000, 2500, 3000 and 3500 MPa were calculated.

Fractographic analysis was performed using scanning electron microscope (SEM).

Results: The beta (β) values indicated that fatigue damage accumulation was associated with increased failure rate over time for C, NS and NUT groups with EH connection and C and NS groups with IH ($\beta > 1$). Within abutment screw design group comparisons demonstrated higher probability of survival for EH connection compared to IH for all set missions, except for NUT group. Regardless implant connection, all groups presented high reliability (up to 94%) at a set stress of 1000 MPa. A decreased probability of survival was observed for Ø1.51 mm groups at 1500 and 2000 MPa (0%), which was significantly lower relative to all Ø2.0 mm groups. TN group also showed a decreased reliability at 2000 and 2500 MPa (significantly lower than C and UT groups). For all set missions, UT and C groups showed higher reliability relative to others. Such a difference was remarkable at higher set stress missions (3000 and 3500 MPa), mainly for EH connection implants that kept their survival rate up to 60%. Failure chiefly involved screw fracture. While Ø2.0 mm groups fracture level correlated with the first thread position, for Ø1.5 mm groups it was associated with screw neck level.

Conclusions: The C and UT groups presented higher probability of survival relative to TN, NS and NUT groups and failure chiefly comprised screw fracture. The higher fracture level for UT group would encourage its clinical use based on its easier removal when screw replacement.

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Lithium disilicate veneers clinical color stability evaluated by two methods

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Purpose/aim: The aim of this clinical study was to evaluate the color stability of lithium disilicate veneers using two different methods: Vita Easyshade spectrophotometer (ES) and standardized digital photographs (ELAB) in 6 months follow-up.

Materials and methods: Vita Easyshade spectrophotometer (ES) and standardized digital photographs (ELAB) in 6 months follow-up. For this split-mouth study, one hundred and sixty-two ceramic veneers were produced either by CAD (CEREC In-Lab CAD/CAM system, DentsplySirona) (IPS Emax CAD) or PRESS technique (heat pressing, Ivoclair/Vivadent) (IPS Emax PRESS) ($n = 81$). For ES color evaluation, a spectrophotometer (Easy Shade, Vita) was used to obtain the measurements of CIE L*a*b* system. The ELAB evaluation was performed taking digital pictures with polarized light and the Whibal card, which were transferred to the software Adobe Lightroom CC2015, in RAW extension. The Digital Color Meter App (Apple) was used to measure L* a* and b* coordinates in this method. Measurements were performed after one week of cementation (baseline) and in 6 months follow-up. For both, ES or ELAB methods, data were analyzed by a blind standardized operator and ΔE* was calculated as described: $\Delta E^*ab = \Delta((L^*2 - L^*1)2 + (a^*2 - a^*1)2 + (b^*2 - b^*1)2)$. The Mann-Whitney-Wilcoxon rank sum test was performed to assess significant differences between them.

Results: No difference was observed between ES and ELAB ($P = 0.331$) evaluation, as well as for CAD x PRESS by ES ($P = 0.833$), either for CAD x PRESS by ELAB ($P = 0.658$).

Conclusions: ELAB could be used to evaluate color stability of lithium disilicate veneers for both manufacturing processes, CAD or PRESS, showing similar results to the well-established ES method.

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Characterization and cytotoxicity analysis of encapsulating simvastatin in PLGA microspheres

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Purpose/aim: This study aims to investigate the biologic behavior of polylactic-co-glycolic acid (PLGA) microspheres encapsulating or not simvastatin (SIM) to obtain a novel biomaterial for bone regeneration.

Materials and methods: Microspheres of PLGA (G1; $n = 9$) and PLGA + SIM (G2; $n = 9$) were prepared through the O/W emulsion solvent evaporation technique with a SIM-polymer ratio of 10% (w/w) for physical-chemical evaluation. Regarding cytotoxicity, G2 samples were prepared with 0.03% SIM and sterilized by ethylene oxide to biological assessment. The microspheres morphology was analyzed by scanning electron microscopy (SEM) and the size was measured by laser diffraction. The SIM incorporated into the polymer was characterized by Fourier Transform Infrared Spectrometry (FT-IR). The encapsulation efficiency of drug was tested to determine the amount of SIM incorporated into PLGA microspheres. Samples were incubated in PBS (pH 7.4) at 36 °C for 25 d to determine the SIM amount released in vitro. The cytotoxicity was evaluated by MTS colorimetric test on fibroblasts L929, pre-osteoblast MCT3T-E1 and mesenchymal stem cells obtained by primary adipose tissue culture from Bichat balls (ASCs). Test was performed in triplicate comparing G1, G2, and control group of cells with culture medium (G3; $n = 9$), at 1, 3, and 7 days. Results were statistically analyzed by one-way analysis of variance (one-way ANOVA) followed by Tukey's test ($p < 0.05$).

Results: SEM analysis demonstrated that the method used for sample preparation was satisfactory for obtaining microspheres with homogeneous morphology, smooth surfaces and regular spherical shape. The size was widely distributed, 80% between 37 and 690 μm, mean diameter of about 109 μm. The encapsulation efficiency was 85.2% (±3.5) and the FT-IR spectrum confirmed that SIM was successfully incorporated into the polymer. In vitro evaluation demonstrated a slow release of SIM, reaching 0.98 mg of drug released in 25 d with no

periods of rapid initial release. Concerning biologic behavior, none experimental group was cytotoxicity at days 1, 3, or 7. There were no statistical differences among groups at any experimental time. At day 7, the cell viabilities were 110.4% (±5.1), 102.3% (±1.8), 101.8% (±1.9) for G1, G2, and G3, respectively for L929. Regarding MC3T3-E1, results were 93.3% (±7.1), 90.1% (±4.9), and 100% (±9.8) for G1, G2, and G3, respectively. Finally, G1, G2, and G3 demonstrated 105.3% (±10.1), 95.7% (±3.3), 102% (±0.71) of viability for ASCs.

Conclusions: The microspheres with 0.03% simvastatin were not cytotoxic to tested cells, suggesting the potential of this biomaterial in bone tissue regeneration applications.

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Does hydrofluoric acid concentration influence fatigue of feldspathic restorations?

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Purpose/aim: To evaluate the influence of hydrofluoric acid (HF) etching at different concentrations on the fatigue failure load of feldspathic ceramic crowns and discs adhesively cemented to a dentin analogue material (epoxy resin).

Materials and methods: Eighty feldspathic ceramic crowns with simplified geometry and eighty discs (Vita Mark II, Vita Zahnfabrik) were cemented to the respective identical simplified dentin-like polymer machined preparations and to epoxy supporting discs. The inner surface of each ceramic crown/disc was treated with one of the four surface conditioning methods ($n = 20$): non-etched/control (CTRL), or etched for 60 s with different HF concentrations: 1% (HF1), 5% (HF5), or 10% (HF10). The treated ceramic surfaces received a silane application (Monobond Plus). For luting, the cementation surface of the epoxy resin preparations/discs was etched with 10% HF for 60 s and received a primer coating (Multilink Primer A + B). Adhesively cementation was performed (Multilink Automix), and each cemented crown/disc was cyclically loaded in water with a G10 epoxy-glass piston following a staircase approach (500,000 cycles; 20 Hz). Fatigue failure load data were analyzed using 1-way ANOVA and Tukey's tests ($\alpha = 0.05$). Additionally, topographic and fractographic analyses were performed.

Results: For the machined ceramic crowns, mean fatigue failure loads of groups CTRL (245.0 ± 15.1 N), HF1 (242.5 ± 24.7 N) and HF10 (255.7 ± 53.8 N) were statistically similar ($P > .05$), while the mean fatigue failure load of the HF5 group (216.7 ± 22.5 N) was significantly lower. In the condition of cemented discs, mean fatigue failure load of the HF5 group (255.0 ± 23.0 N) was also significantly lower; HF1 group (301.7 ± 71.0 N) presented intermediate values, and the highest values were achieved in CTRL (351.7 ± 13.4 N) and HF10 (341.7 ± 20.6 N) groups (Table 1). Topographical analysis showed that the higher the hydrofluoric acid concentration, the higher the topographical changes. All the failures were radial cracks starting from the bonding surface.

Conclusions: Etching with 5% HF had a deleterious effect on the fatigue failure load of adhesively cemented feldspathic ceramic crowns and discs, while etching with 10% HF had no negative influence in both tested conditions (crowns and discs).

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Degree of conversion and biaxial flexural strength of composite resins

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Purpose/aim: The aim of this study was to evaluate the degree of conversion (DG) and biaxial flexural strength (BFS) of three composite resins [IPS Empress Direct (E), Filtek Z350 (ZR) and Zirconfill (Z)] at different storage times after curing.

Materials and methods: Degree conversion analysis was carried out through Fourier transform infrared (FTIR) in Near Infrared mode. Disk-shaped specimens with 5 mm in diameter x 1,5 mm thickness ($n = 5$) were evaluated immediately after curing, 24 h, 7 d, 21 d and 30 d after light-cured for 20 s. For biaxial flexural strength, thirty disk-shaped specimens were made for each group with 15 mm in diameter × 1.5 mm thickness and tested immediately after curing, 24 h and 21 d after ($n = 10$) in a EMIC DL 3000 universal testing machine. The load was applied with a stainless steel sphere with 2.5 mm in diam-

Table 1 – Experimental design, surface treatment, mean fatigue failure loads (FFL) and standard deviation (SD) of adhesively cemented feldspathic ceramic crowns and discs from staircase tests.

Group	Surface treatment	Feldspathic cemented crowns FFL (*N*) (±SD)	Feldspathic cemented discs FFL (*N*) (±SD)
CTRL	Non-etched control, only silane application	245.0 (±15.1)^{A}	351.7 (±13.4)^{A}
HF1	Etching with 1% HF acid[a] (60 s) + silane application	242.5 (±24.7)^{A}	301.7 (±71.0)^{B}
HF5	Etching with 5% HF acid[b] (60 s) + silane application	216.7 (±22.5)^{B}	255.0 (±23.0)^{C}
HF10	Etching with 10% HF acid[b] (60 s) + silane application	255.7 (±53.8)^{A}	341.7 (±20.6)^{A}

[a] Experimentally formulated (FGM).
[b] Condac Porcelana 5% and 10% (FGM). Different superscript letters indicate statistically significant differences in the same column ($P < 0.05$).

Table 1 – Mean of biaxial flexural strength values and SD at different storage times after curing.

	0 h	24 h	21 d
GE	126.2 ± 9,.2 ^{aA}	150.0 ± 14.6 ^{abA}	164.0 ± 15.3 ^{bAB}
GZ	197.4 ± 39.6 ^{aB}	269.9 ± 25.9 ^{bB}	156.1 ± 28.0^{cAB}
GZR	168.1 ± 20.8 ^{aBC}	215.5 ± 15.8 ^{bcC}	202.1 ± 15.9 ^{cC}

eter at a cross-speed of 0.5 mm/min until fracture. During the storage times the specimens were stored in distilled water at 37 °C. The data were analyzed using two-way ANOVA and Tukey's post-hoc test ($p = 0.05$).

Results: It was observed an increase in the degree of conversion for all materials tested in the periods from 0 h to 24 h followed by a stabilization from 24 h to 7 d, 21 d and 30 d: group E 36.27%, 52.13%, 53.33%, 59.07% and 54.13%; group Z 48.71%, 66.14%, 65.15%, 72.48% and 69.11%; and group ZR 56.6%, 71%, 69%, 70.06% and 71.68%. For biaxial flexural strength the results are presented in Table 1, a statistically significant difference ($p < 0.05$) was observed between the materials and the evaluation periods.

Conclusions: Within the limitations of this study it can be concluded that the degree of conversion of the composite resins analyzed increased from 0 h to 24 h and remained stable from 24 h to 7 d, 21 d and 30 d. The Z and ZR groups showed the highest values of conversion degree. The biaxial flexural strength increased from 0 h to 24 h for Z and ZR groups but decreased after 21 days of storage for group Z. Group E presented the lowest values of biaxial flexural strength in all the evaluated periods.

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Dicyclohexylcarbodiimide (DCC) effect on push-out bond-strength and MMPs in dentin

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Purpose/aim: Endogenous matrix-metalloproteinases of dentin (MMPs) are claimed to be responsible for the degradation of resin-dentin interface. Aim of the study was to evaluate the effect of dicyclohexylcarbodiimide (DCC) applied as a conditioning primer on immediate push-out bond strength and MMPs activity within the hybrid layer (HL).

Materials and methods: Root canal treatment was performed on 36 extracted single-rooted human teeth. A 10-mm post space was prepared in each tooth. Specimens were randomly assigned to three groups (N = 12) according to the dentinal pretreatment: (1) Water wet bonding (control): post space irrigation with distilled water for 60 s; (2) Ethanol wet bonding: post space irrigation with 100% ethanol for 60 s; (3) Ethanol wet bonding with DCC: post space irrigation with 0.5 M DCC in 100% ethanol for 60 s. After pre-treatment every group was subjected to the same adhesive procedures and post were luted with dual curing cement and light cured for 40 s. 1 mm slices were prepared for micro push-out test and interfacial nanoleakage evaluation of the coronal and apical region of the canal space after 24 h of storage in artificial saliva. In-situ zymography was performed to investigate endogenous matrix metalloproteinase activities within the hybrid layer. Results were statistically analysed with three-way ANOVA test or Chi Square test. Statistical significance was set at $\alpha = 0.05$.

Results: Two-way ANOVA showed that only the variable region ($p = 0.01$) significantly influenced the results immediate push-out test results. No differences were found in bond strength between the three pre-treatment techniques. In situ zymography quantification analyses revealed that the adhesive tested seemed to activate MMPs gelatinolytic activity, while 0.5 M DCC reduced fluorescence signal at the adhesive/dentin interface.

Conclusions: DCC did not alter immediate push-out bond strength, however it was effective in reducing the activities of intra-radicular endogenous proteases. These results should be validated with in vivo studies to clarify the role of the collagen cross-linker in stabilising resin-dentine bonds in endodontically-treated teeth.

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High-fluoride dentifrices reduce dentin permeability

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Purpose/aim: The aim of this study was to compare the effect of high-fluoride and arginine-based toothpastes in dentin treatment in order to reduce its permeability

Materials and methods: This in vitro study involved 5 toothpastes compared to a fluoride varnish: D – Duraphat (22,600 μg F/g sodium fluoride varnish), CP – Colgate Prevident Plus® (5,000 μg F/g), CL – Clinpro 5000® (5,000 μg F/g) associated with (f TCP), CN – Neutraçucar (1.5% arginine + 1,450 μg F/g), S – Sensitive Pro-Alívio (8% arginine + 1,450 μg F/g), CT – Colgate Total 12® (1,450 μg F/g). Dentin specimens (1.0 + 0.2 mm thickness) were standardized from sound human third molars ($n = 10$) for hydraulic conductance (Lp) for comparative assessments using Flodec. The maximum Lp values of each disc were taken after phosphoric acid etching solution (15 seconds) and randomly allocated to the 5 tested groups for the analyses in the subsequent conditions: minimum (smear layer) and maximum (after acid etching) Lp values, treatment and new acid challenge with 6% citric acid. Confocal laser scanning microscopy (CLSM) analyses were also performed. Data were submitted to two-way ANOVA and Tukey tests analyses regarding Lp.

Results: All the products were effective to obliterate dentin tubules and provide the reduction of the permeability, however, CT and CN were statistically less effective ($p < 0.05$). No interaction between the factors treatments and conditions was significant ($p > 0.05$).

Conclusions: The current high-fluoride technology seems to offer beneficial for reduce dentin permeability, allowing the presence of residual molecular arrangements that contribute to obliterate the dentin tubules and therefore, offer an efficient at-home tool for patient.

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Correlation between fluoride release and acid erosion of glass-ionomer cements

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Purpose/aim: The aim of this study was to verify the correlation between acid erosion and fluoride release of conventional glass-ionomer cements, according to the ISO 9917-1.

Materials and methods: The grups were Maxxion (MA), VitroFil (VF), Magic Glass (MG), Ion Z (IZ), Bioglass (BG), Ionomaster (IM), Ionglass (IG), Ionofil Plus (IF), GlassIonomer Type II (GT), VitroMolar (VM), IonoStar (IS), Equia Forte (EF), Vidrion R (VR), Fuji IX (FIX), Riva (RV), Ketac Molar (KM), Fuji II (FII) and Chemfil Rock (CR). Fluoride release: after placed in pH cycling solution, the concentrations of fluoride were measured by a fluoride-ion selective electrode all days for 15 days ($n = 10$). Acid erosion: the specimens were immersed in a lactic acid and measured with a spring-loaded dial gauge ($n = 5$). The data was submitted to 3-way ANOVA, followed by Tukey's test ($p < 0.05$).

Results: All materials showed ability to elute fluoride in the 15th, with same pattern of high fluoride release at the first 24 h. Despite this, amount of fluoride released was statistically different among the 18 groups, with the highest for MA and the lowest for CR ($p < 0.05$). The highest acid erosion values were registered for MG, IZ, VF and MA, which exceeded the maximum stipulated by ISO 9917-1. A positive linear correlation ($r^2 = 0.4886$) was found between the properties.

Conclusions: Acid erosion and fluoride release are related properties, and factors as pH and P/L ratio from each material may be related to the different fluoride release values.

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Strength behavior of veneered zirconia after different surface treatments

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Purpose/aim: The aim of this study was to evaluate the flexural strength of a veneered zirconia system after different surface treatments as a pre-cementation procedure and before veneering.

Materials and methods: Translucent Y-TZP ceramic bars, for four-point bend testing, were prepared and divided considering the compressive (surface treatment for cementation) and lower tensile surfaces (surface treatment for veneering). Two different surface treatments were evaluated: 1 – glass interlayer; 2 – sandblasting + glass interlayer. Four-point bending test data were statistically analyzed using ANOVA.

Results: The flexural strength was significantly affected by sandblasting the surface for cementation. Sandblasting + glass interlayer on the surface for veneering combined with sandblasting the surface for cementation presented the highest flexural strength and better strength reliability.

Conclusions: Sandblasting + glass interlayer on the surface for veneering combined with sandblasting the surface for cementation presented better results regarding flexural strength and reliability.

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Can a multi-mode adhesive substitute silicatization + silanization in zirconia ceramics?

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Purpose/aim: Zirconia-based ceramics presents high flexural strength, biocompatibility and long-term chemical stability, allowing it to be applied in several clinical situations. Despite these excellent properties, some studies have reported difficulties in zirconia ceramics adhesion to resin cements due to their high crystalline content, which makes hydrofluoric acid etching ineffective. Therefore, several methods for surface treatment of these materials have been proposed. This study aims to evaluate the effectiveness of a multi-mode adhesive (SBU-Scotch Bond Universal/3M) as a substitute for silica coating and silane application on the bonding of zirconia ceramics to resin cement.

Materials and methods: One hundred and twenty sintered zirconia ceramic blocks ($5 \times 5 \times 5$ mm) were obtained, finished by grounding with silicon carbide paper (#600, #800, #1000 and #1200) and randomly divided into 12

groups ($n=10$) according to surface treatment (ScSi – silicatization + silanization; ScSBU – silicatization + SBU; SBU – no photoactivated SBU and SBUp – photoactivated SBU) and ceramic (Lava/3M ESPE, Ceramill Zirconia/Amann Girrbach and Zirkonzahn/Zirkonzahn). Dual resin cement cylinders (RelyX Ultimate/3M ESPE) were produced, using a silicon matrix (Ø = 2 mm, h = 5 mm), in the center of each block and photoactivated for 40 s (1200 mW/cm^2). Samples were stored for 30 d in distilled water (37 °C) and then submitted to shear bond strength test (1 mm/min, 100 KgF). Data (MPa) were analyzed using ANOVA (2 levels) and post-hoc Tukey test (5%).

Results: ANOVA revealed that only the surface treatment showed significant differences on the bond strength of zirconia to resin cement ($p=0.0001$). The ScSi treatment (14,286A) promoted statistically higher bond strength values than other surface treatments (ScSBU (9.034B), SBU (8.478B) and SBUp (7.821B)), which were similar (Tukey).

Conclusions: Silicatization followed by the silanization promoted significantly higher values of bond strength of zirconia to resin cement when compared to the surface treatments using SBU, regardless of the ceramic type used.

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Antimicrobial properties and cytotoxicity of a modified polymer

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Purpose/aim: Investigate antimicrobial properties and cytotoxicity of a polymer on poly methyl methacrylate (PMMA) incorporated with dimethylaminohexadecyl methacrylate (DMAHDM) and chlorhexidine diacetate (dCHX), isolated and associated.

Materials and methods: 104 disk-shaped specimens (68 in 8-mm diameter × 2-mm thickness and 36 in 5-mm diameter × 2-mm thickness) were obtained and divided into three groups according to the DMAHDM and dCHX incorporations at 5% and 1%, respectively: dCHX, DMAHDM and DMAHDM + dCHX. One group without antimicrobial agents was used as control group. Initially, the specimens were stored for 48 h in distilled water at 37 °C. Isolates of ATCC strains were used for the induction of Streptococcus mutans and Candida albicans biofilms. The analysis of microbial viability was performed using a colorimetric analysis of MTT. Cytotoxicity was measured after 24 h, 3 and 7 days of elution by MTT test on L929 cells (ISO 10993-5: 2009). Data were submitted to ANOVA and Bonferroni's/Tukey's tests ($p \leq 0.05$).

Results: All the tested groups showed significant antimicrobial activity against Streptoccocus mutans and Candida albicans, when compared to control group ($p<0.05$). Only the dCHX group, in 24 h of elution, demonstrated no cytotoxic effects (lower than 30% of reduction of cells viability). In 3 and 7 days of elution, the DMAHDM group (6.797, sd ± 0.237) and the association's group (DMAHDM + dCHX) (20.94, sd ± 0.5123) presented, respectively, the highest cytotoxic dilutions.

Conclusions: The results of this study suggest that polymers incorporated with dCHX and DMAHDM presents antimicrobial properties but a higher cytotoxic effect. Due to the significant antimicrobial action found, future studies can be carried out, decreasing the concentration of DMAHDM and dCHX, in order to develop a material with antimicrobial action and lower cytotoxic effects.

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Influence of preheating in microhardness of bulk fill composite resins

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Purpose/aim: The purpose of this study was to verify and compare the influence of preheating of two Bulk-fill composites (Filtek Bulk-fill, 3 M ESPE and Tetric N-Ceram Bulk-fill, Ivoclar Vivadent), compared to a conventional nanoparticle resin (Filtek Z350 XT, 3 M ESPE) for microhardness, on top and bottom surfaces of 4 mm deep restorations.

Materials and methods: For the restoration, 48 opaque metal matrices, 4 mm thick and 5 mm in diameter were used, and the specimens were divided into 6 groups ($n=8$), according to restorative material, using or not heating the composite prior to its insertion. The matrices were supported on a glass plate and restored according to the technique employed for each group. After 24 h, the samples were submitted to the Vickers test, with 100 g (980.7 mN) for 10 s, at five random points on the upper surface (0 mm) and lower surface (4 mm) of the specimens. The values obtained were submitted to Student's *T*-test and two-way ANOVA test. The detail of the analysis was done by Sidak's post-hoc test, only for the factors that presented the significant difference. For both tests was adopt the significance of (α) 5% ($p<0.05$).

Results: The microhardness values were lower in the base of the restoration, regardless of the preheating or not, for all the resins evaluated. There was interaction between the variables for both evaluated surfaces (top and bottom). For the top, when comparing preheated composite resins, a statistically significant difference was observed for Tetric N-Ceram Bulk-fill and Filtek Z350 XT ($p<0.05$). Among the composite resins, without the preheating, Filtek Z350 XT presented the lowest values of microhardness and Tetric N-Ceram Bulk-fill the highest values ($p<0.05$). When preheated, Tetric N-Ceram obtained the lowest values of hardness ($p<0.05$). For the base, all the composite resins showed a significant increase of the hardness with the preheating ($p<0.05$). The Filtek Z350 XT resin presented the highest hardness values, while the Tetric N-Ceram Bulk-fill resin presented the lowest values.

Conclusions: In conclusion, preheating of Bulk-fill composites positively influenced the microhardness on the lower

surface (base) of the specimens. However, in the top of the sample, only the conventional nanoparticulate composite resin (Filtek Z350 XT) showed an increase in microhardness after preheating.

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Antimicrobial effect of TiO_2 nanotubes coating for dental implant

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Purpose/aim: This study investigated the adhesion and biofilm formation (S. aureus and C. Albicans) behavior on titanium dioxide (TiO_2) nanotubes coating produce by anodization process on novel Ti-30Ta alloy to the dental implant application.

Materials and methods: The Ti-30Ta alloy was fabricated by mixing Ti cp and Tantalum using an arc-melting furnace in a high purity argon atmosphere. The resulting ingots were homogenized and then cold worked by swaging process. Discs with 6 mm in diameter and 3 mm in thickness were cutting. The anodization process was realized in an electrolyte solution containing 0.2 M NH_4F at 30 V for 6 h. The nanotube layer was annealed in an oxygen ambient furnace at 530 °C (5° C/min) for 1 h. C. albicans and S. aureus were selected to investigate the antimicrobial activity. The number of colony-forming units per milliliter (CFU/mL) was determined and analyzed statistically (ANOVA, Tukey test, $p < 0.05$). Characterization techniques such as scanning electron microscopy (SEM) were used in order to investigate the surface of samples.

Results: The results demonstrate the influence of titanium dioxide nanotubes (TiO_2) formation on bacterial adhesion and biofilm formation. Significant statistical differences ($p < 0.05$) for bacterial adhesion and biofilm formation were observed on surface covered with TiO_2 nanotubes on novel Ti-30Ta alloy. SEM images show Ti-30Ta alloy with and without nanotubes after the biofilms have been grown by incubated at 37 °C for 48 h. The surface coating with nanotube decrease bacterial adhesion and biofilm formation.

Conclusions: The TiO_2 nanotube has an influence on bacterial adhesion and biofilm formation. The number of colony-forming units per millimeter has been decreasing after the anodization process. Thus, TiO_2 nanotubes coating novel Ti-30Ta alloy can be promising in the dental implant field due to potential to prevent implant infection.

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Is alveolar biomechanical balance restored after periodontal therapy? A vector-numerical analysis

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Purpose/aim: (i) To determine, analytically, the influence of alveolar height on the biomechanical response of the bone crest, under functional loads; (ii) To evaluate the vector-analytical model as a coherent simplification when compared to numerical models of finite elements.

Materials and methods: Odontometric dimensions of a superior premolar, occlusal load (oblique direction and magnitude 100N), static equilibrium conditions and five different alveolar heights (100%, 85%, 70%, 55%, 40% height) were also designed to the two models: vector and numerical. Vector model: Under trans-rotational static conditions, a three-dimensional matrix-vector algorithm was established to neutralize the occlusal load by means of two reaction forces in the bone (crest and apex). The magnitude of the force of reaction in the bone crest (FR-c) was calculated for the five heights. Numerical model: As elastic-linear, homogeneous and isotropic materials, the structures of the premolar (enamel, dentin, pulp, periodontal ligament, cortical and trabecular bone) were represented. The magnitude of the major strains in the bone crest was calculated for each finite element two-dimensional model.

Results: Vector model: The magnitude of the FR-c was greater than the magnitude of the reaction force at the apex. This increased 77% when simulated the lowest alveolar height (Δ106.6N). The relationship between alveolar height and FR-c was inverse, represented by a nonlinear function, in a potential way. Numerical model: The relationship between alveolar height and the extent of major strains regions was inverse. The location of the tensile peak was in the cervical region and compression in the apical region. It is possible to identify the same non-linear pattern in the bone response when compared to the vector model. In numerical simulation, the beginning of the curve showed a decrease due to the difference in stiffness between the cortical and trabecular bone. The vector model, of rigid solids, does not consider this difference.

Conclusions: The decrease in alveolar height determines the increase in the mechanical response generated in the bone crest. A potential nonlinear relationship was obtained in both vector and numerical models. The curve inflection point was close to 65% of the alveolar height. The vector-analytic model resulted in a coherent simplification to describe the biomechanical response concentrated on the bone crest of a reduced periodontium. To rehabilitate the balance of the system, these results evidenced the importance of occlusal adjustment and / or splint in periodontally treated teeth.

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Evaluation of bromelain as a new dentin pre treatment

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Purpose/aim: The objective of this study was to evaluate the influence of bromelain proteolytic activity in bond strength and nanoleakage associated with adhesive systems Adper Single Bond 2 (SB) and Prime Bond 2.1 (PB), as well as the influence of their antimicrobial activity against Streptococcus mutans biofilm formation.

Materials and methods: The bromelain solutions were prepared in diferent concentrations (0.5 and 1%) and 10% NaClO was used as deproteinization group control. For nanoleakage (N) and microtensile bond strength (μTBS), eighty bovine incisors were wet ground until expose vestibular dentin. After the dentin treatments and respective adhesives systems were applied, the resin composites build ups were incrementally constructed. The bonded teeth were cut into resin-dentin beams. The tests were conducted after 24 h or 6 months of water storage at 37 °C. Streptococcus mutans biofilm on resin surface was tested for metabolic activity and lactic acid production.

Results: The analysis of the chemical elements in EDS, deproteinized groups showed lower percentages of carbon and larger amounts of calcium and phosphorus. Bond strength test, the groups treated with bromelain solutions and 10% NaOCl showed no statistical difference compared to control groups at 6 months of storage. Evaluating nanoleakage, the treatment with bromelain solution 1% had lower penetration of silver when compared to other treatments. Acetone-based adhesive PB showed the less infiltration. The metabolic activity and lactic acid production by S. mutans biofilm was statistically lower in bromelain groups (0.5% and 1%).

Conclusions: It can be conclued that the proteolytic activity of bromelain 1% was able to induce the deproteinization on dentin surface and improve the performance of acetone based adhesive system. According to their antimicrobial properties, all bromelain solutions tested were able to reduce the metabolic activity and lactic acid production of Streptococcus mutans biofilm.

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Effect of a proanthocyanidin mouthrinse on dentin erosion

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Purpose/aim: The organic matrix is of great importance in the process of loss of dental tissue because it functions as a barrier that prevents the diffusion of the acids to the tissues. For its degradation to be avoided, some agents have been tested in an attempt to inhibit the MMPs, the enzymes responsible for this process. Proanthocyanidin has been shown to be efficient in inhibiting these enzymes and therefore the aim of this study in situ was to evaluate the protective effect of a mouthrinse based on proanthocyanidin applied on the dentin submitted to erosion.

Materials and methods: Seven volunteers wore 1 palatal device in each phase. The groups under study were: First Phase/G1 - Erosive challenge with acid drink (Coca-cola®) before dentin treatement with 10% proanthocyanidin mouthrinse (neutralized to pH 7.0, Experimental group 1), G2 - Erosive challenge with acid drink (Coca-cola®) before dentin treatement with 10% proanthocyanidin mouthrinse (without neutralization, pH 3.0, Experimental group 2). Second Phase/G3 - Erosive challenge with acid drink (Coca-cola®) before dentin treatement with 0.12% Chlorhexidine mouthrinse (pH 7.0, Positive control group), G4 - Erosive challenge with acid drink (Coca-cola®) with no previous treatment (Negative control group). Treatments with different mouthrinses were applied once after the second erosive challenge, for 5 min. Volunteers continuously wore the oral appliance and for the erosive cycling, each device was immersed into the 32 ml of acid beverage, 3 times a day for 5 min during 5 d. Profilometry was used to quantify the dentin loss (μm).

Results: Data were analyzed by Repeated measures ANOVA followed by LSD Fishers's test ($p < 0.05$). G1 ($1.17a \pm 0.69$) and G3 ($1.22a \pm 0.25$) showed significant lower wear values with no statistical difference between them. There was also no significant differences between G2 ($2.99b \pm 1.15$) and G4 ($2.29b \pm 1.13$) resulting in more wear when compared to others groups.

Conclusions: This study suggests that 10% neutralized proanthocyanidin mouthrinse could be a good strategy to diminish dentin wear progression.

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Influence of different irrigation solutions to clean the post space

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Purpose/aim: This ex vivo study evaluated the bond strength of glass fibre posts after cleaning of post space with different irrigation solutions. The null hypotheses were (I) different irrigation solutions do not affect the bond strength and (II) the regions of root canal do not show different values of bond strength.

Materials and methods: Forty bovine roots were root filled, covered with polyether and embedded in acrylic resin. After removal of filling (12 mm), roots were randomly divided into four groups ($n = 10$), according to the irrigation solution for cleaning: CG (Control Group): saline solution; SH (Sodium Hypochlorite Group): 2.5% Sodium Hypochlorite solution; CLX (Chlorhexidine group): 2% gluconate chlorhexidine solution; EDTA (ethylenediaminetetraacetic acid group): 17% EDTA solution. Posts were luted using dual resinous cement and a silicon matrix was attached to make total crowns in composite resin. Specimens were submitted to mechanical aging (1,200,000 cycles; 90N; 4 Hz). Roots were sectioned in slices (1 mm thickness) to perform the push-out test (100N; 0.5 mm/min) and values were subjected to statistical analysis (ANOVA two-way and Tukey test; $P < 0.05$). Coronal, middle and apical thirds of each root were analyzed in stereomicroscope for failure mode classification. One extra root of each group was prepared and irrigated for qualitative SEM analysis.

Results: EDTA (7.07 ± 2.58) had the greater bond strength values, followed by CLX (5.78 ± 2.13), SH (4.69 ± 2.16) and CG (4.80 ± 2.21), differing statistically from the last two ($P < 0.05$). There was no difference in bond strength between the three thirds of root ($P > 0.05$). Adhesive failure between were predominant, followed by mixed failures. SEM images showed pronounced smear layer removal in EDTA group.

Conclusions: The bond strength values between the glass fiber posts and dentin of the root canal vary according to the cleaning of post space. The different regions of the root canal showed similar union values, even when submitted to different cleaning of post space. EDTA 17% was better than other solutions for cleaning of post space when using glass fiber posts.

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Curing cycle effect on complete dentures porosities: OCT evaluation

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Purpose/aim: To evaluate the degree of internal porosities of complete dentures processed two different cycles using Optical Coherence Tomography (OCT).

Materials and methods: Upper arch edentulous patients ($n = 14$) were rehabilitated with complete dentures done by a single technician. Polymerization has held in a digital pneumatic machine (60lb), according to the type of cycle: short cycle – 70 °C for 1 h and terminal boiling (100 °C/1 h); Long cycle – 70 °C for 9 h cycle and terminal boiling. Prostheses were then evaluated using Swept Source OCT (1300 nm) at four sites: inner palatine raphe; central incisor top gingival margin; tuberosity region; border region. The amount of porosity (%) was obtained using classical methods of digital image processing, comprising, filtering, enhancement and binarization techniques. To generate a binary image, a pixel count was made according to the signal: "0" = black/ porous regions; "1" = white/solid regions). Data was submitted to ANOVA and T-test ($p = 0.05$).

Results: No differences were observed between the polymerization cycles. Within each cycle, significant differences were found between sites for both cycles ($p = 0.019$ and 0.017). A higher porosity percentage was found in the raphe, and the lowest in the border, with statistically significant differences between them.

Conclusions: Polymerization cycles studied have shown similar results regarding the number of porosities in the denture base. Thicker regions may lead to higher porosity concentration. The elapsed time for each cycle and the number of complete dentures must be considered in daily clinical routine. OCT aided with digital image processing seemed a valuable method for porosity evaluation and therefore quality control. Being a nondestructive method, OCT can be used to evaluate alterations in porosity in prostheses being used by patients, due to undesirable daily use effects such as stomatitis or premature cyclic fatigue.

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Coupling agents heat-treatment effect on resin cement/Y-TZP bond strength

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Purpose/aim: The purpose of this study was to evaluate the effect of two different heat-treatment temperatures for three different coupling agents on the microshear bond strength (μSBS) of a 10-methacryloyloxydecyl-dihydrogen-phosphate (MDP)-based resin cement to an yttria-stabilized tetragonal zirconia polycrystal (Y-TZP) ceramic.

Materials and methods: Bar-shaped specimens were produced from Y-TZP presintered cubes and had their larger surface sandblasted by silica-coated alumina particles (110 μm) after sintering. Following finishing, the specimens were ultrasonically cleaned and randomly divided into nine experimental groups ($n = 24$), according to the heat-treatment temperatures and coupling agents that were used. The temperatures used for a 5 min heat-treatment, inside a furnace, were: ambient temperature (24 °C; control), 75 °C and 100 °C. Three coupling agents were investigated in this study: Clearfil Ceramic Primer (CF; Kuraray), Monobond N (MN; Ivoclar Vivadent) and Single Bond Universal (SB; 3 M ESPE). A cylinder of MDP-based resin cement (Ø = 0.7 mm) was constructed on the treated surface of the specimens of each experimental group and stored for 24 h at 37 °C. Half of the specimens from all experimental groups were aged by thermal cycling (2,000 cycles, 5 °C/55 °C, 30 s per bath) and water storage (2 m).

Results: Table 1.

Table 1 – μSBS means and standard deviations (SD) for tested specimens.

Coupling agent	Aging	Mean ± SD (MPa)	Grouping*
SB	No	32.5 ± 5.3	A
MN	No	30.0 ± 4.9	A
CF	No	22.4 ± 5.3	B
MN	Yes	17.0 ± 5.3	C
SB	Yes	9.8 ± 3.7	D
CF	Yes	6.4 ± 4.1	E

* Different letters represent significant difference by Tukey's test ($\alpha = 0.05$).

Conclusions: In conclusion, heat-treatment of the coupling agents improved bond strength in general, however did not promote stable bonding after aging condition.

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Immunomodulatory potential of silver-doped bioactive glasses microparticles in human leukocytes

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Purpose/aim: Bioactive glasses (BG) applications include tissue engineering for bone regeneration, coating for implants and scaffolds for wound healing. BG can be conjugated to ions like silver, which might add some antimicrobial properties to this biomaterial. The immunomodulatory activity of ion-doped bioactive glasses particles was not investigated before. The aim of this work was to evaluate the cytotoxic and immunomodulatory effect of BG and silver-doped bioactive glass (BGAg) in human peripheral blood cells.

Materials and methods: BG and BGAg samples belonging to the system $58SiO_2 \cdot (36\text{-}x)CaO \cdot 6P_2O_5 \cdot xAg_2O$, where $x = 0$ and 1 mol%, respectively, were synthesized via sol-gel method and characterized. Cytotoxicity, modulation of cytokine production (TNF-alpha, IL-1, IL-6, IL-4, IL-10) and oxidative stress response were investigated in human polymorphonuclear cells (PMNs) and peripheral blood mononuclear cells (PBMCs) cultures. Cytokines were titrated by ELISA on supernates of cells cultivated in the presence of 5ug/ml PHA, for 24 h 37 °C in a 5% CO_2 environment. Zymosan-induced ROS production was determined by luminescence using a microplate multireader. Statistical analyses were performed using GraphPad Prism 5.0 v, with p-value <0.05.

Results: Cell viability in the presence of BG or BGAg was concentration-dependent. Also, BGAg presented higher PBMCs toxicity (LC50 = 0.005%) when compared to BG (LC50 = 0.106%). Interestingly, Interleukin-4 was produced by PBMCs in response to BG and BGAg in absence of PHA and did not modulated PHA-induced cytokine levels. Subtoxic concentrations (0.031% for BG and 0.0008% for BGAg) did not change other cytokines in PBMCs nor reactive oxygen species (ROS) production by PMN. However, BG and BGAg particles decreased zymosan-induced ROS levels in PMN.

Conclusions: Although ion incorporation increased BG cytotoxicity, the bioactive glass particles demonstrated a potential in vitro anti-inflammatory. Future studies are needed to clarify the scavenger potential of the BG/BGAg particles/scaffolds as well as to elucidate the effect of the anti-inflammatory potential in modulating tissue growth in vivo.

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Effect of toothbrushing with fluoride-containing dentifrices on ceramic optical properties

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Purpose/aim: This in-vitro study evaluated the influence of toothbrushing cycles and dentifrice types on color, translucency and gloss of a CAD-CAM ceramic.

Materials and methods: CAD-CAM ceramic blocks (e.max CAD/Ivoclar Vivadent) were sectioned into $14 \times 14 \times 1$ mm plates ($n = 5$), which were randomly distributed into three groups, according to dentifrices containing different concentrations of fluoride (F): 0 ppm F, 1100 ppm F and 5000 ppm F. Plates were attached to a toothbrushing machine (Toothbrush Simulation/Biopdi) and submitted to total of 60,000 toothbrushing cycles (6 Hz-frequency, 200 g-weight) with soft toothbrushes (Oral B 40/Oral B). Lightness (L*) and color coordinates (a* and b*) were measured against a black and a white background with a spectrometer (Easyshade/Vita Zahnfabrik), while gloss was measured against a black background with a glossmeter (Zehntner Testing Instruments/Sissach). The measurements were performed at baseline and after 20,000, 40,000 and 60,000 brushing cycles. The color difference (ΔE) was calculated comparing baseline to 20,000 (ΔE B-20), 40,000 (ΔE B-40) and 60,000 (ΔE B-60) cycles. Translucency was calculated as the difference of color coordinate values obtained from the same specimen against black and white background. ΔE, translucency and gloss data were analyzed by two-way ANOVA and Tukey's test ($\alpha = 0.05$).

Results: No statistical difference was observed between ΔE B-20, ΔE B-40 and ΔE B-60, regardless of the fluoride concentration ($p > .05$). After 60,000 cycles, translucency values of 0 ppm F and 1100 ppm F groups did not differ from the baseline ($p > .05$). For 5000 ppm F group, translucency at baseline was lower than after 20,000 and 40,000 cycles, but greater than 60,000 cycles ($p < .05$). Although differences in gloss among dentifrices were obtained at the baseline ($p < .05$), at 60,000 cycles no difference was observed ($p > .05$). Only 0 ppm F group showed lower gloss, at the baseline, than after 60,000 cycles ($p < .05$).

Conclusions: In general, color, translucency and gloss of a CAD-CAM ceramic were not influenced by fluoride concentration in dentifrices or toothbrushing to up to 60,000 cycles.

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Thiourethane-functionalized fillers: Characterization in model composite materials

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Purpose/aim: To determine the degree of conversion, water absorption and solubility, color stability, surface roughness, antimicrobial properties and cytotoxicity of experimental composites containing different concentrations of thiourethane-functionalized fillers (TU).

Materials and methods: BisGMA and TEGDMA were used to formulate one model resin. Camphorquinone/EDMAB was used as photoinitiator/co-initiator system. To this blend, TU was added according to the following experimental groups: 0 (Control-TU0), 25% (TU25), 50% (TU50), 75% (TU75) and 100wt% (TU100). Degree of conversion was measured by Fourier-transformed infrared spectroscopy (FTIR). Absorption and solubility were performed according to ISO4049. Color stability was analyzed using the CIELab parameter. Surface roughness was obtained in a rugosimeter. The antimicrobial properties were detected through the exhaustion test and counting of Streptococus mutans colonies for biofilm formation. To evaluate the possible cytotoxicity of the material to human gingival fibroblasts a multiparametric test was conducted, evaluating three different parameters (XTT, NRU and CVDE) in the same cells. ELISA was used to measure the IL-6 and b-FGF markers.

Results: Regarding degree of conversion, water absorption and solubility, there was no statistical difference among experimental groups. The control group (TU0) presented the best values of color stability, but TU75 and TU100 had higher values of color variation. TU100 presented rougher surface than TU0. The groups tested did not demonstrate the inhibitory capacity of biofilm formation. None of the experimental groups presented values below 70% of cell survival (cytotoxic) in the evaluated periods (24 h and 7 days). Positive control (toxic) had high IL-6 values and low b-FGF values.

Conclusions: The use of thiourethane did not affect degree of conversion, water absorption and solubility. Color stability and surface roughness were affected as TU concentration increased. The material did not present antimicrobial and cytotoxic activities.

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Violet led bleaching: Efficacy and enamel surface morphology analysis

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Purpose/aim: This study evaluated color alteration and surface morphology of enamel submitted to violet LED light (LED) and hydrogen peroxide (HP) in-office bleaching.

Materials and methods: Sixty enamel blocks (5 × 5 mm and 3 mm thick) were subjected to two types of staining: cigarette smoke (one package a day for 5 days) and black tea immersion (for 24 h). Untreated enamel blocks were used as a control. Stained and untreated enamel blocks were bleached following the protocols ($n = 10$): twenty LED irradiations of 1 min at 30-s intervals in eight sessions or two 15-min application of 40% HP (Opalescence Boost, Ultradent) in two sessions. Color alteration (?ΔE) based on the Cie L*, a*, b* system was determined with a hand spectrophotometer (Vita EasyShade, Vita) at baseline (after staining) and after bleaching. Data were statistically analyzed by two-way ANOVA e Tukey test, with significance level at 5%. Enamel surface morphology was analyzed using scanning electron microscopy (SEM).

Results: Color alteration was detected for all groups ($p < 0.05$). LED and HP promoted similar ΔE when bleaching was performed on enamel stained with cigarette smoke. At the end of LED bleaching, enamel stained with cigarette smoke exhibited higher ΔE ($p < 0{,}001$) than black tea and control groups. SEM images demonstrated that HP-bleaching promoted more aggressive enamel morphological changes than violet LED light.

Conclusions: Enamel cigarette smoke staining was more susceptible to bleaching with LED violet light than black tea staining; however, no differences were observed between LED and HP bleaching protocols. Moreover, contrarily to HP, violet LED light maintained enamel surface integrity after treatments.

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$Ca(OH)_2$ sustained release from a cactus extract vehicle

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Purpose/aim: Calcium hydroxide (CH) pastes are employed to promote sustained release of calcium ions (Ca^{+2}) to induce apical closure in apexification. Polyethylene glycol (PEG) is a polymer commonly used as a vehicle for CH. But PEG is a high-cost synthetic polymer. Green dentistry is arising as a field exploring eco-friendly and low-cost alternatives for patients. We are investigating an extract obtained from the nopal–a Mexican edible cactus–as a vehicle for CH. The cactus extract is a water-soluble viscous gel; it is easy to get from the leaf of the nopal thus it is a low-cost product. The aim this study was to evaluate the sustained release of Ca^{+2} and pH induced by a CH paste based on a nopal-extract.

Materials and methods: Nopal leaves were washed and disinfected with 1% sodium hypochlorite. The skin of the leaves was removed and then the leaves were blended to get the extract. The extract was treated with sodium carbonate (2% w/v) to avoid oxidation and was stored at 4 °C. We formulated 2 pastes: P1, 10 mg of CH and 50 mg PEG 400 as a control; and P2, 10 mg of CH and nopal extract with sodium carbonate. The pastes were putted in a dialysis membrane (Avg. flat width 10 mm; typical molecular weight cut-off = 14,000), and the membrane was sealed. The membrane with the pastes ($N = 6$) were submerged in 3 mL of deionized water in a plastic tube. The samples were stored in an oscillatory shaker at 37 °C to promote the release of Ca^{+2} and OH^-. Deionized water was collected at different experimental time (3-6-9-24-48-72 h;1-2-3-4-5-6 weeks) and Ca^{+2} concentration and pH value were measured with an electrode (Orion Star A342).

Results: The pastes showed a sustained release of Ca^{+2} for all the experimental times. The control paste released a higher amount of Ca^{+2} compared to the nopal extract based paste. Thus the experimental paste released Ca^{+2} in a slow manner. The release of Ca^{+2} at the end of the experiment was: 5248.44 ± 17.21 PPM and 4609.20 PPM ± 7.04 for the control and the experimental paste, respectively (significant statistical differences). The pH of the deionized water changed from 10.9 to 7.19 and from 10.85 to 7.35, for the control and the experimental paste, respectively.

Conclusions: The CH paste based on nopal extract showed sustained release of Ca^{+2} for 6 weeks; that paste showed a CH release slower than the one showed by the control paste.

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Effect of oxidizing agents on bond of new self-adhesive cement

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Purpose/aim: The purpose of this study was to evaluate the effect of the pre-treatment of dentin with dental oxidizing agents (dental bleach and sodium hypochlorite), on bond strength of a new calcium-releasing self-adhesive resin cement, TheraCem (Bisco).

Materials and methods: Human dentin was randomly divided into 4 groups ($n = 5$). They were polished with 320-grit SiC paper, rinsed and dried. Group 1 received no further treatment. Group 2 were treated with 6% sodium hypochlorite solution (VISTA Dental Products) for 30 min, rinsed and dried. Group 3 and 4 were treated with dental bleach (35% carbamide peroxide, Opalescence, Ultradent) for 30 min, rinsed and dried. Shear bond strength was tested using the notched-edge shear

Table 1 – Shear bond strength of TheraCem on dentin with and without the 30-minute pre-treatment of oxidizing agents ($n = 5$).

Treatment	Shear bond strength (MPa)
No treatent	8.9 (3.8) a
6% sodium hypochlorite – bonding immediately after treatment	10.2 (2.3) a
Bleach (35% Carbamide peroxide) – bonding immediately after treatment	0.1 (0.2) b
Bleach (35% Carbamide peroxide) – bonding 1 day after treatment	8.1 (1.9) a

bond strength test method (ISO 29022:2013). Self-adhesive resin cement (TheraCem) was placed on the dentin surface and self-polymerized (15 minutes/37 °C). The specimens were then stored in water at 37 °C for 24 hours and tested by universal testing machine (Instron, crosshead-speed 1 mm/min). The data were analyzed statistically by one-way ANOVA and Student-t Test.

Results: Mean shear bond strengths in MPa (standard deviation) are shown in Table 1. Means with different letters are statistically different ($p < 0.05$).

Conclusions: The treatment of sodium hypochlorite did not adversely affect the bond strength of TheraCem. The bond strength was significantly lower if bonding was done immediately after bleaching, while it was not adversely affected if bonding was done 1 day after bleaching.

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Development of a phosphoric acid containing proanthocyanidin as cross-linker agent

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Purpose/aim: The aim of the present study was to evaluate the effect of a phosphoric acid containing proanthocyanidin on interaction between resin and dentin after bonding procedures and chemical and mechanical properties of the dentin surface treated and restored.

Materials and methods: The groups studied were: G1) self-etch system - control, G2) total-etch system 35% phosphoric acid – control, G3) experimental 35% phosphoric acid; G4) experimental 35% phosphoric acid containing 10% Proanthocyanidin. The experimental phosphoric acid was produced using a 35% phosphoric acid solution and a thickening agent, then 10% (w/v) proanthocyanidin (PA) was added. As controls, a commercial total-etch system 35% phosphoric acid (Ultra-Etch/Ultradent – Adper™ Scotchbond™ Multi-Purpose Adhesive-3M) and a 2-step self-etch system (Clearfil SE Bond/Kuraray) were used. The chemical composition of the acid solutions was evaluated by X-ray Photoelectron Spectroscopy (XPS) and the Ca/P ratio in the hybrid layer, sound dentin and treated dentin was analyzed by Energy Dispersive X-ray Spectroscopy (EDX). The adhesive interface and resin tags formation after bonding procedures were observed by Scanning Electron Microscopy (SEM) and the microhardness of the dentin after acid treatments was measured by Knoop hardness testing. Microtensile bond strength was conducted using a universal testing machine at a cross-head speed of 0.5 mm/min and a load cell of 100 N and the results expressed in MPa. All tests were performed 24 h after the acid treatments. Data were analyzed by descriptive statistics, ANOVA and Tukey test ($p < 0.05$).

Results: Hybrid layer and resin tags formation were observed in all groups. The chemical composition analysis of the solutions revealed a similar atomic percentage of phosphorus between the G3, G4 and G2. The Ca/P ratio in sound and treated dentin was similar among the groups and in the hybrid layer it was equivalent between the experimental acids and the G1, while the G2 exhibit the least ratio. The microhardness of the dentin surface G2 showed statistically different from G1. The G3 and G2 exhibit higher microtensile bond strength when compared to G1.

Conclusions: The experimental acids showed similar amount of phosphorus to demineralize the dentin when compared to the total-etch system and the pattern of interaction between dentin and resin after bonding procedures was comparable among all the groups. The acid containing PA did not affect the hardness of dentin and in terms of immediate bond strength (24 hours after treatments) it showed no significant difference when compared to the commercial acids.

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Does a self-etch-glass-ceramic-primer etch feldspathic ceramic? A FE-SEM analysis

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Purpose/aim: To compare the ultramorphology of feldspathic ceramic treated with hydrofluoric acid (HF) or with a self-etching ceramic primer (MEP).

Materials and methods: Two feldspathic ceramic blocks (VITABLOCS Mark II, VITA Zahnfabrik) were cut into 8 sections ($4 \times 4 \times 1$ mm^3) using a slow-speed diamond saw, wet-polished up to 1200-grit SiC paper, cleaned ultrasonically in distilled water (CDW) and assigned ($n = 2$) into: G1 = 10% HF (Condac Porcelana 10%, FGM) applied for 1 min; G2 = 5% HF (IPS Ceramic Etching Gel, Ivoclar Vivadent) applied for 1 min; G3 = MEP (Monobond Etch&Prime, Ivoclar Vivadent); G4 = control, no surface treatment. MEP was applied as per the manufacturer's instructions for Ivoclar Vivadent glass ceramics, i.e., scrubbed with a small brush for 20 s, left on the ceramic surface for 40 s, then thoroughly rinsed with air-water spray, and air-dried with a strong jet of water- and oil-free air for approximately 10 s. After the surface treatment, the specimens were CDW

for 10 min, air-dried, sputter-coated with gold-palladium, and observed under a FE-SEM (JSM-6701F, JEOL) at magnifications of 2,000× to 20,000×.

Results: Both HFs (G1 and G2) exhibited similar ultramorphology, including a honeycomb etching pattern characteristic of glass-matrix ceramics, preservation of crystal integrity, and formation of 0.5 to 10 μm-wide porosities for G1, and 1.0 to 15 μm-wide porosities for G2. The ceramic glass-phase showed a deeper etching pattern in few areas of G2. G3 did not result in a ceramic etching pattern comparable to those of G1 and G2. G3 presented some areas in which the ceramic surface was similar to that of the control group, while a very superficial and not homogeneous ceramic etching pattern was observed in sporadic areas. Also, 100 nm-wide porosities were observed in the glass phase for G3 specimens (at 20,000×), which might correspond to the start of a corrosion process. G4 (control) did not show any ceramic etching pattern.

Conclusions: Concentrations of 5% and 10% hydrofluoric acid are still the best choice to treat feldspathic ceramic to obtain a micro-retentive surface receptive to adhesive materials.

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Does MDP-based adhesive associated with chloerhexidine affect bonding to dentin?

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Purpose/aim: The impulse of the clinical use of functional monomer-based dental bonding systems (DBS) was imperative for the launch of multimode adhesives, especially with 10-methacryloyloxy-decyl-dihydrogen phosphate (MDP). As they can act with different bonding strategies, their use with chlorhexidine (CHX) as an antiproteolytic agent still presents great potential for clinical application. However, since MDP and CHX have a calcium-dependent mechanism of action, there is a concern if a possible interaction could impair the bonding to dentin. This study investigated a possible antagonist action between a MDP-based universal and a MDP-free etch-and-rinse DBSs with 2% digluconate CHX on their bonding effectiveness to dentin.

Materials and methods: This in vitro experiment involved three factors: DBS (in 3 levels), dentin pretreatment (in 2 levels) and time (in 2 levels). Seventy two extracted molars ($n = 12$) were randomly divided into three groups according to the DBS: SB – Adper Single Bond 2 (MDP-free DBS/control group); SU-ER – Adper Single Bond Universal on etch-and-rinse (ER) mode and SU-SE – Adper Single Bond Universal on self-etching mode (SE). All groups were divided into two subgroups according to the dentin pretreatment: W – water, CHX – 2% digluconate chlorhexidine, applied before DBS for 30 s in passive mode. All specimens were restored according to each DBS, following manufacturer's instructions. Resin-dentin beams (0.64 mm^2) were obtained (500N/0.5 mm/min) and microtensile bond strength was tested after 24 hours and 6 months of storage. Failure mode was assessed by optical microscopy (40×). Data was analyzed by three-way ANOVA and Tukey post-hoc tests ($p < 0.05$).

Results: DBS was the only significant factor ($p < 0.0001$) on bonding results, with higher bond strength to dentin obtained with MDP-containing adhesive. Both pretreatment ($p = 0.0917$) and time ($p = 0.547$) as well as the interaction between the factors were not statistically significant ($p > 0.05$).Means and standard deviation of initial and 6 months bond strength to dentin (MPa) were: SB-W: 33.35 (9.01)/32.59 (9.44); SB-CHX: 28.41(7.64)/31.55 (6.15); SU-ER-W: 31.62 (8.20)/32.05 (7.04); SU-ER-CHX 33.66 (7.78)/33.79 (6.24); SU-SE-W: 45.62 (12.39)/40.15 (14.77); SU-SE-CHX: 37.47(10.68)/34.25 (11.21).

Conclusions: MDP-based multimode system shows improved dentin bonding performance, particularly in the self-etching mode, compared to a MDP-free ER system. CHX did not affect bond strength of any of the tested DBSs. Therefore, a negative impact between MDP and CHX was not proven

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Antibacterial activity of dental composite: Four months evaluation

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Purpose/aim: The aim of this study was to evaluate the antibacterial activity of an experimental composite with different concentration of montmorillonite nanoparticles (MMT) incorporated with chlorhexidine (CHX) through four months.

Materials and methods: Six formulations of experimental composites were made with organic matrix based BisGMA/TEGDMA in equal proportions by weight. The composites received MMT nanoparticle with or without incorporated CHX. The concentrations were determined in 2.5; 5 or 10% by weight. Disc specimens were prepared with 5 mm diameter and 1 mm. A total of 25 discs were made for each experimental composite, and they were storage in distilled water at 37 °C until testing. The water was changed weekly, and 5 specimens per month for each composite were tested. The first test was performed without storage, and considered as time 0. The antibacterial activity was evaluated by the inhibition halo test. This method was conducted according to Clinical Standard Laboratory Institute M2-A8 protocol, with some modifications (CLSI, 2003). The bacteria selected was the Streptococcus mutans. Discs specimens were positioned over the agar and plates were incubated in the appropriate

Table 1 – Means for the inhibition halo (mm).

Month	Concentration (% wt)	CHX	No CHX
0	2.5	3.27	0.59
	5	4.80	1.39
	10	6.07	0.91
1	2.5	3.11	0
	5	2.27	0
	10	2.09	0
2	2.5	1.14	0
	5	1.73	0
	10	0	0
3	2.5	3.85	0
	5	2.04	0
	10	0	0
4	2.5	0	0
	5	3.27	0
	10	0	0

conditions for 48 h. After this period, inhibition zones were measured using a caliper rule.

Results: Results are presented in Table 1. It is important to point out that the groups without incorporated CHX presented inhibition halo only when immediately tested and after storage, none of the concentrations presented inhibition halo.

Conclusions: Within the limitations of the study, it is possible to conclude that only 5% of nanoparticle loaded with CHX presented inhibition halo over the evaluation period of four months.

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CAD/CAM or conventional ceramic restorations longevity: Systematic review and meta-analysis

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Purpose/aim: This systematic review and meta-analysis aimed to evaluate the difference in longevity for conventional and computer-aided design/computer-aided manufacturing (CAD/CAM) techniques of tooth-supported ceramic prosthesis (single crown, multiple-unit or partial ceramic crown).

Materials and methods: Two reviewers searched Web of Science, PubMed, SCOPUS and LILACS databases for randomized controlled clinical trials (RCTs) and prospective studies, published between 1966 and October 2017. Clinical studies that compared the survival rate of CAD/CAM against conventional restorations were included.

Results: Data from the included studies ($n = 14$) were pooled in a meta-analysis of Relative Risk using default Mantel and Haenszel method for binary variables. Total of 1209 restorations had been placed in 957 patients in the included trials and failures were analyzed by type and material restoration. From a total of 72 restorations failures, the CAD/CAM system resulted in a risk of 1.84 (IC95%: 1.28–2.63) times higher than the conventional manufacturing of ceramic restoration. Nevertheless, when drop-outs were included as failure risk the CAD/CAM system resulted in a risk of 1.32 (IC95%: 1.10–1.58). Multilevel analysis of tooth-supported ceramic restorations, considering drop-outs as success, resulted in failure rates of 1.48 and 2.62, (per 100 restoration/year respectively), for the controls and CAD/CAM groups. Considering drop-outs as failures, we found rates of 4.23 and 5.88 failures per 100 restoration-years, respectively for the controls and CAD/CAM groups.

Conclusions: The meta-analysis results suggest that the longevity of tooth-supported single crown, multiple-unit or partial ceramic crowns, made by computer-aided design/computer-aided manufacturing, is lower than the conventional technique.

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Carbodiimide effect on MMPs and hybrid-layer micro-hardness in radicular dentine

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Purpose/aim: Collagen cross-linking agents strengthen the dentine organic matrix and inhibit endogenous matrix metalloproteinases to improve the stability of the hybrid layer. The present in vitro study evaluated the effect of 1-ethyl-3-(3-dimethylaminopropyl) carbodiimide (EDC), a cross-linking agent used as an additional therapeutic primer, on push-out bond strength, enzymatic endogenous activity and mechanical properties of the adhesive interface in endodontically treated teeth.

Materials and methods: Root canal treatment was performed on 80 extracted single-rooted human teeth. A 10-mm post space was prepared in each tooth. Specimens were randomly assigned to four groups ($N = 20$) according to the dentine bonding system: 1) All Bond 3 (Bisco); 2) All Bond 3 + 0.3 M EDC; 3) Prime%Bond XP (Dentsply Sirona); 4) Prime&Bond XP + 0.3 M EDC. In groups 2 and 4, EDC was applied on phosphoric acid-etched dentine for 1 min. Fibre posts (RelyX Fiber Post, 3 M ESPE) were luted with a dual-cured resin cement (Core X flow, Dentsply Sirona). Slices were prepared for micro push-out test and interfacial nanoleakage evaluation of the coronal and apical region of the canal space after 24 h of storage in artificial saliva. In-situ zymography was performed to investigate endogenous matrix metalloproteinase activities within the hybrid layer and hardness of the adhesive interface was assessed with a Nanoindenter XP (MTS/Agilent, USA), equipped with a diamond Berkovich indenter and characterized by a theoretical force resolution of 50 nN and a

theoretical displacement resolution lower than 0.01 nm. The loading–displacement (*P–h*) curves have been analyzed by using the Oliver-Pharr method to obtain the Elastic Modulus and the Hardness. Results were statistically analysed with three-way ANOVA test or Chi Square test. Statistical significance was set at $\alpha = 0.05$.

Results: No significant influence was identified between the two adhesives. The use of EDC did not significantly improved fibre post bond strength at 24 h. Application of 0.3 M EDC prior to bonding significantly reduced gelatinolytic activities within the radicular hybrid layers and improved the hardness of the hybrid-layer.

Conclusions: Carbodiimide did not alter immediate push-out bond strength and was effective in reducing the activities of intra-radicular endogenous proteases. Furthermore, HL pre-treated with EDC showed better mechanical properties. These results should be validated with in vivo studies to clarify the role of the collagen cross-linker in stabilising resin-dentine bonds in endodontically treated teeth.

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Influence of occlusal splint on implant-supported fixed dental prosthesis (FEA)

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Purpose/aim: The purpose of this study was to investigate the occlusal splint (OS) influence and the different abutment materials: titanium (Ti) and yttria-stabilized zirconia (Y-TZP) on three-element implant-supported fixed prosthesis (FP), in the upper maxillary region using an external hexagon (EH) implant and morse taper (MT) with loads of 100 N and 300 N, using the finite element method (FEM).

Materials and methods: A 3D virtual model was created simulating the situation: cortical and cancellous bone of the region from the first premolar to the maxillary first molar using two EH or MT implants (4 × 11 mm) with Ti and Y-TZP abutments in the first premolar region and only Ti in the first molar region. The second premolar was the pontic and an OS was considered of acrylic resin. Axial and oblique loads of 100 N and 300 N were applied over the occlusal region of the FP with and without interposition of the OS.

Results: The tensile stresses on MT bone tissue produced values of 4–19% lower than those of EH implants. The lowest differences were for oblique loading with an OS, with a 4% (Ti-Y-TZP) and 9% (Ti–Ti) decrease. When the compressive stresses were evaluated, EH produced 15% lower on average than MT. Regarding the prosthetic elements and the Y-TZP abutments in MT, the decrease in the stress ratios for the premolars ranged from 43 to 74%. On the contrary, molar implant abutments (Ti) increased 10% with the replacement of the premolar abutments, the only exception being the splint less oblique loading groups, which there was an 18% (molar) and 43% (premolar) decrease. For the HE connection Y-TZP abutments, the premolar stress ratios had their values decreased by 67–72%. However, this decrease was less significant for the molar abutments, which decreased 6% with the replacement of the premolar abutments. The stress values did not produce a ratio of 1:3 with the load increase (100N–300 N) due to the non-linearity of the contacts considered in the analysis. In the bone, the MT induced lower tensile stresses. However, it induced higher compressive stresses.

Conclusions: For the prosthetic system, the best combination was the use of MT implants in both premolar and molar regions. Lower stress decreases were observed with MT and Ti abutments. In general, a significant increase was evaluated in the oblique loading stresses in the absence of occlusal splints, regardless of the applied load.

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Bioglass air-abrasion influences bonding and conversion of an etch-and-rinse adhesive

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Purpose/aim: The aim was to investigate dentin bonding and in situ degree of conversion of an etch-and-rinse adhesive with adjuctive air-abrasion of bioactive glasses (BAGs) 45S5 (with calcium) or fully strontium-substituted 45S5 (Sr-45S5) before or after phosphoric acid-etching.

Materials and methods: The two-step etch-and-rinse adhesive Optibond S (Kerr) was used as per manufacturer's instructions (Control), with prior 45S5 air-abrasion (45S5 + H_3PO_4), with prior Sr-45S5 air-abrasion (Sr-45S5 + H_3PO_4), with 45S5 air-abrasion after phosphoric acid-etching and before adhesive application (H_3PO_4 + 45S5) or with 45S5 air-abrasion after phosphoric acid-etching (H_3PO_4 + Sr-45S5). Extracted third molars were cut to expose flat dentin surface and bonded according to the groups. Bonded teeth ($n = 5$) were cut into resin-dentin sticks and microtensile bond strength test was performed after 24 h water storage. Further sticks ($n = 3$) were surveyed by Micro-Raman (Horiba) spectroscopy to assess in situ degree of conversion by the ratios of 1608/1638 cm^{-1} peaks and by scanning electron microscopy to observe silver nanoleakage. The results were analyzed with one-way ANOVA and Tukey's test ($p < 0.05$).

Results: The bond strength of Control (51.4 ± 3.6 MPa) was significantly higher than all groups, except Sr-45S5 + H_3PO_4 (46.4 ± 3.4 MPa) ($p = 0.346$). The degree of conversion analysis depicted no statistical difference between control and all groups ($p > 0.05$). However, H_3PO_4 + Sr-45S5 (83.8 ± 2.3%) attained higher conversion ($p = 0.018$) than

Control (61.2 ± 10.1%). Nanoleakage was slightly higher in interfaces created with bioactive glasses air-abrasion after acid-etching.

Conclusions: Bioactive glass air-abrasion may reduce the initial bond strength of etch-and-rinse adhesives, especially when performed after phosphoric acid-etching. Nevertheless, strontium-substituted 45S5 BAG achieves major positive effects than traditional calcium-containing 45S5.

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Flexural strength and flexural modulus of urethane resin-based resin composites

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Purpose/aim: To evaluate the influence of type and concentration of urethane monomers on flexural strength (FS) and flexural modulus (FM) of resin composites.

Materials and methods: Six resin composites were made with ethoxylated bisphenol-A dimethacrylate (BisEMA), triethylene glycol dimethacrylate (TEGDMA), and different molar concentrations (2.3%, 5.75% or 11.5 mol%) of urethane dimethacrylate (UDMA) or Exothane 24, namely U1, U2, U3, E1, E2 and E3, respectively. Barium aluminum borosilicate glass and colloidal silica were used as filler particles (60 wt%). Bar shape specimens (2 × 2 × 25 mm; $n = 10$) were photoactivated with 1.200 mW/cm^2. The FS (MPa) and FM (GPa) were evaluated by three-point bending test in a universal testing machine with 1 mm/min. Data were submitted to 2-way ANOVA and Tukey-s test ($\alpha = 0.05$).

Results: FS (U1-29.0; U2-50.6;U3-70.6; E1-28.6; E2-32.5; E3-26.7) and FM (U1-0.51; U2-1.15; U3-2.06; E1-0.52; E2-0.68; E3-0.67). The higher the UDMA content, the higher the FS and FM of resin composite; however, there was no significant influence of Exothane 24 content on FS and FM of resin composites. At 2.3 mol% there was no significant difference between UDMA and Exothane 24-based resin composites; but at 5.75 mol% and 11.5 mol% UDMA-based resin composites had significantly higher FS and FM than Exothane 24-based resin composites.

Conclusions: The type of urethane monomer influenced the FS and FM of resin composites from 5.75 mol% concentration. The higher the UDMA content, the higher the FS and FM of resin composite; however, the content of Exothane 24 does not influence the FS and FM of resin composites.

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Effect of resin-cements containing thio-urethane on bond strength after aging

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Purpose/aim: The aim of this study was to determine the effect of thio-urethane (TU) additives to experimental resin cements on the microshear bond strength (μSBS) to ceramic IPS e.max Press after 24 h or one year of water aging.

Materials and methods: Forty flat and polished plates of lithium disilicate glass ceramic (IPS e.max Press) were prepared and divided onto 4 groups ($n = 10$): Group 1- bonded with experimental control cement (EC) without thio-urethane; Group 2–bonded with experimental cement with 20 wt% of aromatic TU; Group 3 - bonded with experimental cement with 20 wt% of aliphatic TU; and Group 4–bonded with commercial cement, RelyX Ultimate-RU. Ceramic surfaces were etched (10% hydrofluoric acid–20 s) and treated with silane left in contact for 60 s, followed by compressed air for 30 s. Four resin cements cylinders (0.75 mm in diameter × 1.0 mm in height) made with micro-bore Tygon tubing were bonded to each ceramic plate surfaces using the respective resin cements. After 24 h or one year of water storage, bonding performance was measured by μSBS testing at a crosshead speed of 1.0 mm/min. Data were analyzed with ANOVA/Tukey's test ($\alpha = 0.05$).

Results: Results are shown in Fig. 1. For the specimens stored 24 h and 1 year, the μSBS (MPa) for aromatic TU were significantly higher than for RU and aliphatic TU, which were higher than EC. The storage for 24 h showed significant higher value than 1 year for all resin cements.

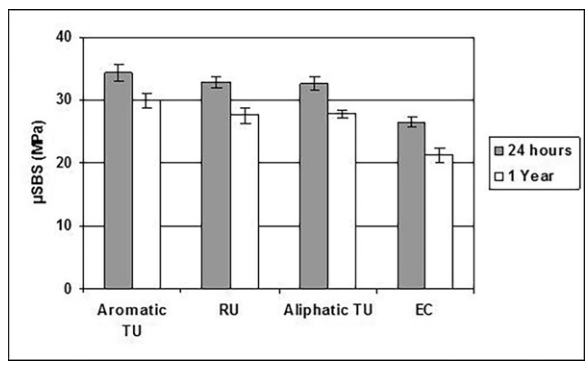

Fig. 1 – Means of μSBS (MPa) after aging times of 24 h and 1 year for the resin cements EC, aromatic TU, aliphatic TU and RU.

Conclusions: The use of thio-urethane oligomers, mainly the aromatic version, was able to increase the μSBS to the

ceramic surface specimens. Storage time reduced the μSBS values equally for all resins cements.

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Cleaning methods and contamination with saliva/blood affects ceramic bond strengths

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Purpose/aim: The aim of this study was to determine the effects of saliva, blood and saliva/blood contaminations on microshear bond strength (μSBS) between resin cement and ceramic interfaces, and the best cleaning methods to recover the original resin cement-ceramic bond strength.

Materials and methods: One hundred sixty ceramic discs (13 mm in diameter × 3 mm thickness) were fabricated and divided into four groups: control group (CG)–no contamination ($n = 10$) and according to contamination types: saliva (S), blood (B) and saliva + blood (SB). The cleaning methods were: 37% phosphoric acid (PA), 5% hydrofluoric acid (HF), air/water spray (AW), Ivoclean (IC) cleaning paste, no cleaning method–no treatment (NT). The ceramic surfaces were sandblasted with Al_2O_3 and etching with 5% HF. After contamination followed by cleaning methods, the ceramic surface was treated with a silane coupling agent followed by a thin layer of an unfilled resin. Three resin cements cylinders (1 mm in diameter) were made on each ceramic surface, which was then stored in deionized water at 37 °C for 24 h. After 24 h, bonding performance was measured by μSBS testing at a crosshead speed of 1.0 mm/min until failure. Data were analyzed with ANOVA/Tukey's test ($\alpha = 0.05$).

Results: The μSBS (MPa–mean ± standard deviation) of S (20.9 ± 4.9) and NT (9.9 ± 2.5) were significantly higher than contaminants B and SB for cleaning methods IC (14.1 ± 2.4 and 13.2 ± 3.0) and NT (7.8 ± 2.5 and 7.6 ± 2.3). No statistical difference was found among contaminants S, B and SB for cleaning methods PA (17.1 ± 6.5, 13.2 ± 2.7 and 12.9 ± 1.9), HF (12.4 ± 1.8, 12.2 ± 2.1 and 12.1 ± 1.6) and AW (11.6 ± 1.3, 10.8 ± 1.6 and 10.3 ± 1.4). The most effective cleaning method for the samples contaminated with S was IC, whereas in the cases with B and SB, no method was able to equal the values of the control group - CG (23.4 ± 3.8).

Conclusions: The contamination of the ceramic surface with S, B or SB decreased significantly the μSBS. The cleaning methods increased the μSBS of the contaminated ceramics, but not at the Control group (CG), except for the Ivoclean method.

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Two-year clinical evaluation of proanthocyanidins added to an adhesive system

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Purpose/aim: The aim of this double-blind randomized clinical trial was to compare the retention rate of Proanthocyanidins (PA)-free and a PA-containing two-step etch-and-rinse adhesive on the clinical behavior of resin composite restorations in non-carious cervical lesions (NCCLs) over a 6-m (6 M) and 24-m (24 M) period.

Materials and methods: 135 restorations were randomly placed in 45 subjects. The NCCLs were conditioned (37% phosphoric acid for 15 s) and distributed into 3 groups: Control (EX0) - ExciTE F (Ivoclar Vivadent) adhesive applied following the manufacturer's recommendations; EX2 and EX5–2 wt% and 5 wt% of PA from grape-seed extract was added to ExciTE F, respectively, and applied as in EX0. Resin composite was placed incrementally and light-cured. After 1 week, each restoration was finished and polished. The restorations were evaluated at baseline, 6 M and 24 M, using FDI and USPHS criteria. Statistical analyses were performed using Friedman and Wilcoxon tests ($\alpha = 0.05$).

Results: The retention rates were 98% (95% confidence interval 88–99%) for EX0, 92% (80–97%) for EX2; and 85% (72–93%) for EX5 at 6 M. A significant difference was found only for EX5 at 6 M when compared with the respective baseline findings ($p = 0.03$) and when compared with EX0 and EX2 ($p = 0.001$). After 24 M, the retention rates were 98% (88–99%) for EX0, 73% (59–84%) for EX2, and 71% (56–82%) for EX5. Only EX0 did not result in significant difference at 24 M when compared with baseline, but showed a significant higher retention rate when compared with EX2 and EX5 ($p = 0.001$).

Conclusions: Adding proanthocyanidins to the adhesive solution jeopardized the retention of composite resins restorations in non-carious cervical lesions after 24 months.

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Enzymatic activity of the hybrid layer of irradiated teeth

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Purpose/aim: Radiation-related caries and early restorations failures can be considered the main consequences of

radiotherapy for head and neck cancer patients. Cysteine cathepsins (CT) have a crucial role in collagen degradation of the hybrid layer being the CT-K alone responsible for 98% of the protease activity of the cathepsins. Thereby, the aim of this study was to evaluate CT-K distribution on the hybrid layer and the gelatinase activity of restored dentin with a self-etch and an etch-and-rinse adhesive.

Materials and methods: Specimens were divided into 4 groups, according to its irradiation form (not irradiated and irradiated) and the adhesive system tested (Adper Single Bond, 3 M ESPE or Clearfil SE, Kuraray). Samples were irradiated submerged in distilled water with a total and single application of 70 Gy with X-rays from a linear accelerator (Mevatron MX2 6 mV; Siemens Healthcare, Erlangen, Germany). The restored specimens were submitted either to a preembedding or to a postembedding immunolabeling technique using primary monoclonal antibody anti-CT-K and exposed to a secondary antibody conjugated with 15 nm gold nanoparticles. In situ zymography assay was performed in accordance with Mazzoni et al., 2014 using a self-quenched fluorescein-conjugated gelatin as the substrate.

Results: Positive immunolabeling patterns for CT-K were observed in partially demineralized dentin surfaces under FEI-SEM and along the collagen fibrils und TEM. No difference between the distribution and localization of the CT-K among the hybrid layer of all groups could be noticed. The results of in situ zymography suggest a higher level of enzymatic activity in the teeth treated with radiotherapy prior to restoration. This increased activity seems to be both substrate and adhesive system dependent.

Conclusions: Radiotherapy seems to increase the enzymatic activity of restored teeth without influencing the distribution and localization of CT-K. Further studies are ongoing to better understand the interaction of radiotherapy and endogenous proteases.

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Drug-delivery at endodontic materials: In vitro and in vivo behavior

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Purpose/aim: The aim of this study was to assess the behavior of a newly synthesized endodontic material with anti-inflammatory, antimicrobial and remineralizing properties. The formulation is presented in powder/liquid form, in which the powder is composed of tricalcium phosphate (α-TCP), calcium tungstate and amoxicillin microspheres. The liquid is composed of nanocapsules containing indomethacin.

Materials and methods: The material was characterized in vitro in pre-osteoblastic cells (MC3T3-E1) and in vivo by male Wistar rat models, the evaluated groups were: experimental paste (EX), calcium hydroxide-based paste (UC) and an iodoformium-based paste (GP). Cells were plated at 5×103 cells/well ($n = 3$) and exposed to 10% conditioned medium concentration for 24 h at MTT and SRB tests, and for 7 and 14 days for alkaline phosphatase activity (ALP) and Alizarin Red S. For the scratch assay, cells were plated at 2×105 cells/well ($n = 6$) and photos were taken every 6 h until complete healing. For in vivo assays, periapical lesions were induced by exposing the pulpal tissue of immature mandibular molars ($n = 6$) to oral environment, 24 h later teeth were treated with materials for periods of 7, 30 and 90 d. Further, the bone regeneration potential of the materials was investigated by comparing different groups of treatment using a critical-sized rat calvarium defect model, for periods 30 and 90 d. Lesion/defect regeneration was evaluated after animal euthanasia using ex vivo micro-CT images, analyzed by Image J. Data were analyzed using one-way and two-way anova and Tukey post hoc at IBM SPSS ($\alpha = 0.05$).

Results: The values for MTT showed better citocompatibility for the experimental paste when compared to other materials with fresh conditioned medium ($p < 0.05$). For the SRB assay, the EX was equivalent to UC paste, however, EX showed better results when compared to GP ($p < 0.05$). The conditioned medium after setting for 24 h didn't show any difference among groups. The ALP activity and formation of mineralized nodules demonstrated the potential of remineralization for UC and EX paste. Cell migration showed continuous wound closure until complete cell-monolayer healing, the EX paste accelerated the process when compared to control and GP ($p < 0.05$). Micro-CT results showed that the volume of periapical lesions diminished at the last period for all materials tested, except for GP group. Rat calvarial defect was partly covered by new bone formation for all groups in function of time.

Conclusions: Considering experimental data, the present study lays the foundation for the development of drug-delivery-based materials for future clinical applications in periapical regeneration of large lesions.

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Physical and adhesion properties of bulk-fill composites

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Purpose/aim: The aims of this study were to evaluate biaxial flexural strength (BFS), polymerization shrinkage stress

(PSS) and dentin bond strength (DBS) of one conventional and five bulk-fill restorative systems.

Materials and methods: Five bulk-fill restorative materials tested were: Tetric EvoCeram Bulk Fill (TEC), Opus Bulk Fill (OBF), Fill-Up! (FUP), Equia Forte (EQF), Activa BioActive Restorative (ABR). Filtek Supreme Ultra (FSU) was used as a negative (bulk-filling) and positive control (incrementally) for the BFS test, in which sets of eight stacked composite discs (0.5 mm thick and 6 mm diameter) were prepared simulating bulk filling of a 4-mm-thick increment ($n = 7$). PSS was determined using composite bonded to acrylic rods attached to a universal testing machine ($n = 5$). For the DBS test, a standardized class I cavity preparation (4 mm × 4 mm × 3 mm) was made on the occlusal surface of a tooth and the prepared teeth were randomly divided into the six experimental groups represented by a restorative material and its respective bonding agent ($n = 10$). Restored teeth were cut into sticks-shaped specimens and tested in a universal testing machine. Data were statistically analyzed by two- (BFS) and one-way (PSS and DBS) ANOVA and Tukey post-hoc test (alpha of 0.05).

Results: ABR and negative control were the materials that showed lower BFS values at deeper regions. PSS means (SD) were (in MPa): TEC–5.3(0.5)c; OBF–7.3(1.1)ab; FUP–7.9(0.8)a; EQF–0.3(0.1)d; ABR–6.2(0.9)bc and FSU–7.5(1.0)ab. DBS means (SD) were (in MPa): TEC–20.0(8.6)b; OBF–23.0(6.9)ab; FUP–26.6(4.3)ab; EQF–12.4(3.1)c; ABR–19.6(6.8)b and FSU–29.2(8.6)a.

Conclusions: Most of bulk-fill restorative materials did not exhibit BFS reduction with the increase of the depth. PSS of the conventional composite resin (FSU) did not differ from OBF, FUP and ABR bulk-fill materials. The lowest PSS and DBS were observed for EQF (glass ionomer/resin hybrid material). DBS of the two bulk-fill composites (OBF and FUP) did not differ statistically from conventional composite resin (FSU), which presented higher DBSs.

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Universal adhesive system and resin-based fissure sealant sorption and solubility

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Purpose/aim: The aim of this study was to compare the water sorption and solubility of a universal adhesive system (Scotchbond Universal Adhesive–SBU) and a resin-based fissure sealant (Fluoroshield–FLSH).

Materials and methods: Sorption and solubility evaluation were performed in compliance with ISO 4049:2009. Ten disk-shaped specimens (15.0 mm in diameter × 1.0 mm in thickness) were prepared with SBU. 10 drops of adhesive system were applied and the solvent was evaporated by an air-blown at 20 cm distance for 5 s. Then a micropipette was used to dispense the adhesive system directly into the metal mold. The disks were light cured for 80 s on the top and for 80 s on the opposite side. FLSH disks were obtained applying the material directly into the metal mold and the light curing was performed in the same manner as described above. Disks were assigned in two groups ($n = 10$) according to the materials. Specimen disks were stored separately in a desiccator containing dehydrated silica gel at 37 ± 1 °C. The disks were weighed daily in an analytical balance, accurate to 0.001 mg until reached a constant mass (three days of no weight change) (m1). Therefore the disks were individually placed in sealed vials containing 10 ml of distilled water at 37 ± 1 °C. On the first day, the disks were weighed after 4 and 24 h. The disks were weighed after 7, 14, 30, 60, 90, 120, 150 and 180d or until reaching a constant mass (m2). After weighing, the specimens were again placed in the desiccator containing dehydrated silica gel and transferred to an oven at 37 ± 1 °C. Then, weighed daily until obtaining a constant mass as described above (m3). Sorption (S) and solubility (S1) were calculated using the following formulae (in mg/mm^3), respectively: $S = m2 - m3/V$ and $Sl = m1 - m3/V$; where V is the volume (mm^3) of the specimen. The actual percentage amount of water absorbed (SPc%) was obtained using the formulae: $SPc\% = m2 - m1/m1$. Sorption and solubility values were analyzed by Mann–Withney U test ($p = 5\%$).

Table 1 – Means and standard deviations of water sorption (WS), solubility (SL) and the percentage amount of water absorbed (SPc%) for each material.

Material	WS*	SL*	SPc%
Fluroshield	0.07 (0.01)^A	−1.34 (0.15)^A	4.85 (0.12)^A
Scotchbond Universal Adhesive	0.25 (0.03)^B	−0.90 (0.1)^B	23.41 (0.22)^B

Superscript letters indicate significant differences ($p < 0.000$) between rows. (*mg/mm^3).

Results: SBU showed the higher means of water sorption ($p < 0.000$) and solubility ($p < 0.000$) than FLSH (Table 1). The actual percentage amount of water absorbed (SPc%) by SBU was almost 5× higher than that absorbed by FLSH ($p < 0.000$).

Conclusions: The universal adhesive system undergoes more water intake (sorption and solubility) than a resin-based fissure sealant.

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Bond strength of recycled metallic brackets after different surface treatments

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Purpose/aim: The objective of this study was to evaluate the effect of different surface treatment protocols on the shear bond strength of metallic brackets that will be recycled and bonded again to dental enamel.

Materials and methods: Forty-eight (48) metallic brackets were randomly divided into 4 experimental groups ($n = 10$), according to the surface treatment performed on the brac-

Table 1 – SBS means and standard deviations (SD) for tested experimental groups.

Experimental groups ($n = 10$)	Mean (MPa)	Standard deviation	Grouping*
MetalU	5.31	1.20	B
Metal	8.82	4.14	A B
MetalGlas	9.38	2.78	A
MetalRoc	8.29	3.95	A B

* Different letters represent significant differences by Tukey's test ($\alpha = 0.05$).

kets' bases. New brackets were considered the positive control group (Metal), whereas the negative control group (MetalU) consisted of brackets that debonded during orthodontic treatment. The other experimental groups were formed by debonded brackets that received a recycling surface treatment: i) MetalRoc group - sandblasting with silica-coated alumina particles of 30 μm (RocatecTM Soft) and ii) MetalGlas group–sandblasting with spherical glass particles of 40–70 μm (Glass Beads). The treated surfaces of the brackets from MetalRoc and MetalGlas groups received silane application for 120 s, following the manufacturer's recommendation. Bovine crowns embedded in acrylic resin, leaving only one tooth surface of enamel free, were used to make the specimens. All the brackets were bonded to this enamel surface with resin composite (Transbond XT). Prior to the bond strength test, all experimental groups were aged in water at 37 °C for 60 days. The shear bond strength test was performed in a universal testing machine (1 mm/min). Data were subjected to one-way ANOVA and Tukey's test ($\alpha = 0.05$).

Results: The surface treatments significantly ($p = 0.037$) influenced the bond strength of the brackets. Table 1 shows the shear bond strength (SBS) means and standard deviation for all experimental groups. MetalGlas (9.38 ± 2.78 MPa) showed the highest bond strength values when compared to those obtained for the other groups. Brackets that did not receive any surface treatment (MetalU, 5.31 ± 1.20 MPa) showed the lowest bond strength values.

Conclusions: In conclusion, sandblasting with glass beads proved to be an effective alternative to recycle metallic brackets that were debonded during treatment orthodontic.

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Anti-proteolytic agents on shear bond strength: Systematic review and meta-analysis

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Purpose/aim: When minerals from dental structures, such as acid etching or application of acidulous primer, are removed, there is an exposure of collagen fibrils. This condition makes them susceptible to reactions such as hydrolytic or enzymatic degradation, leading to premature failure of adhesive restorations. In this context, researchers are looking for alternatives to postpone the failure of the technique using metalloproteinases inhibitors in the pre-treatment of demineralized dentin or incorporated in the adhesive system to increase the long-term stability of the resin-dentin interface. Therefore, the objective of this study was to systematically review the literature in the search for in vitro studies that evaluated the effect of metalloproteinase inhibitors on the shear bond strength of healthy dentin after six months of restoration aging.

Materials and methods: This review was registered in PROSPERO (CRD42017077516) and followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement. The search was conducted in seven databases (PubMed, LILACS, Scielo, Cochrane, Web of Science, Embase, Scopus) and the gray literature IBICT-BDTD, with no publications year limits and limited to English, Spanish and Portuguese languages. The last search was performed in January 2018. The search strategy was established for each database and a total of 6848 references were obtained. Duplicates were removed with the EndNote online tool, remaining 5134 studies. Two reviewers independently selected the studies considering the eligibility criteria (Kappa 0.86), finalizing with 4 studies for qualitative analysis and 2 studies for the meta-analysis. In the selected studies for the quantitative analysis, six types of inhibitors were verified, besides the different adhesive systems used, resulting in a total of fourteen combinations for meta-analysis. One reviewer assessed the risk of bias and extracted the data included in review and meta-analysis. These studies were divided according to test (with metalloproteinase inhibitors) and control (without metalloproteinase inhibitors) groups, from where data were collected for meta-analysis, considering the following eligibility criteria: tooth type (permanent), substrate type (sound), aging (yes), time of aging (six months), type of adhesive system and type of agent inhibitor (solution or incorporated into the adhesive system).

Results: The Comprehensive Meta-analysis Software® (Random Effect) was used and showed a significant effect of the agents tested in the increase of the bond strength of permanent teeth submitted to the micro-shear in in vitro studies.

Conclusions: These results demonstrate evidence that non-specific inhibitory agents of MMP have a significant effect on improving micro-shear bond strength.

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Translucent zirconia: Mechanical reliability, fatigue strength, survival and phase analysis

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Purpose/aim: This study characterizes the mechanical properties (under static and fatigue tests), the crystalline microstructure and phase content (monoclinic–m, tetragonal–t and cubic–c), and the surface topography of three yttria-stabilized zirconia (YSZ) ceramics with different levels of translucency, before and after aging in an autoclave (low temperature degradation).

Materials and methods: Disc-shaped specimens were produced from YSZ ceramics (Kuraray Noritake Dental Inc.) of second (Katana ML/HT–high-translucent) and third generations (Katana STML–super-translucent and UTML–ultra-translucent), following the ISO 6872–2015 guidelines for biaxial flexural strength testing (final dimensions: 15 mm in diameter and 1.2 ± 0.2 mm in thickness), and then subjected to the respective tests and analyses (X-ray diffractometry and surface micromorphology analyses, biaxial flexural strength testing, biaxial flexural fatigue testing by step-stress approach, and fractography analysis). Data from the static biaxial flexural strength test were submitted to Weibull statistical analysis to describe the mechanical reliability of the ceramic (Weibull modulus) and its characteristic strength, while data regarding fatigue strength and number of cycles until fracture were recorded for survival analysis through Kaplan Meier and Mantel-Cox tests.

Results: Katana ML was mainly composed of tetragonal crystals, while STML and UTML presented cubic content. Aging increased the monoclinic content for ML and did not affect STML and UTML. Topographical analysis highlights different grain sizes on the ceramic surface (UTML > STML > ML) and aging had no effect on this outcome. Weibull analysis (Table 1) showed the highest characteristic strength for ML both before and after aging and statistically similar Weibull moduli for all groups. ML material also obtained the highest survival rates (ML > STML > UTML) for both fatigue strength and number of cycles to failure. All fractures originated from surface defects on the tensile side.

Conclusions: Third-generation zirconia (Katana STML and UTML) are fully stabilized materials (with tetragonal and cubic crystals) being totally inert to autoclave aging and presenting lower mechanical properties than the second-generation zirconia (Katana ML).

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Table 1 – Results from Weibull statistical analysis of the monotonic static biaxial flexural strength data (characteristic strength, Weibull modulus and respective 95% confidence intervals), fatigue findings via step-stress test (mean and standard deviation for strength and for number of cycles to failure), and the percentage of decrease in strength relating the values from monotonic to fatigue biaxial flexural tests.

Groups	Weibull analysis from monotonic biaxial tests ($n = 15$)		Fatigue tests (Step-stress, $n = 10$)		Strength decrease from monotonic to fatigue
	Mean Characteristic Strength (MPa)	Weibull Moduli	Mean Strength (MPa) to Failure (SD)	Mean Number of Cycles to Failure (SD)	
ML	889.9 (851.6–929.8)^{c}	13.5 (8.6–20.7)^{a}	605 (59.9)^{c}	188,032 (22,610)^{c}	32%
ML Ltd	1,045.6 (980.1–1,115.4)^{d}	9.2 (5.8–14.1)^{a}	850 (57.7)^{d}	288,317 (21,134)^{d}	19%
STML	507.6 (487.6–528.5)^{b}	14.7 (9.4–22.6)^{a}	370 (42.2)^{b}	95,799 (16,286)^{b}	27%
STML Ltd	518.2 (493.1–544.5)^{b}	11.9 (7.6–18.4)^{a}	355 (28.4)^{b}	93,063 (10,241)^{b}	32%
UTML	470.2 (431.4–512.5)^{ab}	6.9 (4.4–10.6)^{a}	300 (40.8)^{a}	70,098 (15,388)^{a}	36%
UTML Ltd	430.3 (410.9–450.7)^{a}	12.8 (8.1–19.7)^{a}	265 (33.8)^{a}	59,151 (15,895)^{a}	39%

*Different letters in each column (outcome) indicate statistical differences among conditions; analyses based on overlapping of confidence intervals for Weibull, and Kaplan Maier and Log Rank tests for the survival analysis under fatigue.

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Antimicrobial potential of resin matrices with coffee compounds

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Purpose/aim: The aim was to synthesize experimental resin matrices loaded with 3 potentially bioactive compounds of coffee: trigonelline (TR), chlorogenic acid (CA) and nicotinic acid (NA) and analyze the antimicrobial potential of each.

Materials and methods: The minimum inhibitory concentration (MIC) against Streptococcus mutans was determined using the wild-type strain UA159 with 24 h of incubation at 37 °C under 5% carbon dioxide (CO2). Cytotoxicity was also evaluated using odontoblast-like cells (OD-21) under the same incubation conditions as before. The compounds were then incorporated with 3 different concentrations (10, 20 and 50%) into resin matrices composed of Bis-GMA/TEGDMA (70/30% w/w) and camphorquinone/ethyl-4-dimethylaminobenzoate (0.5/1%, w/w). For the evaluation of antimicrobial activity, 3 disks (6 mm × 2 mm) of each compound and a control group without antimicrobial agent were photoactivated for 40s (~550 mW/cm^2) and incubated with *S. mutans* to measure its biofilm formation on the disks (24 h of incubation at 37 °C under 5% CO_2). The antimicrobial activity was analyzed by luciferase assay (GloMax® Discover System) to quantitate viable cells adhered to the disk surfaces. One way ANOVA/Tukey's test was used to compare the groups ($\alpha = 0.05$).

Results: The MIC for the compounds were: TR = 6 mg/ml, CA = 6 mg/ml, NA = 4 mg/ml. The Luciferase assays showed a significant difference for the compounds at 50% concentration when compared to the control group.

Conclusions: All three compounds tested showed antimicrobial activity at 50% concentration, which make them useful for consideration as antimicrobial additives for dental resins.

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Effect of removal of temporary cement on zirconia-dentin bond strength

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Purpose/aim: This study evaluated the effect of several removal techniques of temporary cement residue in human coronary dentin and the influence of these techniques on the adhesively cemented zirconia bond strength.

Materials and methods: 40 non-carious human molars were included in acrylic resin and the dentin was exposed. A chamfer finish line was performed and temporary acrylic crowns were provisionally cemented with zinc oxide cement without eugenol (RelyX Temp NE, 3 M ESPE) and then stored in distilled water (37 °C/15 days). After crown removal, the excess of temporary cement was removed from dentin according to the "cleaning technique" factor (5gr/n = 8): Air/water rinse (AW), pumice paste (PP), air-abrasion with Al_2O_3 particles (50 μm)(AA), air-abrasion with sodium bicarbonate spray (SB) or air-abrasion with Clinpro Prophy Powder/3 M ESPE (CP). Forty (40) zirconia cylinders (3.4 mm × 4 mm) were made (ISO TS 11045) and each cylinder was adhesively cemented onto each tooth with Scotch Bond Universal (3 M ESPE) and RelyX Ultimate cement (3 M ESPE) and photoactivated for 20 s on each face (1200 mW/cm^2 Radii Cal/SDI). All samples were stored in distilled water (37 °C) for 90 d. A shear test (1 mm/min), wettability, Scanning electron microscopy (SEM) and Energy dispersive spectroscopy (EDS) were performed.

Results: Data (MPa) were analyzed by one-way ANOVA and Tukey's test (? = 5%). ANOVA ($p = 0.0289$) revealed that the "cleaning technique" influenced bond strength. The group AA (20.83 ± 7.8)A presented higher bond strength than air-abrasion with SB (12.93 ± 3.1)B, but similar to CP (14.30 ± 5.7)AB, PP(13.58 ± 4.0)AB and AW (13.32 ± 4.7)AB. CP group (92.8 ± 4.1) showed better wettability than PP group

Table 1 – Failure types (%) after bond strength test and mean (±) standard deviation (SD) of the contact angles (°) in the experimental groups.

Groups	Failure types							Total	Contact angles Mean (±) SD
	A1	A2	C1	C2	C3	A1C1	A2C1		
PP	–	–	–	–	–	3 (40%)	5 (60%)	8 (100%)	100.1 ± 6.9
AW	–	–	–	–	–	3 (40%)	5 (60%)	8 (100%)	96.1 ± 9.9
AA	–	–	–	–	–	3 (40%)	5 (60%)	8 (100%)	97.2 ± 8.2
CP	–	–	–	–	–	3 (40%)	5 (60%)	8 (100%)	92.8 ± 4.1
SB	–	–	–	–	–	8 (100%)	–	8 (100%)	97.5 ± 10.9

A1 = cement-ceramic adhesive; A2 = cement-dentin adhesive; C1 = cement cohesive, C2 = dentin cohesive; C3 = ceramic cohesive; A1C1 = mixed (predominantly cement-ceramic adhesive + cement cohesive); A2C1 = mixed (predominantly cement-dentin adhesive + cement cohesive).

(100.1 ± 6.9). The types of failures were predominantly mixed for all groups (Table 1).

Conclusions: All cleaning techniques were effective in removing temporary resin cement. The air-abrasion with Al_2O_3 50 μm promoted higher mean bond strength values compared to air-abrasion with sodium bicarbonate.

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Niobium silicate as filler particle on experimental photopolymerizable resin cement

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Purpose/aim: The aim of this study was to formulate a photopolymerizable resin cement containing niobium silicate as the filler particle and evaluate its properties.

Materials and methods: The resin cement was formulated from the methacrylate monomers BisGMA, UDMA and TEGDMA in the proportion of 50%, 30% and 20% by weight, respectively. Bis-akyl phosphinic oxide (BAPO) was used as the photoinitiator. As a filler particle, Niobium Silicate (SiNb) was synthesized and added at concentrations of 50% and 65% by weight. The SiNb particles were synthesized by the sol-gel method and characterized by X-ray diffraction, FTIR, laser diffraction and BET. The photopolymerizable resin cement was tested for the degree of conversion, softening in solvent, radiopacity and refractive index at wavelengths of 380–450 nm.

Results: In the XRD analysis, the particles presented amorphous content. In the FTIR, the Si-O-Nb binding in the 1087 cm^{-1} absorbance region was observed. The SiNb particle size was 2.054 μm; the surface area was 616.962 m^2/g. The resin cement containing 50% SiNb showed a conversion degree of 65.076% (± 1.59), with no statistical difference in comparison to the SiNb 65% group, which showed a conversion degree of 66.58% (± 7.91). There was no statistical difference between the two groups regarding radiopacity–1.226 (±0.11) for SiNb50% and 1.132 (± 0.15) for SiNb65%. As for solvent softening, there was no significant difference in the degradation percentage in both groups −7.328% (± 3.6) SiNb 50% and 11.9% (± 5.06) for SiNb 65%. The refractive index ranged from 1.52 to1.48 for the group containing 50% SiNb and 1.54–1.51 for the group containing 65%.

Conclusions: The use of SiNb as a filler particle of photopolymerizable resin cements did not compromise the properties of the material at both concentrations.

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Long-term effectiveness of CAD/CAM materials provided by self-etching silane primer

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Purpose/aim: To evaluate the surface roughness and long-term bond strength produced by hydrofluoric acid or self-etching silane primer on CAD-CAM materials.

Materials and methods: Plates obtained from three materials (lithium disilicate glass-ceramic-LDC (IPS e.max CAD), leucite-based glass-ceramic-LEU (IPS empress CAD), and polymer infiltrated ceramic-PIC (VITA Enamic CAD) were treated according to ($n = 10$): 1. No treatment (C); 2. Hydrofluoric acid (5%) applied during the recommended time for each material (HF); 3.Self-etching ceramic primer (MBEP). Surface roughness (Sa) was analyzed using a laser profiler. Ceramic beams were treated ($n = 20$): 1.No treatment (C); 2.Hydrofluoric acid plus silane (HF + S); 3.Self-etching ceramic primer (MBEP); bonded to pre-polymerized resin composite sticks using resin cement (Variolink II), stored for 24 h and 1 year ($n = 10$), and submitted to tensile bond strength test (TBS). Data were analyzed using ANOVA and Tukey test ($\alpha = 0.05$). Failure pattern, surface and interface morphology were assessed using scanning electron microscopy.

Results: Only individual factors resulted statistically significant for both variables. HF (0.50 ± 0.12 μm) showed statistically higher roughness values than control groups (0.44 ± 0.10 μm), while MBEP (0.48 ± 0.11 μm) was comparable to both. HF produced greater surface alterations than MBEP and C. PIC (0.60 ± 0.05 μm) exhibited significantly higher roughness values than LDC (0.37 ± 0.07 μm) and LEU (0.45 ± 0.04). Regarding TBS, PICs' general mean (24.6 ± 10.1 MPa) resulted higher than LEUs'(14.7 ± 6.7 MPa) and LDCs'(13.1 ± 4.8 MPa), while treatments HF + S(17.9 ± 10.0 MPa) and MBEP(20.5 ± 9.7 MPa), produced higher TBS values than control groups (14.2 ± 5.5 MPa). Adhesive failure was associated with low TBS values and aged specimens, while cohesive/resin-cement and mixed, to higher TBS values. Interface debonding was detected on C groups for LDC and LEU. PIC exhibited better interface stability.

Conclusions: MBEP produced smoother surfaces than HF. HF + S and MBEP significantly improve ceramic/cement-bonding performance.

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Can protease inhibitors stabilize the adhesive interface after cariogenic challenge?

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Purpose/aim: Evaluate the effect of proteases inhibitors on *S. mutans* biofilm activity and resin-dentin bond performance after cariogenic challenge.

Materials and methods: Dentin discs and resin-dentin beams are obtained from molars were etched with phosphoric acid only (control group–CTG) and also pretreated with chlorhexidine diacetate (CHXDG), 1,10-phenanthroline (PHENG), Trans-Epoxysuccinyl-L-Leucylamido (4-guanidino) butane (E-64G) and Epigallocatechin-3-gallate (EGCGG). The dentin wettability by goniometry. The bonding performance was evaluated by microtensile bond strength (μTBS) and nanoleakage expression (SNU%) and (SMP%) before and after exposition to *S. mutans* biofilm. The MTT cell viability and lactic acid production by S mutans biofilm were used to evaluate the antibacterial activity of the proteases inhibitors. The data were treated by ANOVA and Tukey HSD test.

Results: The four proteases inhibitors increased the dentin wettability (CTG < CXDG < PHENG < E-64G < EGCGG), ($p < 0.05$). The *S. mutans* biofilm decreased the μTBS of CTG ($p < 0.05$), whereas for the groups treated with the four proteases inhibitors maintained the (SNU%) and (SMP%) after cariogenic challenge ($p > 0.05$). The four protease inhibitors decreased the MTT viability and the lactic acid production by *S. mutans* biofilm ($p < 0.05$). The four proteases inhibitors increased the dentin wettability and preserve the resin-dentin bond and the nanoleakage expression after cariogenic challenge.

Conclusions: The *S. mutans* metabolic activity and the lactic acid production were reduced after dentin treatment with proteases inhibitors.

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Clinical evaluation of restorations in cervical lesions with copper-containing adhesive

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Purpose/aim: Copper particles have been incorporated in resinous materials with the aim of conferring antimicrobial effect and increasing the longevity of the adhesive interface. This triple-blind randomized clinical trial evaluated the effect of a universal adhesive system containing copper nanoparticles at 0.1% using etch-and-rinse (ER) and self-etch (SE) strategies for restorations of non-carious cervical lesions (LCNC).

Materials and methods: Thirty-six patients participated in this study. Two hundred and sixteen restorations were divided into 4 groups ($n = 54$): 1) Etch-and-rinse strategy with 0.1% copper (ER-CP); 2: Etch-and-rinse strategy without copper (ER-CT); 3: Self-etching strategy with 0.1% copper (SE-CP); 4: Self-etching strategy without copper (SE-CT). The nanohybrid composite resin was inserted in 3 increments. The evaluations were carried out according to the FDI and USPHS criteria at baseline (immediately, soon after restorative procedure), 6 and 12 months. The data were submitted to statistical analysis. The differences in the criteria evaluated between the 4 groups after each time (baseline vs. 6 months, baseline o vs. 12 months and 6 months vs 12 months) were submitted to the Friedman test ($\alpha = 0.05$) and the performance of the different groups at each time was evaluated by the Wilcoxon test ($\alpha = 0.05$).

Results: After 12 months, retention of the universal adhesive with addition of copper nanoparticles was similar when compared with the copper-free adhesive both in the etch-and-rinse and self-etching modes. According to the FDI criterion, all groups presented small discrepancies in the marginal adaptation, and the etch-and-rinse group had better results than the self-indulgent group.

Conclusions: The universal adhesive with addition of copper nanoparticles did not decrease the clinical performance of the universal adhesive without copper. However, long-term evaluations are required to confirm these results.

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Pre-treatment using natural collagen cross-linkers on dentin bonding and biomodification

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Purpose/aim: The aim of this study was to evaluate the dentin biomodification, bonding and collagen interaction of plant-derived collagen crosslinking agents applied as pretreatment prior to adhesive for composite resin restorations.

Materials and methods: The cross-linkers solutions (all with 2 wt% concentration) were prepared using: proanthocyanidins (PAC) from grape seed extract, cardanol (CARD) extracted from cashew nut shell liquid and negative control without crosslinking agent (Control). Sound third molars were cut and prepared for different experiments. Quantitative tests were microtensile bond strength ($n = 5$) at 24 h and after 1000 thermal cycles aging, three-point flexural test of

demineralized dentin bars to obtain the elastic modulus (E) variation before and after 1-min biomodification treatment ($n = 12$) with the solutions, mass change ($n = 12$) after 1-min biomodification, after 48 h and after 4 w water storage. Qualitative tests were Micro-Raman spectroscopy, nanoleakage and dentin micropermeability. The results were analyzed with ANOVA or repeated measures ANOVA and Tukey's post-test ($p < 0.05$).

Results: Control reduced the bond strength from 51.23 ± 4.92 MPa to 36.78 ± 7.20 MPa after aging ($p < 0.001$), whilst CARD and PAC maintained the bond strength stable. CARD improved in 72.32% the elastic modulus ($p = 0.013$) and increased the mean dentin bar mass in 24.2% after 48 h, and PAC attained 31.86% higher mass after 4 w from biomodification. The formation of peaks at 1117 cm^{-1} and 1235 cm^{-1} in Raman analysis demonstrated the crosslinking both for CARD and PAC, but not for Control specimens. Both plant-derived biomodification agents achieved protection of the hybrid layer in nanoleakage and micropermeability experiments.

Conclusions: The use of natural (plant-derived) dentin collagen crosslinking agents as pretreatment may improve bonding, mechanical and degradation resistance of demineralized dentin.

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Retention rates of cervical restorations: A systematic review and meta-analysis

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Purpose/aim: This systematic review compared the retention rates of non-carious cervical restorations restored by the sandwich technique (a glass ionomer cement lining [GIC] or resin-modified glass ionomer cement [RMGIC] + composite resin [CR]) or CR restorations. Secondary outcomes such as marginal discoloration, marginal adaptation, color match, surface texture and secondary caries were also analyzed.

Materials and methods: This research followed the PRISMA recommendations, including randomized clinical trials that compared the retention rates of NCCLs by sandwich technique with composite resin restorations. The search for primary studies was performed in the following electronic databases: BBO, Lilacs, Cochrane, PubMed, Scopus and Web of Science. Additional search of grey literature was performed. The abstracts from the IADR (1990–2017), ongoing and unpublished trials were also searched. The quality of the studies was evaluated using the Cochrane Collaboration bias risk tool.

Results: Initially, a total of 3.645 articles were selected. After selection by titles, abstracts and full texts, 6 articles were included in this systematic review. Out of these six articles, three were follow-ups of the same clinical trial and therefore a total of four studies remained for qualitative evaluation and meta-analysis.

Conclusions: All articles were considered at "unclear" risk of bias. Higher retention rates in NCCLs restorations with the sandwich technique compared to CR restorations can be observed after three years of evaluation. Marginal discoloration, color match, marginal adaptation and secondary caries were not influenced by the restorative technique employed.

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Dentin bimodification with EGCG: Two-year clinical evaluation

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Purpose/aim: To evaluate the 2-year effect of dentin biomodification with Epigallocatechin-3-gallate (EGCG) on clinical performance on restorations of non-carious cervical lesion (NCCLs) with Single Bond Universal applied in two different modes (i.e. self-etch and etch-and-rinse).

Materials and methods: In this randomized clinical trial, 33 volunteers were selected and 156 NCCLs were assigned to four groups: ER: etch-and-rinse; ER-EGCG: 0.1% EGCG dentin pretreatment + etch-and-rinse; SE: self-etch; and SE-EGCG: 0.1% EGCG dentin pretreatment + self-etch. The total NCCLs were restored with the nanofilled composite resin Filtek Z350XT and evaluated at baseline, 6, 12, 18 and 24 months using FDI criteria for retention, marginal staining, marginal adaptation, caries and postoperative sensitivity. Two evaluators were blinded to the treatments performed and impressions were taken for the construction of replicas to allow indirect observations. Statistical analysis was performed with Kruskal-Wallis and McNemar tests with a significance level of 5%.

Results: Six restorations (1 from ER; 2 from SE, 1 from ER-EGCG and 2 from SE-EGCG) were lost at 24-months with no significant differences ($p > 0.05$). The retention rates were 97.0% (ER and ER-EGCG), 94.11% (SE) and 94.21% (SE-EGCG). For marginal adaptation, a significant difference was detected on baseline and 24-month comparison for SE group ($p = 0.0313$). There were no statistically differences among all other evaluated criteria at 24 months, neither for each group for baseline and 24-month comparisons ($p > 0.05$).

Conclusions: The clinical retention of the universal adhesive at 24 months does not depend on the bonding strategy and dentin biomodification with epigallocatechin-3-gallate.

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Synthesis of sol–gel derived calcium silicate with calcium tungstate addition

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Purpose/aim: The aim of this study was the development of a bioactive sealer with calcium silicate and calcium tungstate ($CaWO_4$).

Materials and methods: The calcium silicate was synthesized through sol-gel method. The resulting particles were characterized by x-ray diffraction, Raman spectroscopy, Fourier transformed infrared spectroscopy, laser diffraction, Brunauer–Emmett–Teller theory (BET) and scanning electron microscopy (MEV). The sealers were produced with the addition of $CaWO_4$ as radiopacifier in the following concentrations: 10%, 20% and 30%. On group without $CaWO_4$ addition were produced as control group. Sealers were tested for radiopacity, setting time and pH. Cytotoxicity against pulp fibroblasts was tested for sealers before and after setting

Results: Particle characterization showed calcium silicate particles with tricalcium and dicalcium silicate crystalline phases (Ca_3SiO_5 and Ca_2SiO_4). Raman bands related to Ca3SiO5 (860 cm^{-1} and 843 cm^{-1}) and Ca_2SiO_4 (981 cm^{-1}, 553 cm^{-1}, 367 cm^{-1}, 233 cm^{-1}, 201 cm^{-1}). FTIR showed Si–O–Ca bonds in 996 cm^{-1} and 898 cm^{-1}. The mean particle size was 13.49 μm and surface area was 9.563 m^2/g. The addition of $CaWO_4$ increased radiopacity of the tested sealer ($p < 0.05$). No statistical difference was found for setting time ($p = 0.127$). Cell viability decreased with the addition of 30% of $CaWO_4$ when fresh sealers were tested ($p < 0.05$).

Conclusions: Calcium silicate was successfully synthesized and the addition of up to 20% of calcium tungstate resulted in sealers with adequate properties for applications in dentistry.

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Remineralization of early caries lesion by application of different materials

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Purpose/aim: The purpose of this study was to evaluate the remineralization effect of different materials against early enamel caries lesion.

Materials and methods: This in vitro study was approved by the Ethics Committee (Process n° 31/2017, University of São Paulo State–UNESP, Araraquara School of Dentistry, Brazil). Seventy-two ($n = 72$) bovine incisors were used. Dental blocks (4 mm × 4 mm × 3 mm) were obtained and included in a polyether resin (Redelease®, SP, Brazil), planned and polished with 600, 1200 and 1500 grit paper and diamond paste, and cleaned using a ultrasound. Specimens with a KHN upper than 270 were included. Early caries induction was performed using a medium viscosity methylcellulose gel (Methocel® MC, Sigma Aldrich®) and lactic acid solution (pH = 4.6) during 10 days at 37 °C. The remineralizing agents were applied and the specimens were stored in artificial saliva for 24 h. After that, the specimens had their surface divided into two parts, sound and demineralized/treated and untreated enamel and then divided into six Groups (G1 - artificial saliva–negative control, G2–1.23% acidulated phosphate fluoride gel–Nova DFL, G3–Duraphat®–5% NaF–positive control, 2.26% F (Colgate-Palmolive), G4–Bioglass® 45S5, G5–Biosilicate® and G6–F18, Laboratory of Vitreous Materials–LaMAV, Federal University of São Carlos–UFSCAr, SP, Brazil). The cross-sectional Knoop hardness (CSH) was performed at seven enamel depths (10, 30, 50, 70, 90, 110 and 220 μm) until the outer enamel surface using 25 g load for 10 s. Three indentations were done on each depth. Repeated measures analysis of variance (ANOVA) with Greenhouse-Geisser (GG) correction and with Bonferroni correction under a significance level of 5% was applied. Also, the enamel surface ($n = 24$) was analysed by SEM under 1000 and 5000× magnifications.

Results: The Knoop hardness values showed that only G2 (32.97 ± 28.83–10 μm and 105.95 ± 23.38–200 μm) had no remineralizing effect ($p > 0.05$), whereas only G5 and G6 were able to remineralize the early lesions on the enamel surface (51.50 ± 19.32–10 μm and 124.73 ± 35.58–200 μm and 56.15 ± 14.71–10 μm and 109.42 ± 28.12–200 μm), respectively in comparison to the negative control Group (27.98 ± 12.66 - 10 μm and 87.02 ± 44.70–200 μm). The SEM images showed that G5 and G6 presented a surface morphology close to the sound surface.

Conclusions: Biosilicate® and F18 were effective on the remineralization process of the enamel surface and can be a new possibility to remineralize the early enamel caries lesion.

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The effect of ionizing radiation on monolithic zirconia

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Purpose/aim: The aim of this study was to evaluate the effect of ionizing radiation on flexural strength and optical properties of monolithic yttria-tetragonal zirconia polycrystalline (Y-TZP)

Materials and methods: High and low translucency Y-TZP were used to prepare fully-sintered bar-shaped specimens (14 mm × 4.0 mm × 1.5 mm) of each material. Samples were randomly divided into four groups ($n = 15$): high-translucency/control (HT/C), high-translucency/irradiated (HT/I), low-translucency/control (LT/C), low-translucency/irradiated (LT/I). Irradiated specimens received a single dose irradiation (70 Gray–Varian linear

accelerator/Princess Margaret Hospital). Ten specimens from each group were tested for flexural strength (FS) using a 3-point-bending test. Optical properties ($n = 5$) were analyzed using a dental spectrometer. Translucency parameter (TP), and FS data were analyzed by two-way Analysis of Variance (ANOVA) and Tukey Honest Significant Difference (HSD) at 5% significance level.

Results: Material and irradiation had a significant effect on both properties. LT zirconia (650.42 MPa ± 129.1) presented flexural strength significantly higher than HT zirconia (323.10 MPa ± 71.8) ($p < 0.001$). Also, there was a significant difference between control (526.11 MPa ± 207.4) and irradiated (447.42 MPa ± 178.6) ($p < 0.014$) samples. HT zirconia (20.39 ± 2.9) presented TP value significantly higher than LT zirconia (12.97 ± 1.2) ($p < 0.001$). Irradiated zirconia (18.59 ± 2.7) showed TP significantly lower TP than control samples (22.19 ± 2.2) ($p < 0.043$).

Conclusions: Ionizing irradiation therapy (IIT) used for head and neck cancer treatment affects both, mechanical and optical properties of dental zirconia. Other properties need to be investigated and considered when recommending zirconia for the treatment of patients to be submitted to IIT.

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Effect of bromelain gel on demineralized dentin bond strength

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Purpose/aim: This study aimed to evaluate the cytotoxicity and antimicrobial effect of a bromelain gel (GB) and its influence on microtensile bond strength (μTBS) of a self-etching adhesive system to demineralized dentin used as a chemomechanical caries removal agent (CMCR).

Materials and methods: The cytotoxicity of GB at concentrations of 0.05, 0.10, 0.25%, and of a papain gel agent (Papacárie Duo-PD) at concentrations of 0.05, 0.10, 0.25% were quantified by enzyme–linked immunoserbent assay. For the antimicrobial activity evaluation, four cylindrical cavities were prepared on dentin surface of 16 teeth and incubated with *S. mutans* (Sm) ($n = 8$) and L. casei (Lc) ($n = 8$). One cavity from each tooth served as contamination (control without any treatment), and the others were treated with PD, 0.05% GB and 1% GB. The cavities were sealed and after 72 h, dentin were collected and microbial count was undertaken (CFU/mg). For the μ-TBS test, 24 demineralized human dentin blocks were randomly distributed into four groups, according to the CMCR: 0.05% GB, 1%, PD, and control (only manual excavation). A self-etching adhesive (Clearfil SE Bond/Kuraray Medical Inc.) was applied. The blocks were restored with a resin composite and sectioned into resin-dentin slabs of 1.0 mm^2 thick. After 24 h, μTBS tests were performed in a universal testing machine at speed of 0.5 mm/min. The fractured specimens were observed under a stereomicroscope to assess the failure mode. The dentin–resin interface was evaluated by SEM analysis.

Results: ANOVA and Tukey test showed that all agents presented cytotoxicity, except 0.05% GB and 0.05% PD ($p < 0.001$). For the microbial count test, both agents reduced bacteria inside cavities compared with control, Kruskal–Wallis and Student–Newman–Keuls tests showed significance differences between Sm and Lc ($p = 0.008$); however there was no significance difference between the group treated with GB and PD. The application of all agents and the manual excavation yielded μ-TBS values that were statistically similar among them ($p = 0.696$). For the failure mode, the most frequently fracture observed was the adhesive type. G-test showed no difference among the groups in the failure mode ($p = 0.439$). SEM analysis showed that GB provided the thickest hybrid layer.

Conclusions: 0.05% GB and 0.05% PD agents were not cytotoxic to pulp cells. The application of PD and GB showed antimicrobial potential. Caries removal with a chemomechanical papain and bromelain-gels did not influence adhesion of a self-etchisng adhesive system to demineralized dentin.

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Optical coherence tomography in evaluation of Veneer's cementation layer

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Purpose/aim: In aesthetic ceramic restorations, the better the quality of the cementing layer, the longer the longevity of the treatment. Imaging by Optical Coherence Tomography (OCT) was employed as the only noninvasive method in the evaluation of failures in veneer's cementation stratum.

Materials and methods: This work was approved by the Ethics Committee in Animal Experiments (UFPE 23076.018892/2015-10). Fifteen bovine incisors undergone disinfection with Chloramine-T solution at 0.5%, followed by prophylaxis and then stored in distilled water. To obtain a regular surface, the specimens were lightly polished. All teeth were square shaped in 5 × 5 mm of fragments in its flatter region and included in acrylic resin matrix. Veneers were produced with Lithium Dissilicate ceramic (E.Max Ivoclar, Liechtenstein) with high translucency in color A1, and in the same shape as the teeth and a thickness of 0.5 mm.

Specimens were randomly divided in three groups ($n = 5$), according to the resin cement agent: AC–All Cem Veneer (FGM, Brazil); RX–RelyX Veneer (3 M ESPE, USA); NX3–Nexus Third Generation (Kerr, USA). The color of each cement was the most translucent of each. Veneers' cementation was carried out according to the respective manufacturer instruction. For AC and RX groups, the teeth surfaces were conditioned with phosphoric acid at 37% and followed by the adhesive system application (AC–Ambar/FGM; RX–Adper Single Bond/3 M ESPE). NX3–Optibond All in One/Kerr was used for group

Table 1 – The results of the Weibull analysis.

Silane	Etched β	Non-etched β	Etched η (95% CI)/MPa	Non-etched η (95% CI)/MPa
CSA	6.45	6.55	46.93 (41.55–51.46) a $r^2 = 0.92$	6.08 (5.47–6.68) a $r^2 = 0.99$
GMP	2.86	4.70	40.75 (31.53–50.89) a,b $r^2 = 0.96$	2.73 (2.33–3.11) b $r^2 = 0.89$
KSP	5.20	5.44	29,70 (25,75–33,36) b $r^2 = 0.92$	4.68 (4.11–5.24) c $r^2 = 0,95$
MBP	3.04	2.46	20,78 (16,41–25,46) c $r^2 = 0.98$	4.59 (3.39–4.64) c $r^2 = 0,75$
SBU	4.79	3.50	28.38 (24.48–32.25) b $r^2 = 0.89$	4.99 (4.11–5.92) a,c $r^2 = 0,82$

NX3. The photoactivation device was Radii Plus (SDI, Brazil), emitting 1200 mW/cm^2. The OCT system used was Spectral Domain (SD-OCT), Ganymede (Thorlabs Inc.), 930 nm and axial resolution of 3.0um. The images were acquired with 8 mm in transverse scanning, with of 1024 columns and 512 lines. The optical images evaluation was done qualitatively and processed with an algorithm using Matlab language.

Results: Images of the cement-veneer interface were clearly seen, and its thickness readily quantified. Failures as bubbles and gaps could be seen, independent of cements manufacturers, and their dimensions and location identified, through 3D imaging. There was no statistical difference in the observed failures as a function of cement brand.

Conclusions: Cementation interface is always susceptible to bubbles that can cause staining of the restoration, tooth sensitivity, infiltration and, consequently, caries. OCT is the only technique that could evaluate the cementation layer without destruction of the sample, in a non-invasive way in vitro or in vivo and without the use of ionizing radiation.

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Bonding of silanes to a glass-ceramic with and without etching

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Purpose/aim: The aim of the study was to assess the bond strength of a glass ceramics with five silane coupling agents with and without etching.

Materials and methods: For the evaluation of shear bond strength (SBS), glass ceramic surfaces (IPS e.max Press–Ivoclar Vivadent) were prepared and polished with SiC papers up to 2500 grit size ($n = 100$, 20/silane). Half of the specimens were etched with HF acid (IPS Ceramic Etching Gel-Ivoclar Vivadent) for 20s and the remaining were kept intact. The ceramic surfaces were then treated according to the manufacturers' instructions with the following silanes: Calibra Silane Coupling Agent (CSA, Dentsply), G Multi Primer (GMB, GC), Monobond Plus (MBP, Ivoclar Vivadent), Kerr Silane Primer (KSP, Kerr) and Scotchbond Universal Adhesives (SBU, 3 M ESPE). Resin composite (G Aenial Flow, GC; Ø = 3.5 mm, $h = 2$ mm) were bonded onto. After 1 week of storage (water/37 °C), the specimens were debonded under shear loading (notch-end method) at a crosshead speed of 1 mm/min. The debonded ceramic surfaces were examined under a stereomicroscope to characterize the failure mode. Statistical evaluation was performed by Weibull analysis. The β parameter (slope of the curve, treatment reliability), η parameters (strength of 63.2% of the samples), confidence intervals (CI) and the correlation coefficients (r^2) were determined.

Results: The results of the Weibull analysis (Table 1) revealed that CSA was the most reliable treatment on etched and non-etched specimens. CSA and GMP provided the highest η values on etched and CSA plus SBU on non-etched. In most etched specimens failure was mixed (adhesive and resin cohesive), whereas in most non-etched it was mainly adhesive.

Conclusions: Acid etching provided higher SBS values. The prehydrolyzed silane primer CSA was the most reliable treatment for etched and non-etched specimens. Silane primers with conventional (KSP) and adhesive (GMP, MBP) monomers and the universal adhesive (SBU) were less reliable, with lower strength on etched (KS, MBP, SBU) and non-etched (GMP, KSP, MBP) substrates.

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TiO_2 nanotubes incorporation in Y-TZP surface: Synthesis, characterization and biocompatibility

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Purpose/aim: To evaluate the addition of TiO_2 nanotubes into zirconia surfaces and the biocompatibility to modified ceramics.

Materials and methods: TiO_2 nanotubes were produced by alkaline synthesis, mixed with Isopropyl alcohol (50 wt%) and applied on pre-sintered zirconia disks (IPS e.max ZirCAD). The ceramics were sintered and surfaces were characterized by confocal laser microscopy, scanning electron microscopy (SEM) and EDS analysis. Then, the biocompatibility was evaluated through the cell viability tests of MTT and Violet Crystal. For this purpose, the specimens were divided into 2 groups: 1) with application of TiO_2 nanotubes and 2) without application of TiO_2 nanotubes ($n = 8$). The in vitro evaluation was performed by means of tests in which NIH 3T3 fibroblast cells were placed in indirect contact with the materials. For cell viability MTT assay and Crystal Violet tests were made in duplicate and after 24, 48 and 72 h the absorbance levels were analyzed by spectrophotometry Elisa reader. The absorbance levels were analyzed by the Elisa spectrophotome-

ter reader. The data obtained were submitted to the Student t-test ($\alpha = 0.05$).

Results: The nanotubes were incorporated in the zirconia surface and the EDS analysis has confirmed that nanoagglomerates were composed of TiO_2. The confocal laser microscopy analysis showed an increase in the surface roughness with the application of nanotubes. For the biocompatibility, the results showed that in 24 and 48 h both materials were biocompatible. In the period of 72 h the highest increase of absorbance happened for the Y-TZP group without TiO_2 nanotubes.

Conclusions: It was possible to incorporate nanotubes to the zirconia surfaces. In addition, the incorporation of nanotubes into Y-TZP surface has not interfered in cell viability in both tests.

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Color stability and roughness of cover materials over composite resin

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Purpose/aim: To evaluate different cover materials (adhesives and surface sealants) regarding color stability and roughness when applied over the surface of a composite resin.

Materials and methods: Forty specimens were made with the Z350 XT composite resin, shade A2E (3 M Oral Care), with aid of a Teflon mold (5 mm × 5 mm × 3 mm). The composite resin was inserted using an incremental technique, with two increments per specimen. Then, they were polished using a polishing machine and randomly distributed into the groups, according to the cover material: G1 (C)–only polishing (control); G2 (SB)–Single Bond II (3 M Oral Care)–adhesive; G3 (SB)–Single Bond Universal (3 M Oral Care)–adhesive; G4 (CF)–Clearfill SE Bond (Kuraray)–adhesive; G5 (AP)–Ambar APS (FGM)–adhesive; G6 (BF)–Bioforty (Biodinâmica)–surface sealant; G7 (FF)–Fortify (Bisco)–surface sealant; G8 (PS)–PermaSeal (Ultradent)–surface sealant. A thin layer of the cover material was applied using a brush and the specimens were stored for 24 h. The specimens were analyzed regarding roughness, with an optical profilometer ($n = 5$), and color, with a spectrophotometer ($n = 5$). After initial measurements, specimens were immersed in wine and the roughness and color measurements were repeated after 24, 72 and 168 h of immersion. Results were analyzed with two-way repeated measures analysis of variance (ANOVA) and Tukey post-hoc tests (α: 0.05).

Results: Regarding roughness, AP presented a similar behavior to the surface sealants. Initially, the roughness of the sealants was lower than the adhesives and of the control ($p < 0.05$). However, after 24 h, the sealants had a higher roughness variation, reaching roughness values similar to the adhesives results. After 72 and 168 h, the roughness values of the sealants and adhesives were similar ($p \geq 0.05$). Regarding color changes, SB presented behavior similar to the sealants. The sealants presented lower color changes than the adhesives considering all the measured times ($p < 0.05$).

Conclusions: Within the limitations of the present study, considering roughness and color stability, sealants, and not adhesives, should be used as cover materials to composite resins.

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Influence of protease inhibitors on sound, sclerotic and caries-affected dentin

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Purpose/aim: The aim of this study was to evaluate influence of protease inhibitors on degradation of sound, sclerotic and caries-affected dentin.

Materials and methods: Thirty-nine molars were used, thirteen for each dentin condition. Three slices were obtained from each tooth, each one immersed in the following different solutions for 1 h: 1) artificial saliva; 2) 2% chlorhexidine; 3) 0.5% EGCG. After immersion, samples were subjected to enzymatic degradation challenge (collagenase from Clostridium histolyticum). Nanohardness (HIT) and elastic modulus (Er) were measured before and after enzymatic challenge, as well as the ultimate tensile strength (UTS). Data of UTS, HIT and Er tests were submitted to repeated measurements ANOVA and Tukey post-test ($\alpha = 0.05$).

Results: Higher values of UTS were found for sound dentin in control (40.30 ± 21.38 MPa) and 0.5% EGCG (30.05 ± 19.67 MPa) groups. Before degradation, higher values of HIT (0.237 ± 0.062 GPa) and Er (5.58 ± 1.75 GPa) were found for 0.5% EGCG group in caries-affected dentin. After degradation, 2% chlorhexidine group had higher values of HIT and Er for sound (0.134 ± 0.020 GPa and 3.57 ± 0.40 GPa) and sclerotic (0.201 ± 0.048 GPa and 4.30 ± 0.56 GPa) dentin.

Conclusions: The 2% chlorhexidine showed best effect increasing HIT and Er, mainly for sclerotic dentin, before/after enzymatic degradation. The 0.5% EGCG showed better effect on HIT and Er in caries-affected dentin, before enzymatic degradation.

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Diphenyl-iodonium modulating properties of resins with low concentrations of camphorquinone

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Purpose/aim: The aim of the present study was to evaluate the effect of diphenyliodoium hexafluorphosphate (DPI) on properties of light curing resin materials containing reduced concentration of camphorquinone (CQ).

Materials and methods: Light-curing resin composites (50/50% wt BisGMA/TEGDMA + 60% wt inorganic filler) were prepared. The groups were established according to the concentrations of CQ (0.125, 0.25, 0.5, 0.75 and 1 mol%) and DPI (0 or 0.5 mol%). The real-time polymerization was monitored using a Fourier transformed infra-red spectrometer (FTIR). The real-time volumetric shrinkage was analyzed using a linear variable displacement transducer (LVDT). The light transmission was spectroradiometrically characterised using calibrated fiber coupled spectrophotometer device (MARC®; Bluelight Analytics Inc., Halifax, NS) to obtain information on absolute irradiance. The temperature changes during the polymerization process were evaluated using a thermocouple. The obtained results were analyzed by two-way ANOVA and Tukey's test ($\alpha = 0.05$).

Results: For the resins without DPI, properties like degree of conversion, rate of polymerization, maximum rate of shrinkage and temperature changes during polymerization increase according to the increase of CQ concentration. Volumetric shrinkage for groups without DPI was similar, except for the resins containing 0.125 mol% CQ, which had the lowest shrinkage. Reduced CQ concentrations (0.125 and 0.25 mol%) allow higher light transmission at the first seconds, however the final transmission is lower than the other groups. The addition of DPI increase all properties evaluated compared to the CQ only resins. As well as the materials tested without DPI, the properties of resins containing DPI increase with higher amounts of CQ. The light transmission through the resins containing DPI is quickly increased compared to the CQ only resins, however the final transmission is lower than the resins without DPI.

Conclusions: It can be concluded that better properties can be reached with increased amount of CQ on light curing resins. The addition of DPI can promote excellent degree of polymerization at high rate of conversion. However, the results should be analyzed with caution due to the significant increase on volumetric shrinkage and temperature during the polymerization process.

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Repair of resin nanoceramic: Effect of aging and surface treatments

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Purpose/aim: To evaluate the effect of different surface treatments and aging on bond strength between a nanoceramic CAD/CAM resin and a repair.

Materials and methods: Twenty-four rectangular blocks (10 × 5 × 2 mm) of Lava Ultimate/3 M (NCR) and composite resin Z350/3 M (CR) were made, embedded in acrylic resin, polished (# 600, # 800, # 1200) and randomly divided into eight groups ($n = 12$) according to "surface treatment" (CJ: Cojet 30 μm or SB: sandblasting with Al_2O_3) and "aging" (24 h or 6 m). The blocks were sandblasted for 20 s (2.5 bar) at a distance of 10 mm standardized with a metallic device. Afterwards, a layer of adhesive (Single Bond, 3 M ESPE) was applied (20 s) and

Table 1 – Mean shear bond strength in MPa (SD) of experimental groups according to the factors "Material", "Surface treatment" and "Storage". Tukey test ($p < 0.05$).

Material	Surface treatment	Storage	Group	Mean (MPa) ± SD
Lava Ultimate(NCR)	Cojet (CJ)	24 h	$NCR_{24h}CJ$	20.88 ± 5.74^{BC}
	Al_2O_3 (SB)		$NCR_{24h}SB$	28.16 ± 7.44^{AB}
	Cojet (CJ)	6 m	$NCR_{6m}CJ$	29.37 ± 5.41^{A}
	Al_2O_3 (SB)		$NCR_{6m}SD$	23.47 ± 5.33^{ABC}
Composite Resin(CR)	Cojet (CJ)	24 h	$CR_{24h}CJ$	19.71 ± 4.21^{C}
	Al_2O_3 (SB)		$CR_{24h}SD$	17.61 ± 5.52^{C}
	Cojet(CJ)	6 m	$CR_{6m}CJ$	20.92 ± 7.29^{BC}
	Al_2O_3 (SB)		$CR_{6m}SD$	18.18 ± 5.60^{C}

light cured for 20 s (1200 mW/cm^2–Radii Cal, SDI). Composite resin cylinders were made (Ø = 2 mm × h = 2 mm) using a Teflon matrix (Ultradent), and light cured for 40 s. All samples were aged in a thermocycler (10,000 cycles, 5/55 °C/30 s) and submitted to the shear bond test (50 kgf, 0.5 mm/min). The data (MPa) were analyzed by 3 way ANOVA and Tukey's test (5%). Failure analysis was performed by stereomicroscopy (20 ×).

Results: The "material" factor was significant ($p = 0.00$), while the "storage" ($p = 0.251$) and "surface treatment" ($p = 0.475$) factors were not. The group NCR6mCJ: (29.37 ± 5.41) presented the highest values of shear bond strength, significantly higher than the NCR24hCJ group (20.88 ± 5.74) and the other CR experimental groups. The CR24hCJ (19.71 ± 4.21) group presented the lowest shear bond strength value, which was statistically different only from the NCR24hSB (28.16 ± 7.44) and NCR6mCJ: (29.37 ± 5.41) groups (Table 1). Failure analysis revealed a predominance of mixed failures (adhesive + cohesive in the base material).

Conclusions: Sandblasting with aluminum oxide particles and silicatization are effective approaches in the repair of NCR and CR restorations.

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Aesthetic and biological analysis of an experimental tooth-bleaching gel

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Purpose/aim: The aim of this study was to assess the aesthetic effectiveness and cytotoxicity of an innovative tooth-bleaching gel with 10% hydrogen peroxide (H_2O_2), which was chemically activated with horseradish peroxidase (HRP) enzyme.

Materials and methods: A bleaching gel was manipulated with or without the addition of HRP. Initially, different concentrations of HRP (2 mg/mL, 6 mg/mL and 10 mg/mL) were evaluated for bleaching effectiveness using UV-vis system (ΔE) (Dunnett's; $\alpha = 5\%$). The concentration of HRP added to the gel that resulted in the best aesthetic outcome was selected for the biological assays. For this purpose, 3D cultures of human dental pulp cells (HDPCs) were prepared and placed in intimate contact with dentin surface of the discs. These discs/3D culture sets were inserted into artificial pulp chamber models with intra-pulpal pressure simulated. Then, the bleaching gels were applied for 45 min on the enamel surface of the discs giving rise to the following groups: NC–negative control (non-bleached samples); PC–positive control (gel with 35% H_2O_2); HP- gel with 10% H_2O_2; PH + HRP–gel with 10% H2O2 + HRP. The 3D cultures were collected and the HDPCs viability was determined by Alamar blue and live/dead assays (ANOVA/Tukey; $\alpha = 5\%$). The cytoskeletal cell morphology (F-actin) and oxidative stress (carboxy-H2DCFDA) were assessed immediately (T1) or 24 h (T2) after the bleaching procedures.

Results: HP + HRP group presented bleaching effectiveness similar to PC ($p > 0.05$). Increased oxidative stress, cellular toxicity associated with membrane cell damage, and alterations in the cell cytoskeleton were observed in the PC group (T1 and T2). In HP group, a discrete toxicity was determined, which was characterized by the reduction of 12.6% in cell viability (T1). No toxic effect was observed in the NC and HP + HRP groups for both T1 and T2 ($p > 0.05$).

Conclusions: It was concluded that the addition of HRP in a bleaching gel with 10% H_2O_2 increases the aesthetic effectiveness of the product without causing toxic effects to human dental pulp cells.

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Polymerization of dual resin cements light-cured through different ceramic materials

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Purpose/aim: The degree of conversion of dual resin cements photopolymerized through lithium-disilicate or zirconia-reinforced lithium-silicate specimens with different thickness was investigated. The effect of the ceramic color was also correlated to the DC% and the light output intensity.

Materials and methods: Resin cements used were Calibra® Ceram (CC, Dentsply) and Calibra® Universal (CU, Dentsply). Lithium disilicate (LS2, IPS e.max System, Ivoclar Vivadent) and zirconia-reinforced lithium-silicate (ZLS, Celtram® Duo, Dentsply) blocks of different color (A3, A3.5) were sectioned at three different thicknesses (1, 1.5, 2 mm) using a microtome (Micromet Remet). Degree of conversion (DC%) of the cements was evaluated using a FTIR-ATR equipment (Nicolet 6700-Thermo Fisher) recording the polymerization kinetic (1 spectrum/s) up to 300 s. Cements were placed on the FTIR diamond stage in a 0.12 × 3 mm mold and photopolymerized for 40 s with the curing-light VALOTM (Ultradent Inc.), in standard power mode, through the ceramic specimens. Infrared (IR) spectra were obtained between 4000 cm^{-1} and 500 cm^{-1} at a resolution of 8 cm^{-1}. DC% was calculated at 40 s and 300 s, considering the ratio between the area of the reactive C = C peak at 1635 cm^{-1} and the internal reference C = O peak at 1715 cm^{-1}. Moreover, the light intensity (mW/cm^2) through the ceramic specimens of different thickness and color was determined using the MARC® PS, Managing Accurate Resin Curing (BlueLightAnalytics).

Results: In all cases, DC% at 300 s was higher than at 40 s of photopolymerization ($p < 0.05$). DC% value was not dependent from the cement used, with no significative differences when the two resin materials were polymerized in the same conditions ($p > 0.05$). On the other hand, there was a clear inverse correlation between DC% and the ceramic thickness: both CC and CU showed the lower DC% when polymerized through the 2 mm specimens. The ceramic color slightly influenced the DC%, as in case of CU photopolymerized through ZLS in A3.5

shade, which decreased its DC%. On the contrary, light intensity measured through the ceramic specimens was strongly dependent from both the thickness and the shade of the material.

Conclusions: The photopolymerization of the tested cements through ZLS and LS2 specimens was not particularly affected by the material type. Thickness was the most important parameter affecting the DC% and light intensity. A darker ceramic shade did not negatively influence the DC%.

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Water sorption, solubility and dentin bonding of experimental self-adhesive composites

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Purpose/aim: The aim was to evaluate dentin bond strength, water sorption and solubility of model self-adhesive resin composites containing different types and concentrations of acidic functional monomers.

Materials and methods: Experimental self-adhesive composites were formulated with 10-MDP (10-methacryloyloxi-decyl-dihydrogenphosphate) or GPDM (1-3-glycerol-phosphate-dimethacrylate) at 5 wt% or 10 wt% concentrations to obtain groups MDP5, MDP10, GPDM5 and GPDM10. Vertise Flow (Kerr) was used as commercial control. For microtensile bond strength test, twenty five extracted human third molars were cut, composites were applied ($n = 5$) and sectioned into 1 mm^2 thick resin-dentin sticks, which were tested for microtensile test in a universal testing machine. Water sorption and solubility experiments were performed with composite discs surveyed following ISO 4049. Data were statistically analyzed by ANOVA and Tukey's test ($p < 0.05$).

Results: MDP5 (17.2 ± 7.1 MPa) e MDP10 (16.0 ± 3.6 MPa) attained the highest bond strength in comparison with further composites, but without significant different between then ($p = 0.918$). Regarding water sorption and solubility, MDP5 (52.2 ± 3.6 and -6.0 ± 1.4 $\mu g/mm^3$ respectively) and GPDM10 (49.1 ± 2.5 and -15.0 ± 5.1 $\mu g/mm^3$ respectively) achieved the lowest outcomes.

Conclusions: It may be concluded that self-adhesive composites containing 5 wt% of 10-MDP provide the best adhesion with lower sorption and solubility.

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Nanoparticulation and characterization of natural hydroxyapatite originated from bovine bone

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Purpose/aim: Hydroxyapatite (HA) is a common biomaterial used for skeletal and dental reconstructions. Bovine bones are a safe and more balanced option from the sanitary, economic and environmental points of view to obtain HA. For this reason, it is of great importance the study of nanoparticulate forms of this material and its characterization in order to optimize their use.

Materials and methods: HA powder (75 μm) obtained from bovine femur were initially characterized by the following protocol: Fourier transform infrared spectroscopy (FT-IR), X-ray diffraction analysis (XRD), field-emission scanning electron microscopy (SEM) and energy dispersive spectroscopy (EDS) analyses. Two methods of nanoparticulation were performed: ball mill (1) and sonication (2). (1) The milling is carried out in a polyethylene jug (300 cm^3) loaded with 40 vol% (500 g) milling elements (3Y zirconia balls, HA, isopropyl alcohol and para-aminobenzoic acid) and was placed in a ball mill (104 rpm, 48 h) and after in a vibratory mill (72 h). (2) The sonication was performed with 40% of the maximum port of 750 W and 20 Hz in aqueous solution added with HA and ammonia polyacrylate (4 h of activation). After these processes, the particles' sizes were measured by Dinamic Light Scattering (DLS) and the same protocol of initial analyses was performed (FT-IR, XDR, SEM and EDS).

Results: The final average grain size of HA was 400 nm for ball mil technique and 1100 nm for sonication, according to DLS. FT-IR showed a broad band at 1300–500 cm^{-1}, and similar peaks, without degradation of the HA bonds, regardless the two forms of HA nanoparticulation. XDR analysis showed peaks equivalent to those in the literature for synthetic and animal HA. In addition, the equivalence between the methods peaks demonstrated the structural maintenance. The same chemical characteristics were also demonstrated in the samples from the EDS.

Conclusions: The results showed that both nanoparticulation forms were able to decrease the size of the HA particles without cause damage in the microstructure as well as in chemical bonds. Meanwhile, the ball mill was able decrease the particles into small sizes than sonication.

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Failure load of fatigued CAD\CAM endocrowns: Material and thickness effect

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Purpose/aim: To investigate the effect of restorative material and restoration thickness on the maximum failure load of CAD/CAM endocrowns subjected to cyclic fatigue loading in a simulated oral environment.

Materials and methods: Sixty third molar teeth received an endocrown preparation, with three different high of remaining dental tissue (1.5, 3.0 or 4.5 mm from the cement-enamel junction). A leucite-based ceramic and a lithium disilicate-based ceramic were selected to manufacture the endocrown restorations by the CAD/CAM facility, totaling 6 groups. The specimens were subjected to fatigue loading (200 N, 2×106 cycles, water) and then, to the single load to fracture test (1 mm/min crosshead speed). Data was analyzed using two-way ANOVA and Tukey multiple comparison test ($p < 0.05$).

Results: All endocrowns showed 100% survival rate after fatigue testing with no signs of fractures or chipping. The endocrown thickness did not influence the restorations failure load ($p = 0.548$). But, the restorative material presented statistically difference ($p = 0.003$). The lithium disilicate-based ceramic showed higher mean values of load to failure (1714.43 N)A than leucite-based ceramic (1313.47 N)B. The endocrowns predominantly failed by bulk fracture: across the crown thickness. Failure modes were categorized according to fracture path.

Conclusions: Regardless the endocrown material and thickness, all evaluated conditions can be recommended to rehabilitate molars of different remnant quantities; due to fatigue survival and maximum failure load. Thus, this restorative modality can be considered conservative.

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Phase, roughness and Young's modulus of Y-TZP ceramic after grinding

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Purpose/aim: The purpose of this study was to evaluate the effect of different grinding protocols on surface roughness, crystallographic phase and dynamic Young's modulus of Y-TZP used to manufacture copings and abutments.

Materials and methods: Bar-shaped specimens were obtained and divided into three groups ($n = 21$): Group C (control, untreated), Group A (grinding was performed using medium diamond burs, finishing was performed using fine diamond burs and high-speed handpiece under constant water cooling) and Group B (grinding was performed using coarse diamond stone, finishing was performed using medium diamond stone and slow-speed handpiece without water cooling). After specimens grinding, topography and surface roughness ($n = 21$) were evaluated on laser confocal microscope, crystallographic phase changes were evaluated using an X-ray diffraction ($n = 1$) and the dynamic Young's modulus ($n = 21$) was performed using the impulse excitation technique. One-way ANOVA and Tukey's test were performed to analyze surface roughness and Young's modulus, and Rietvelt's method was performed to calculate percentages of crystallographic phases.

Results: There was significant difference between groups considering surface roughness (Group A > Group B > Group C) ($p \leq 0.05$) and Young's modulus (Group B > Group A = Group C) ($p = 0.003$). X-ray diffraction data showed that grinding leads to phase changes, once Group C showed only tetragonal phase and Groups A and B showed tetragonal and monoclinic phases.

Conclusions: Although tested grinding protocols modified the surface characteristics, crystallographic phases and Young's modulus, these alterations were not harmful to zirconia specimens.

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Contemporary composites SEM polishing quality and surface porosity level

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Purpose/aim: To compare under scanning electron microscope (SEM) the polishing quality and surface porosity level of 6 contemporary resin composites.

Materials and methods: Specimens ($n = 2$) were made by inserting 4 increments of resin composite [G1 = Palfique LX5 (Tokuyama, Japan); G2 = Empress Direct (Ivoclar Vivadent, Liechtenstein); G3 = Filtek Z350 XT (3 M ESPE, USA); G4 = Essentia (GC, Japan); G5 = Charisma Diamond (Heraeus Kulzer, Germany); G6 = Vittra (FGM, Brazil)] into a putty viscosity polyvinyl siloxane mold (5 mm × 5 mm × 2 mm) and light-cured (Radii, SDI, Australia) for 20 s each increment. Composite cube form specimens were embedded in self-cure acrylic resin using a PVC ring mold with 20 mm diameter. Then, all specimens were sequentially metallographic wet-polished with SiC paper (#600, #800 and #1200-grid for 60 s each), ultrasonically cleaned in distilled water for 180 s, kept dry at 37 °C for 7 d, sputter-coated with gold-palladium and observed under a SEM (JEOL) at magnifications of 500 × –3000×. Energy X-ray dispersive spectroscopy was used to confirm by the chemical composition if the porosities were: in the resin composite matrix polymer, nanoclusters or inorganic fillers. Specimens were coded to blind the two evaluators to 6 experimental groups, classified into 6 scores according to surface smoothness and porosity matrix (very poor, poor, regular, good, very good, excellent).

Results: Composites observed were classified from regular to excellent according to surface polishing and porosities level. G2 presented the worst and G3 the best polishing image.

Conclusions: Current resin composite formulations differ one from the other in relation to surface polishing under SEM. A deeper knowledge of their composition, made by independent researches, may help in a future attempt to classify them according to their surface quality.

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Chlorhexidine-containing phosphoric acid compromises bonding stability of universal adhesive

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Purpose/aim: To examine the influence of chlorhexidine-containing phosphoric acid on the dentin bond stability of a multi-mode and a 2-step etch-and-rinse adhesive system.

Materials and methods: Eighty sound bovine incisors were randomly assigned to 8 groups ($n = 10$) according to: phosphoric acid (CTR: 37% phosphoric acid and CHX: 37% phosphoric acid with 2% chlorhexidine); adhesive system (SBU: Scotchbond Universal Adhesive and SB2: Adper Single Bond 2) and water storage time (24 h and 6 m). A single trained operator applied both acids and adhesives following manufacturer's instructions to flat dentin surfaces. The adhesive systems were applied carefully in a five dentin areas in each tooth and starch tubes (with 0.96 mm internal diameter × 1 mm height) were positioned previously the light curing. The tubes were filled with composite resin and light cured individually for 20 s. For each tooth, five composite cylinder specimens with 0.72 mm^2 of bonded area were obtained. The specimens were stored in distilled water at 37 °C for 24 h or 6 m and the starch tubes were easily removed using air/water spray. After the water storage time, the specimens were examined under a stereomicroscope at 10× magnification and the that with no interfacial gaps, air bubbles or other defects were submitted to microshear bond test, using a stainless-steel wire loop (0.2 mm in diameter) in a universal testing machine (EMIC DL1000) at 1 mm/min. The specimens with any defect were discarded and replaced. A single blinded operator performed the microshear bond test. Bond strength data (MPa) were analyzed using three-way ANOVA and post-hoc Tukey test ($\alpha = 5\%$).

Results: The triple interaction among factors was significant ($p = 0.012$). Both adhesive systems showed similar 24 h bond strength values regardless the phosphoric acid. After 6mos, similar values were found for both materials when control phosphoric acid was used but CHX phosphoric acid produced significant lower values for SBU (Table 1). SB2 bond strength maintained stable using both acids.

Conclusions: Chlorhexidine-containing phosphoric acid induced premature bond strength degradation of Scotchbond Universal Adhesive.

Table 1 – Means and standard deviations of μSBS (in MPa) and PTF (%) for each experimental groups.*.

Adhesive system	Acid conditioner	Storage time	
		24 h	6 mos
SB2	Control acid	13.8 (2.0)[a] [0%]	11.3 (7.3)[a] [8%]
SB2	CHX-containing acid	14.0 (4.4)[a] [2%]	12.5 (5.1)[a] [6%]
SBU	Control acid	13.6 (3.3)[a] [2%]	11.2 (6.2)[a] [16%]
SBU	CHX-containing acid	11.2 (2.6)[a] [8%]	4.0 (2.3)[b] [26%]

* Same superscript lowercase letters indicate no difference among groups ($p > 0.05$).

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Bonding effectiveness of multi-mode adhesive to pre-etched dentine

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Purpose/aim: Multimode adhesives systems can be applied both ways, either with the etch-and-rinse or the self-etch technique. This system has a self-etching characteristic due the incorporation of an acidic resin monomer into it formulation. Therefore, the etch-and-rinse mode implies the application of an acidic monomer in the 37% phosphoric acid etched wet dentine. The purpose of this study was to test if the bonding effectiveness to dentine will be affected when the multi-mode adhesive system adhesive (Scotchbond Universal Adhesive, SU, 3 M ESPE) is applied following a "etch-and-rinse technique". Specific research hypothesis tested was that prior phosphoric-acid etching of dentin will not affect the bond strength after 6 m of storage.

Materials and methods: The results were compared to its previous version, the two-step etch-and-rinse, Adper Single Bond 2, SB, 3 M ESPE. Adhesives restorations were built up in flat, deep dentin from extracted molars. After 24 h under simulate pulpal pressure the teeth were cut following a 'nontrimming' microtensile test technique and tested in tension after 24 h, or 6 m of storage. Additional specimens were processed to ultra-structural analysis of the interfacial interaction at dentine using confocal laser scanning microscopy.

Results: No statistically significant difference in bonding effectiveness was recorded when the multimode adhesive SU was applied compared to its previous version, the traditional adhesive SB (Table 1). After 6 m of storage, both investigated adhesives systems showed significant bond strength reduction when compared with immediate bond strength ($p < 0.05$).

Table 1 – Bond strength means (standard deviation) of adhesive systems to dentin (MPa).

	Initial–24 h	Final–6 month
Scotchbond Universal–SBU	41.55 (11.9) Aa	31.48 (11.1) Ba
Adper Single Bond 2–SB2	40.43 (13.3) Aa	26.52 (14.2) Ba

*Different uppercase letters were statistically different among rows. **Different lowercase letters were statistically different among columns.

Conclusions: Phosphoric-acid etching of dentine prior to adhesive application did not affect the bonding effectiveness of the SU to dentin, because, although the bond strength was reduced after 6 month of storage, the results this study showing similar values on bond strength between the etch-and-rinse Single Bond 2 adhesive system and the multimode adhesive system, Scotchbond Universal used with the etch-and-rinse mode.

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Ferrule thickness on fracture resistance of teeth restored with posts

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Purpose/aim: To investigate the influence of ferrule thickness on fracture resistance after mechanical cycling of teeth restored with different intracanal posts.

Materials and methods: One hundred and twenty bovine incisor teeth were randomized into six study groups, based on the intracanal post used (fiber post or cast post and core) and the presence and thickness of the ferrule (without ferrule, presence of 0.5 mm or 1 mm thick ferrule, keeping unaltered 2 mm in ferrule height). Full metal crowns and the root posts were adhesively cemented. The samples were subjected to mechanical cycling (37 °C, 45°, 130 N, 2.2 Hz, and 2 × 106 pulses). Afterwards, they were subjected to the fracture load test at a speed of 0.5 mm/min and a 45° slope until failure occurred. The failures were classified as favorable and unfavorable. The fracture resistance data were analyzed with 2-way ANOVA and Tukey's test. The Chi-square test was used to analyze the pattern of failure.

Results: When considering cast post and core, 1 mm ferrule thickness group (CPC1) presented a higher resistance to fracture than without ferrule group (CPC, $p = 0.001$). The ferrule thickness had no effect when using fiber post. Of all the specimens, 96.7% survived the mechanical cycling. Fifty-eight per cent of the fractures were unfavorable, while 42% were favorable.

Conclusions: Thicker ferrule only statistically increased the fracture resistance for cast post and core, while resistance for fiber post condition was not affected by the ferrule thickness. Thus, ferrule thickness should be considered when choosing different intracanal posts, looking for the fewer occurrences of unfavorable failures.

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Influence of bulkfill composite viscosity on microhardness and fracture resistance

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Purpose/aim: This study evaluated the influence of viscosity and increment thickness (2 or 4 mm) on the microhardness of bulkfill composites and the fracture resistance of teeth with extended Class II MOD cavities restored with bulkfill composites with different viscosities (paste like or flow) submitted or not to thermomechanical cycling.

Materials and methods: For the microhardness test, samples of 2 and 4 mm high by 6 mm diameter were prepared with bulkfill composites with different viscosities (flow–SDR Dentsply; paste like–Filtek Bulkfill 3 M/ESPE and Tetric N–Ceram Bulkfill Ivoclar Vivadent) ($n = 10$). After 24 h the microhardness test was performed at the top and base of the specimens. For the fracture resistance test, 80 third molars were divided into eight experimental groups ($n = 10$) according to the material (no cavity–control; Filtek Z250 3 M/ESPE, SDR Dentsply and Filtek Bulk Fill 3 M/ESPE) and the presence or absence of thermomechanical cycling. With the exception of control group, MOD cavities with 1/3 of intercuspal width and 5 mm depth were made in all teeth. Half of the specimens were subjected to 100,000 thermomechanical cycles (80 N, 2 Hz and 1 min baths at 5 and 55 °C). The compressive test was performed on a universal test machine. Data were submitted to two way ANOVA and Tukey's test ($\alpha = 0.05$).

Results: The results showed that there was no significant difference between the top and the base for microhardness ($p > 0.05$). At the height of 4 mm, at the top, the Tetric N Ceram resin had a higher microhardness than at the height of 2 mm ($p < 0.05$). At the base, with 4 mm height, Filtek Bulk fill resin 3 M/ESPE presented a surface microhardness significantly lower than the others ($p < 0.05$). Also, it was observed that there was no influence of the composite type and thermomechanical cycling on the fracture resistance of the specimens ($p > 0.05$).

Conclusions: It was concluded that the viscosities of the bulkfill resins did not influence the microhardness of the top and the base irrespective of the thickness and all the viscosities of the bulkfill resins provide similar resistance to the sound tooth even when submitted to thermomechanical cycling.

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Mechanical characterization of lithium-disilicate glass-ceramics by nanoindentation

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Purpose/aim: The assessment of the mechanical property of lithium disilicate glass ceramics (LDGC) is essential for successful application as structural elements in restorative dentistry. Nanoindentation test provides a good method to obtain mechanical behavior of materials at lower scales. Elastic modulus and hardness of LDGC should be highlighted since these properties establish the deformation responses of wear and machinability of these materials. The objective of this study was to evaluate the hardness and elastic modulus of LDGC by nanoindentation.

Materials and methods: LDGC blocks were cut using a slow-speed water-cooled diamond saw to obtain 2mm-thick slice of each group. Five groups were assessed. Two groups were tested as received: i) N!ce (Straumann, Basel, Switzerland) and ii) Celtra Duo (Dentsply Sirona, Hanau-Wolfgang, Germany), and three other groups received a heat treatment according to manufacturer recommendations: iii) IPS emax CAD (Ivoclar-Vivadent, Schaan, Liechtenstein), iv) Vita Suprinity (Vita Zahnfabrik, Bad Säckingen, Germany), iv) Celtra Duo_fired. All the five groups were mounted in acrylic resin and polished with SiC papers with decreasing abrasiveness. The mechanical tests were performed by nanoindentation instrument (Hysitron Ti750, Minneapolis, MN, USA) with a Berkovich indenter tip. Around 350 indentations were carried out on each sample ($n = 5$) and the results of Elastics Modulus (E) and Hardness (H) were reported as the average of the tests and were statistically analyzed (Kruskal–Wallis H test).

Results: The results can be seen in the figure below. The results demonstrated difference among the groups for both hardness and elastic modulus. Elastic modulus ranged from 93 to 118 GPa and the hardness mean values from 7.59 to 10.83 GPa with significant scatter among some of them.

Conclusions: Lithium disilicate glass ceramics presented mechanical properties that lead for an elevated quality of indirect restorative material.

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Effect of bioactive glasses for controlling enamel erosion

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Purpose/aim: To evaluate the effect of calcium phosphate- and strontium-based, titanium- and magnesium oxide-containing bioactive glasses for controlling dental erosion.

Materials and methods: Fifty fragments of enamel were divided into 5 groups: negative control (CTRL), bioglass 45S5 (BAG), Phosphate based glass Ti-containing (PBG-Ti), Phosphate based glass Mg-containing (PBG-Mg), Phosphate based glass Ti and Mg-containing (PBG-TiMg). For the erosive challenge a 0.3% citric acid solution was used. Each specimen received the application of 1 mL of this solution under agitation in a period of 2 min, with 1 mL being applied every minute. Two applications were performed per day for 5 days. The specimens were rinsed with 5 mL of deionized water for 1 min and subsequently, a solution with bioactive substances was applied for 3 min. After the cycles, the analyses of 3D non-contact optical profilometry, roughness, microhardness and scanning electron microscopy (SEM) were performed. The statistical tests used were One-way ANOVA (profilometry, roughness and variation of surface microhardness (%VMS)), Tukey's HSD (%VMS), Games Howell (profilometry), Student's t test (roughness) and Pearson correlation between the variables.

Results: The lower loss of enamel surface and lower VMS was observed in the PBG-Mg and PBG-TiMg groups and only the PBG-Mg group showed similarity in the roughness between baseline and eroded area. In the SEM micrographs, PBG-Ti and PBG-Mg showed lower apparent demineralization.

Conclusions: All bioactive materials provided a protective effect of enamel against erosion. The phosphate based glasses resulted in a greater protect effect in controlling enamel demineralization than 45S5 bioglass, and the presence of Mg in these phosphate based glasses was a determinant factor to success result.

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Effect of brushes cleanliness with different substances on composite resins

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Purpose/aim: The aim of the study was to evaluate the effect of brushes' cleanliness with different substances on the microhardness and surface roughness of three composite resins.

Materials and methods: Three specimens (12 mm × 2.5 mm) of composite resins were prepared: Nanohybrid (IPS Empress Direct, Ivoclar Vivadent), nanoparticulate (Filtek Z350XT, 3 M ESPE) and microhybrid (Point 4, Kerr Corporation). The specimens were divided into four groups according to the substance used for cleaning the composite resin brush ($n = 40$): Control Group; Chlorhexidine 2%; alcohol 70%; and alcohol 90%. In the Control Group, the brush was not used on the surface of the material. The surface roughness (Ra) was obtained using a rugosimeter (RP-100, Instrutherm) and Vickers microhardness (100 g for 10s) was measured with a microdurometer (HMV, Shimadzu). Data were analyzed statistically using two-way ANOVA (roughness) and Kruskall–Wallis (Micro hardness) ($p > 0.05$).

Results: Regarding the Ra values, there was no statistically significant difference between the groups ($p = 0.16$). In the Vickers microhardness, there was no significant statistical difference between the cleaning substances in the composite resins evaluated ($p > 0.05$). However, there was a significant statistical difference only between the microhybrid composite (Kerr) and the nanohybrid (Ivoclar Vivadent) composites in the brush cleanliness with 70% alcohol.

Conclusions: It was observed that cleaning the composite resin brushes with different substances does not affect the surface roughness and microhardness of the material.

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Refractive index matching effect on depth of cure of composites

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Purpose/aim: The objectives were to evaluate physicochemical properties of two commercial composites that features different translucencies in uncured and cured states, and investigate the matrix-filler refractive index matching (RI match) at different stages of polymerization regarding light transmission, depth of cure, and mechanical properties of the composites.

Materials and methods: Filtek Bulk-Fill Restorative Posterior (FBF) and Filtek One Bulk-Fill Restorative (OBF) (3 M ESPE) were characterized by polymerization kinetics, i.e. degree of conversion (DC) and maximum polymerization rate (PRmax), mechanical properties, i.e. flexural strength (FS) and elastic modulus (EM), light transmission (LT) during polymerization, and depth of cure in 5 mm depth increments. Light curing followed manufacturer's recommendation. Experimental composites were manufactured using 70 wt% of 0.4 micron silanated filler (1.555 RI). Resin blends were formulated to RImatch in different stages of composite polymerization: BisGMA/BisEMA/Vinylcarbazole45:45:10 mol%, with RI match in uncured state; BisGMA/BisEMA50:50 mol%, with RI match in mid-polymerization. BisGMA/BisEMA/TEGDMA45:45:10 mol%, with RI match in cured state. Camphorquinone (0.3 wt%) and a tertiary amine (0.8 wt%) were used as initiator system. Experimental composites were tested for DC, PRmax, FS, EM, LT, and depth of cure.

Results: Mean values of DC, PRmax, FS, and EM for commercial and experimental materials are presented in Table 1 (commercial: *t*-test, $\alpha = 0.05$; experimental: 1-way ANOVA and Tukey tests, $\alpha = 0.05$). OBF and RI match uncured presented lower final LT, followed by RI match mid-stage polymerization. More translucent composites (FBF and RI match cured) demonstrated greater LT. Both commercial and experimental materials that had greater final LT demonstrated more homogeneous depth of cure in 5 mm increments. RI match in the uncured state had a reduction up to 50% in conversion. Materials with RI match in the cured state exhibit greater LT, higher DC, PRmax, depth of cure, and in general better mechanical properties.

Conclusions: Matrix-filler RImatch influences LT and depth of cure of composites, as well as physicochemical properties. Materials with higher translucency, i.e. RI match in the cured state, came to present superior material performance.

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Adhesive performance of universal adhesives containing zinc-oxide and copper nanoparticles

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Purpose/aim: To evaluate the effect of addition of zinc oxide and copper nanoparticles (ZnO/Cu Np) at different con-

centrations into two universal adhesive systems, on 24 h resin–dentine interface microtensile bond strength (?TBS), nanoleakage (NL), microleakage evaluation by confocal laser scanning microscopy (ML) and in situ degree of conversion (DC). In addition, it was identified the presence of zinc/copper in the hybrid layer.

Materials and methods: Six universal adhesives were formulated according to the addition of ZnO/Cu Np (0% [control]; 5/0.1 and 5/0.2 wt%) in Ambar Universal Adhesive (AMU; FGM) and Prime&Bond Active (PBA; DentsplySirona). The occlusal enamel of seventy-two caries-free third molars was removed. After enamel removal, the experimental adhesives were applied to sound dentine in etch-and-rinse (ER) or self-etch (SE) mode. After composite resin build-ups, specimens were longitudinally sectioned to obtain resin–dentine bonded sticks (0.8 mm^2). For microtensile bond strength, specimens were tested in tension at 0.5 mm/min after 24 h of water storage. For nanoleakage, 2 bonded sticks from each tooth were prepared and analyzed under SEM after 24 h of water storage. For microleakage (ML), degree of conversion in the interface (DC) and identification of ZnO/Cu in the hybrid layer, 2 bonded slices were prepared and analyzed. All data were submitted to statistical analysis and significance was defined in $\alpha = 0.05$.

Results: After 24 h, zinc oxide and copper nanoparticles did not influenced negatively the μTBS and DC-i ($p > 0.05$) and decrease the NL and ML ($p < 0.05$), in both adhesives and strategies. In addition, it was possible to identify the presence of ZnO and Cu in the hybrid layer in all experimental groups.

Conclusions: The addition of ZnO/Cu Np in the tested concentrations in universal adhesive systems may be an alternative to preserving or even improve the integrity of the hybrid layer.

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The effect of air stream flow on ceramic/resin bond strength

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Purpose/aim: The clinical procedures for ceramics adhesion are as important as the material quality to obtain adequate bond strength. The objective of this study is to evaluate the effect of heating and the air-stream power used for adhesive volatilization in lithium disilicate repair with composite resin.

Materials and methods: Twenty-three lithium disilicate blocks (emax-Ivoclar) were sectioned in 90 specimens with 8 mm × 8 mm × 6 mm. All specimens were crystallized and hydrofluoric acid was applied for 20 s, then they were divided into 9 groups according to the adhesion protocol: UA- application of two layers of Universal Adhesive (3 M) and air stream for solvent evaporation with triple syringe at 7 cm distance; SILAC–Silane application during 1 min and conventional adhesive (single bond 3 M) and air stream, SILUA–Silane (1 min) + Universal adhesive as described above; UA + light air stream, SILAC + light air stream and SILUA + light air stream–were used the same prior protocols associated with the use of 5psi air stream during solvent evaporation and for the groups UA + heated light air stream, SILAC + heated light air stream and SILUA + heated light air stream–5psi heated air (40 °C) during solvent evaporation, both with the same distance standardized in 7 cm. Afterwards, 6 mm of composite resin was added in incremental layers. The blocks were sectioned to obtain 16 specimens (cp) with adhesive area of 0.8 mm^2. A microtensile bond test was performed (0.5 mm/min). The Shapiro Wilk and Bartlett tests were performed to verify the normality and homoscedasticity of the residues, respectively. The data were analyzed using the ANOVA at a significance level of 5%.

Results: There was no statistical difference between silane pretreated or non-silane-pretreated mode, however, the type of air stream used for solvent evaporation had a significant influence ($p < 0.001$) values (UA-17.9 ± 7.2/SILUA 20.7 ± 6.8/SILAC 19.5 ± 7.3) and the use of lighter air stream (5psi) presented significantly higher bond strength (UA–24.1 ± 5.6/SILUA 30.5 ± 12.6/SILAC 27.2 ± 7.0) and similar to the use of heated light air (UA–31.7/SILUA–29.,9/SILAC-27.6).

Conclusions: Air stream control (5psi) used for adhesive volatilization is important to obtain higher bond strength in cases of lithium disilicate repair with composite resin.

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Guanidine solution as a new fungicidal for heat-polymerized acrylic resins

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Purpose/aim: The aim of this study was to evaluate the antifungal activity and the effect of different concentrations of an aqueous solution with polyhexamethylene guanidine hydrochloride (PHMGH) in heat-polymerized acrylic resin properties after immersion for 5 or 10 min.

Materials and methods: The powder and the liquid of acrylic resin were mixed at 2:1 by weight. The dental flasks were pressed with 500 kg, opened and the excess of acrylic resin was removed. The dental flasks were pressed again with 1000 kg and immersed in water in a polymerization unit after 30 min at 75 °C for 9 h. The PHMGH solutions were formulated with distilled water and 0.125 wt%; 0.250 wt%; 0.5 wt% of PHMGH. For the antifungal activity analysis ($n = 3$), the samples were sterilized under hydrogen peroxide plasma and contaminated with Candida Albicans (ATCC 10231) during three days for biofilm formation on resins surfaces. The distilled water was sterilized for PHMGH solution preparation for the antifungal activity analysis. The samples were immersed in the different concentrations of PMHGH solution for 5 or 10 min. Surface roughness before and after immersion ($n = 5$), flexural strength ($n = 5$) and Knoop hardness ($n = 5$) were performed with the same three concentrations of PHMGH solution and 5 or 10 min of immersion. Two groups were immersed in distilled water for 5 or 10 min as control (GCTRL) in all tests.

Results: All concentrations at 5 or 10 min showed antifungal activity compared to GCTRL ($p < 0.05$) and at 0.5 wt.% of PHMGH solution in 5 or 10 min of immersion was not detected any colony. There was no significant difference ($p > 0.05$) between initial and final surface roughness for any tested solutions and times. The flexural strength ranged from 77.8 (±7.2) MPa to 90.1 (±8.7) MPa and there was no significant difference among groups ($p > 0.05$). The Knoop hardness ranged from 13.4 (±1.7) to 15.5 (±1.5), without significant difference ($p > 0.05$).

Conclusions: It was concluded that the PHMGH solution at all tested concentrations presented antifungal activity without influence the properties of a heat-polymerized acrylic resin after disinfection for 5 or 10 min.

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Virtual articulator accuracy in determination of occlusal contacts

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Purpose/aim: Objective: The objective of the study was to evaluate in vitro the accuracy of occlusal contacts obtained in patients through the virtual articulator.

Materials and methods: Thirty-six models were obtained from patients and mounted on a semi-adjustable articulator (ASA) A7 Plus (Bio-art). The intemaxillary registration was performed using silicone occlufast rock (Zhermack). After mounting in the articulator, the occlusal contacts were delimited in the 20 μm thick carbon film (AccuFilm), which was used as reference values. In order to obtain virtual models, the gypsum models were scanned with a laboratory scanner (Dental Wings 7, Straumann). The virtual articulator calibration was performed according to the manufacturer's recommendations and the occlusal contacts in the digital models were obtained automatically through the corresponding software. The quantitative analysis of the occlusal contacts was performed independently by two examiners, so that each examiner repeated the count twice with a 48 h interval between measurements.

Results: The intra and inter-examiner agreement, as well as the correlation between the occlusal contacts obtained in virtual models and gypsum models were statistically evaluated using the Kappa coefficient with significance level $\alpha = 5\%$. The intra-examiner agreement was 0.93–0.98 ($p < 0.001$), whereas the agreement between the examiners ranged from 0.61 to 0.67 ($p < 0.001$) for both virtual and gyspsum models. The contacts obtained in virtual models and conventional gypsum models showed an agreement between 0.52 and 0.55 ($p < 0.001$).

Conclusions: Considering the limitations of the present study, it was possible to conclude that the virtual articulator showed a moderate precision for the determination of occlusal contacts inpatients.

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Influence of infiltrant application time on caries lesions opaqueness

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Purpose/aim: Infiltrant resins were developed to hamper carious lesion progression and mask the whitish appearance of first evidence of caries. This study aimed at testing the hypothesis that a long application time of resin infiltrant in proximal enamel caries improves esthetic outcome compared to the commercially recommend time.

Materials and methods: Twenty teeth with uncavitated inactive proximal white enamel caries lesions (selected by two calibrated examiners; inter-examiner $r = 0.87$) were divided into two groups (experimental and control group; $n = 10$) that agreed regarding lesion surface area. Lesions were infiltrated following the protocol recommended by the manufacturer (two applications, 3 min application first and another 1 min application later; control) and by the protocol tested in this study (one application of 30 min; experimental). Enamel opaqueness (esthetic outcome) was measured by a calibrated examiner (intra-class coefficient of 0.9) before and after infiltration using fluorescence microscopy. Values for fluorescence intensity in the lesion area and in the adjacent normal enamel, the ratio of the fluorescence intensity in normal enamel by the fluorescence intensity in lesion area, before and after infiltrant application, and the percent reduction in enamel opaqueness are shown in Table 1 (An equation, not added in the abstract, was used to calculate opaqueness reduction).

Results: Reduction of enamel opaqueness (Table 1) was significantly higher in the experimental group (40.0% ± 18.5%) than in the control group (18.6% ± 14.9%) ($P = 0.0105$, one-tailed t-test; Hedge's g of 1.28, 95% confidence interval of 0.43/2.13, and power of 86%).

Conclusions: It can be concluded that the application time of 30 min provides a greater reduction in opaqueness of proximal enamel lesion compared to the application time recommended by the manufacturer. The high effect

Table 1 – Percent Reduction in Enamel Opaqueness for the Control Group and Experimental Group. Values of fluorescence intensity for the lesion area (L) and adjacent normal enamel (N), ratio of lesion area fluorescence intensity by normal enamel area fluorescence intensity before (D_1) and after (D_2) caries infiltration, and the percent reduction in enamel opaqueness (D_{Op}) for the control group.

Sample	L_1	N_1	D_1	L_2	N_2	D_2	D_{Op} (%)
Percent reduction in enamel opaqueness for the control group							
1	38.203	51.704	0.261	38.676	49.407	0.217	16.822
2	42.573	59.442	0.284	46.824	59.891	0.218	23.119
3	46.314	59.177	0.217	48.687	59.972	0.188	13.431
4	22.504	58.310	0.614	28.872	55.743	0.482	21.498
5	32.359	58.289	0.445	45.527	69.395	0.344	22.684
6	46.325	57.562	0.195	47.316	53.619	0.118	39.784
7	35.304	53.113	0.335	36.889	59.773	0.383	2.256
8	38.968	56.804	0.314	41.694	58.207	0.284	9.649
9	42.949	58.918	0.271	46.595	56.279	0.172	36.514
10	44.452	54.233	0.180	51.992	61.204	0.151	16.545
Percent reduction in enamel opaqueness for the experimental group							
1	20.818	44.076	0.528	38.710	50.480	0.233	55.814
2	52.472	59.655	0.120	54.402	55.893	0.027	77.846
3	18.910	37.441	0.495	24.689	36.004	0.314	36.503
4	24.686	53.344	0.537	27.286	46.521	0.413	23.037
5	36.379	54.852	0.337	43.178	53.379	0.191	43.255
6	44.047	58.323	0.245	47.574	54.479	0.127	48.219
7	28.452	53.717	0.470	32.317	46.456	0.304	35.290
8	42.904	56.739	0.244	46.603	58.842	0.208	14.698
9	36.122	69.098	0.477	45.016	61.391	0.267	44.109
10	48.101	58.337	0.175	50.789	58.900	0.138	21.517

size could stimulate patients to comply with the treatment time.

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Effects of light-activation time on flexural strength of bulk-fill composites

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Purpose/aim: This study evaluated the effect of light-curing exposure times on biaxial flexural strength (FS) and modulus (MO) of two bulk-fill composites.

Materials and methods: Two bulk-fill composites, Tetric EvoCeram Bulk Fill (TEC, Ivoclar Vivadent) and Filtek One Bulk Fill Restorative (FOR, 3M) were evaluated, using the corresponding LED light-curing units (Bluephase Style and Elipar DeepCure-S). Light activation was performed in three different times: following the manufacturer's recommendations (1), using 50% additional time (2) or double the time suggested by the manufacturers (3). Disc-shaped specimens ($n = 8$) of approximately 0.5 mm thickness and 6.0 mm in diameter were fabricated using a set of three PLA (3D printing filament) molds that were stacked upon each other. Central mold was 3 mm thick, while bottom and top molds were 0.5 mm thick. The three molds were filled with uncured composite pastes, and then covered with a Mylar strip to separate the molds and the uncured composite layers. The molds were stacked with a total thickness of 4 mm, and after light curing from the top, the composite "cylinder" could be disassembled into three detached parts. Only the 0.5 mm top and bottom composite discs were stored at 37 °C and tested. After 24 h, the discs were submitted to a piston-ring biaxial test in a universal testing machine (1.27 mm per minute; model 5844, Instron). FS and MO were submitted to three-way ANOVA and Tukey's post-hoc test (preset alpha of 0.05).

Results: TEC and FOR composite discs from the top presented higher FS than those located at the bottom. TEC showed lower FS than FOR. For both composites, the increase in light-curing time yielded higher FS at the bottom, while no effect was observed for MO. Regarding MO, only TEC showed statistical difference between top and bottom. Yet, no differences were observed between composites, except when TEC at the bottom was light activated following the manufacturer's recommendations and using 50% additional time, which exhibited lower MO than FOR.

Conclusions: For both composites, increasing the light-curing time yielded higher FS at the bottom, but it did not influence the MO. TEC and FOR composites at the top showed higher FS than those at the bottom, however for MO, the result was product-dependent.

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Bond strength of water-free adhesive systems to cross-linked, air-dried dentin

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Purpose/aim: To evaluate the immediate bond strength of two simplified etch-and-rinse, water-free adhesive systems applied to cross-linked and dried dentin.

Materials and methods: Dentin flat surfaces were prepared in 128 human non-carious molars. The dentin surfaces were etched with phosphoric acid for 15 s and rinsed with deionized water. Then, the teeth were divided into four groups according to the cross-linking agent ($n = 32$): 5% proanthocyanidin-rich grape seed extract (PA), 5% glutaraldehyde (GD), Gluma Desensitizer (GL) and deionized water. The solutions were passively applied for 60 s in dentin surface and rinsed with deionized water. Further, each group was randomly divided according to the dentin adhesion technique ($n = 16$): wet-bonding or dry-bonding. A dry dentin surface was produced by continuously air-drying of the conditioned dentin for 60 s. Wet-bonded and dry-bonded groups, with no dentin biomodification, were set as the positive and negative controls, respectively. Finally, the groups were subdivided according to the adhesive system (final n/group = 8): Optbond S and XP Bond. Composite resin blocks were built up and the teeth were stored at 37 °C for 24 h. Beam-like specimens were cut ($0.81 \pm 0.02\ mm^2$ of cross-sectional area) and submitted to the microtensile test. Failure type was classified as cohesive in resin or dentin, adhesive or mixed using a stereomicroscope. Data were submitted to one-way ANOVA and Tukey tests ($p < 0.05$).

Results: A significant reduction in bond strength was observed for both adhesive systems applied to untreated dry dentin (OS: 16.6 and XP: 13.2 μTBS) compared to untreated wet dentin (OS: 43.3 and XP: 34.1 μTBS). When dentin was kept wet, the use of a cross-linker had no effect on the immediate bond strength. Conversely, bond strength to dry dentin reached values equivalent to the positive control (untreated wet dentin) only when collagen was biomodified with the cross-linking agents before air-drying (PA: 31.9, GD: 34.1, GL:34.4 μTBS for OS and PA: 26.3, GD:34.9, GL:35.0 μTBS for XP). No significant differences in bond strength was seen when the cross-linking agents were compared. Most of the failures were classified as adhesive for all groups.

Conclusions: Previous biomodification of the etched dentin with cross-linkers allowed the use of the dry-bonding technique with no detrimental effects on the immediate bond strength of water-free adhesive systems.

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BioGran® funtionalized with PTH(1-34) on peri-implant defect in orchiectomized rats

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Purpose/aim: The objective of this study was to evaluate a synthetic bone graft (BioGran®) funtionalized with PTH 1-34, in peri-implant defects bone repair in rats submitted to orchiectomy.

Materials and methods: For this study, 24 rats were orchiectomized and divided into 3 groups: CLOT, which was performed perimplantar defect and was not filled with biomaterial; BG, the defect was filled with BioGran®, BG-PTH, the defect was filled with BioGran® and topical PTH). The biomaterial processing was performed by sonochemistry, and the protocol was developed in a previous test in periods of 15, 30, 45 and 90 min. The best results were observed at 15 min therefore, this was the chosen period of the protocol performed with PTH. Each animal received two implants being one in each tibial metaphysis. Euthanasia occurred 60 d after implant installation. During the euthanasia, the analysis of the reverse torque was performed by a digital torquemeter, which was coupled to the implant and applied the opposite force to remove the implant. The three-dimensional microtomographic analysis (microCT) was performed for the parameters of bone volume percentage (BV/TV), thickness, number and separation of trabeculae (Tb.Th, Tb.N and Tb.Sp), total porosity (Po.tot) and Bone implant contact (BIC), in addition to the analysis of laser confocal microscopy. The data were submitted to the normality test Shapiro–Wilk, and were compared through ANOVA One-Way test, followed by the Tukey post-test, with 5% as the significance level.

Results: The analysis of microCT showed a higher percentage of bone volume for the BG-PTH followed by BG and lowest for CLOT (CLOTxBGxBG-PTH, $p < 0.05$). For Tb.N, Tb.SP and Po.tot the highest values were for the BG-PTH and BG (CLOTxBG/BG-PTH, $p < 0.05$). In relation to BIC, the BG-PTH showed the highest results when compared to the other groups presenting greater contact at the bone/implant interface (CLOTxBG/BG-PTH, $p < 0.05$). It was possible to evaluate by laser confocal microscopy greater bone turnover for the groups in which it was filled with biomaterial, isolated or associated with topical PTH. For the reverse torque analysis highest results were for the BG-PTH group in comparison to the others, being statistically significant in the comparison with CLOT (CLOTxBG-PTH, $p < 0.05$).

Conclusions: It was possible to conclude from the results that the use of Biogran® to fill peri-implant defects in orchiectomized rats showed good results that were relevantly improved after the funtionalization with PTH 1-34.

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Evaluation of conversion and cytotoxicity of new bioactive composites

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Purpose/aim: The incorporation of chitosan in restorative resin composites is very promising due to its known antimicrobial effect. However, its addition to the polymeric matrix must not jeopardise the material's physical and biological properties. The objective of this study was to evaluate the effect of chitosan on the degree of conversion (DC) and cytotoxicity effect of experimental restorative resin composites.

Materials and methods: Three experimental resin composites were formulated with an equimolar ratio of BisGMA: TEGDMA and 60 wt% barium glass, associated with 0, 0.5 or 1 wt% of sub-micrometric chitosan particles (750 nm). Degree of conversion was determined by Fourier-transform infrared spectroscopy (FTIR), 24 h after photoactivation. Cytotoxicity was measured by MTT assay in human dental pulp fibroblasts, according to the ISO 10993-5 through the indirect technique. The culture media was conditioned for 24 h with the materials and tested in the concentrations of 100, 80, 60, 40 and 20%. Cell viability was determined in relation to the life-control group (cells cultured in fresh culture medium without conditioning). DC data were submitted to one-way ANOVA/Tukey test, and cytotoxicity data were submitted to Kruskal–Wallis/Student–Newman–Keuls test ($\alpha = 0.05$ for both).

Results: Degree of conversion was similar among the materials (control: 81 ± 3%, 1%: 75 ± 2% and 0.5%: 77 ± 3%). All the materials, in all the conditioned medium concentrations, were considered non-toxic, with cell viability higher than 75%, statistically similar to the life-control group (100%) and higher than the dead-control group (cells cultured in culture medium with 20% methanol), which showed cell viability of 4%.

Conclusions: Therefore, it can be concluded that the addition of up to 1% of sub-micrometric particles of chitosan to a composite resin did not affect the degree of conversion nor show cytotoxic effects to dental pulp fibroblasts.

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Surface properties of soft relining material incorporated with plant extract

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Purpose/aim: The aim of this study was to evaluate the effect of the incorporation of nystatin and plant extracts obtained from Schinopsis brasiliensis Engl. leafs on the physical–morphological and mechanical properties of denture soft relining materials.

Materials and methods: Forty samples of a soft relining material (Soft Confort, Dencril) were produced and divided as follows into four groups ($n = 10$): Control group–Standard preparation of the material (G1); material incorporated with 10% of 625 μg/ml *S. brasiliensis* extract (G2); with 10% of 1250 μg/ml *S. brasiliensis* extract (G3) and with 10% of 60 μg/ml nystatin (G4). Samples were then subjected to surface roughness (Sa, Sq and Sz) determination using 50× lens-amplified non-contact 3D Optical Profiler (CCI MP, Taylor Hobson) connected to a PC station equipped with TalySurf CCI (Taylor Hobson) and cut-off determined to 0.25 mm. Shore A hardness was determined by Shore durometer (Mitutoyo Hardmatic Series 811) in five equidistant areas of each sample. Statistical analysis for surface roughness was performed by Kruskal–Wallis test whereas for Shore A hardness ANOVA followed by Tukey's post-hoc test was applied in SPSS v.20 (IBM) with p-value < 0.05.

Results: Surface roughness of G1 group (Sa = 0.072, Sq = 0.15, Sz = 3.51) presented the lowest values in comparison to groups G2 (Sa = 0.199, Sq = 0.56, Sz = 11.31) and G4 (Sa = 0.243, Sq = 0.41, Sz = 7.74) (Kruskal–Wallis, $p < 0.01$). Values from G3 group (Sa = 0.149, Sq = 0.256, Sz = 4.587) differed from G2 and G4 groups (Kruska–Wallis, $p < 0.01$). However, no differences were observed between G1 and G3 groups. For the Shore A hardness, statistical difference was observed between G1 (17.92) and G3 (19.56) and between G1 and G4 (19.68) groups. No differences were observed between G2 (18.8) and any of the groups.

Conclusions: Within the limitations of this study it can be concluded that the addition of the nystatin on denture soft relining materials presented alterations in all properties evaluated, while 625 μg/ml *S. brasiliensis* extract promoted an elevation in surface roughness and 1250 μg/ml *S. brasiliensis* extract altered the Shore A hardness of the material. Further studies on biofilm control are needed to determine the usefulness of these modifications in soft relining materials.

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Translucency of dental ceramics for monolithic restorations

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Purpose/aim: The objective was to evaluate the translucency of different dental ceramic for monolithic restorations in two thicknesses using different parameters.

Materials and methods: Slices of ceramic blocks with thickness 1 mm or 2 mm of different dental ceramics in shade A2 ($n = 6$) were prepared: lithium-disilicate glass-ceramic (LD, IPS e.max Press), zirconia-reinforced lithium-silicate glass-ceramic (LS, Suprinity), feldspathic ceramic (FC, VittaBlocks Mark II) and translucent zirconia (TZ, Zirkonzahn Prettau). A spectrophotometer (Spectro Shade Micro) was used to measure the CIELab coordinates and the reflectance value (Y) of specimens placed on white and black backgrounds. The translucency parameter (TP) and the contrast ratio (CR) were calculated. All readings were done in triplicate. The quantitative analysis of the irradiance was performed using images obtained from the ceramic blocks coupled to a light-emitting source (LED curing unit 870 mW/cm^2). Data were analyzed by two-way ANOVA and Tukey's test ($\alpha = 5\%$). Correlation between CR, TP and light attenuation was determined by the Pearson correlation coefficient.

Results: CR ranged from 0.64 (LS, 1 mm) to 0.96 (TZ, 2 mm). TP values ranged from 3.68 (TZ, 2 mm) to 32.19 (LS, 1 mm). The irradiance and percentage of light attenuation varied, respectively, from 138.70 mW/cm^2 (TZ, 2 mm) to 404.45 mW/cm^2 (LS, 1 mm), and from 53.51% (LS, 1 mm) to 84.06% (TZ, 2 mm) (Table 1). There was a strong negative correlation between CR and TP ($R = -0.9967$), a strong negative correlation between TP and light attenuation ($R = -0.8820$) and a strong positive correlation between CR and light attenuation ($R = 0.9032$).

Conclusions: The dental ceramics and the thicknesses influenced the translucency parameters evaluated. For all parameters, zirconia-reinforced lithium silicate glass ceramic presented the highest degree of translucency, while translucent zirconia showed the lowest translucency. For all materials, the higher the thickness, the higher the CR value, the higher the light attenuation and the lower the TP value. It was observed a strong negative correlation between CR and TP and between TP and light attenuation, and a strong positive correlation between CR and light attenuation.

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Fracture resistance of restored teeth with different resins composites

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Purpose/aim: To compare the fracture resistance of teeth with large mesio-occlusal-distal (MOD) restored with regular and flowable bulk fill resin composite, conventional resin composite and unprepared teeth after chewing simulation of 2500 mechanical cycles.

Materials and methods: Twenty-eight extracted molars with similar dimensions were selected. Class II MOD cavities were prepared in all specimens with 2/3 of the intercuspal width and 4 mm depth in occlusal box. The teeth were divided into 4 groups based on resin composite type and insertion technique ($n = 8$): G1: unprepared teeth (control), G2: teeth restored with conventional resin composite (Tetric N-Ceram), with incremental technique, G3: teeth restored with regular bulk fill resin composite (Tetric N-Ceram Bulk Fill) with a single increment, and G4: teeth restored with flowable bulk fill resin composite (Tetric N-Flow Bulk Fill), except for a 1 mm-thick layer at the oclusal surface that was restored with conventional resin composite. The specimens were submitted to a chewing simulator (SD Mechatronic GmbH) with a load of 100 N and a 1.5 Hz frequency for 2500 cycles. All specimens were evaluated to detect the presence of enamel cracks and propagation before and after mechanical cycles using a transillumination LED light. The specimens were then subjected to a compressive force into a universal testing machine (DL2000,

Table 1 – Mean values and SD for CR, TO under different conditions.

Ceramic	Thickness (mm)	CR	TP	Irradiance (mW/cm^2)	Light attenuation (%)
FC	1	0.76 ± 0.01^{b}	21.65 ± 1.18^{b}	339.10 ± 91.15^{abc}	61.02 ± 10.48^{abc}
	2	0.85 ± 0.01^{c}	14.31 ± 0.55^{c}	196.66 ± 82.70^{cd}	77.39 ± 9.51^{cd}
LS	1	0.64 ± 0.02^{a}	32.19 ± 1.63^{a}	404.45 ± 107.35^{a}	53.51 ± 12.36^{a}
	2	0.77 ± 0.01^{b}	22.63 ± 0.73^{b}	261.41 ± 55.65^{bcd}	69.95 ± 6.40^{bcd}
LD	1	0.77 ± 0.01^{b}	20.70 ± 0.94^{b}	378.27 ± 59.73^{ab}	56.52 ± 6.78^{ab}
	2	0.85 ± 0.01^{c}	13.07 ± 1.23^{c}	235.14 ± 62.79^{cd}	72.97 ± 7.22^{cd}
TZ	1	0.93 ± 0.02^{d}	6.65 ± 1.34^{d}	233.06 ± 92.31^{cd}	75.51 ± 10.61^{cd}
	2	0.96 ± 0.00^{e}	3.68 ± 0.20^{e}	138.70 ± 42.70^{e}	84.06 ± 4.91^{e}

For each parameter (in column), values followed by the same superscripts are statistically similar ($p > 0.05$).

EMIC) until fracture. The maximum fractured load of the specimens was measured (N) and the fracture patterns were classified based on the fracture site, above or below the cementoenamel junction (CEJ). Data were statistically analyzed with one way analysis of variance (ANOVA).

Results: All specimens survived after 2500 mechanical cycles. No statistically significant differences among groups were observed in the fracture resistance after cycling ($P < 0.05$). The fracture analysis demonstrated that failures below the CEJ were more frequent in G2 (75%), while G1, G3 and G4 showed this type of failure in 38%, 63% and 63% of the specimens, respectively. The results of the crack analysis showed that the occurrence of new cracks and crack propagation was also higher in G2 with 33.3%, while the G1, G3 and G4 showed cracks in 11.1%, 14.3% and 13.8% of the specimens, respectively.

Conclusions: Teeth restored with regular bulk fill composite and flowable composite showed similar fracture resistance after cycling compared to those restored with conventional composite resin and unprepared teeth. Furthermore, teeth restored with bulk fill composite (regular and flowable) showed a lower percentage of enamel cracks and fractures below the CEJ.

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Cytocompatibility, bioactivity, and antimicrobial activity of experimental calcium-silicate sealer

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Purpose/aim: An experimental calcium-silicate based sealer (EXP) composed by tricalcium silicate, dicalcium silicate, calcium phosphate monobasic, calcium hydroxide, zirconium oxide, calcium tungstate and polyethylene glycol was developed to be used as root canal filling material. The present study evaluated cytocompatibily, bioactivity and antimicrobial activity of the new sealer, compared to AH Plus (AHP) and TotalFill (TF).

Materials and methods: The cytocompatibility was evaluated by 3-(4,5-dimethyl-thiazoyl)-2,5-diphenyl-tetrazolium bromide (MTT) and neutral red (NR) assays, after exposure of Saos-2 to cement extracts at 1:2, 1:4, 1:8, 1:16 and 1:32 dilutions for 24 h. The cell bioactivity was assessed by alizarin red staining (ARS) and alkaline phosphatase activity (ALP). For the ARS, Saos-2 was exposed to cement extracts at 1:8 dilution for 21 d. For ALP, Saos-2 was exposed of to cement extracts at 1:8 dilution for 1, 3 and 7 d. Antimicrobial and antibiofilm activities were determined by the direct contact test on planktonic cells (DCTPC) and the modified direct contact test (MDCT), respectively. In the DCTPC, the contact time between sealers and biofilms of Candida albicans and Enterococcus faecalis was 1 h and 30 min. In the MDCT, the contact time between the disks of sealers and the bovine dentin contaminated by *E. faecalis* biofilm was 15 h. Data obtained by MTT, NR and ALP were analyzed by Two Way ANOVA and Bonferroni tests, ARS data were submitted to ANOVA and Tukey tests, and microbiological data were submitted to Kruskall–Wallis and Dunn tests ($\alpha = 0.05$).

Results: EXP, AHP and TF did not show cytotoxicity for Saos-2 at all dilutions evaluated in MTT and NR assays, compared to the negative control ($P > 0.05$). Increased production of mineralized nodules was observed for TF and EXP ($P < 0.05$). In the DCTPC, EXP and TF promoted a greater reduction of *E. faecalis* compared to AHP and control ($P < 0.05$). EXP and TF eliminated *C. albicans*. In the MDCT, EXP and TF showed higher antibiofilm activity (*E. faecalis*) compared to AHP ($P < 0.05$).

Conclusions: In conclusion, the experimental calcium-silicate based sealer presented biocompatibility, bioactivity, induced the formation of mineralized tissue, besides antimicrobial activity on *E. faecalis* and *C. albicans*. This material has potential for clinical application as endodontic sealer.

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Effect of copper-containing universal adhesive bonding in different substrates

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Purpose/aim: The purpose of this in vitro study was to evaluate the effect of copper addition on a universal adhesive system in microtensile bond strength (μTBS) and nanoleakage (NL) of sound, eroded and carious resin-dentin interface, using both self-etch [SE] and etch-and-rinse [ER] adhesive strategies.

Materials and methods: The experimental adhesive system was formulated with the addition of 0.1% copper nanoparticles on Ambar Universal. For μTBS and NL, 80 human third molars were randomly distributed in 8 experimental conditions ($n = 10$) based on the combination of the variables: concentration of copper [0 and 0.1%] vs. dentin surface (sound and carious) vs. adhesive strategies (ER and SE). After bonding procedures and restored with composite resin, teeth were stored for 24 h and then longitudinally sectioned to obtain specimens–dentin–resin sticks (0.8 mm^2), tested in a tension of 0.5 mm/min for μTBS. For NL, 3 specimens per tooth were prepared and analyzed by scanning electron microscopy (SEM). The data of μTBS and NL were analyzed by three-way ANOVA, submitted to Tukey's post hoc test for multiple comparisons. Statistical significance was set at $\alpha = 0.05$.

Results: The inclusion of 0.1% of copper nanoparticles on the universal adhesive system improved both μTBS and NL values on sound and eroded substrate for both strategies. On carious dentin, better results were found when combined

etch-and-rinse strategy to the application of the adhesive with copper.

Conclusions: It means that the addition of copper on universal adhesive systems could be considered an alternative to improve the immediate bonding performance to sound, eroded and carious dentin.

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Novel self-adhesive composites: Chemical and microstructural comparisons to commercial materials

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Purpose/aim: The aim of this study was to assess the chemical composition and characterize the microstructural morphology of commercial and experimental self-adhesive materials used in restorative dentistry.

Materials and methods: Three commercial self-adhesive products were tested: flowable resin composites–Constic (DMG, NJ, USA), Vertise Flow (Kerr, Orange, CA, USA) and resin-modified glass ionomer Activa Bioactive Restorative (Pulpdent, MA, USA). Two experimental flowable composites were made by combining urethane and polypropylene glycol dimethacrylates with the adhesion promoter 4-META and a hybrid filler phase with low versus high levels of monocalcium phosphate (MCPM) and antibacterial polylysine (PLS). FTIR-ATR (Perkin Elmer, UK) was used to obtain spectra, before and after curing each paste, to determine monomer compositions and polymerisation kinetics. Solid discs of 2 mm thickness and 10 mm diameter were prepared and Raman mapping employed to characterize the surface filler chemistry and dispersion. Light microscopy and SEM/Energy Dispersive X-ray (EDX) imaging of fractured discs (Phillip XL-30, Eindhoven, The Netherlands) was undertaken to examine internal material microstructure and elemental composition.

Results: IR Spectroscopy results of the uncured pastes revealed Constic and VF had Bis-GMA as their main monomer constituent. Activa was found to be predominantly UDMA-based as with the experimental materials. Raman mapping showed Activa had particles larger than 4 μm and the highest filler content. The degree of conversion of the experimental composites showed competitive levels to the commercials. All the formulations displayed irregular morphology of the filler phase. Constic and VF had similar microstructural features and filler dispersion. Elemental analysis confirmed all fillers had high percentage of silicon, but differences in other elements were found. VF contained ytterbium and fluoride, while Activa had fluoride and sodium. Barium was found in all materials. With the experimental materials, the active ingredients could also be detected as well dispersed particles within the set formulations.

Conclusions: The commercial self-adhesive composites VF and Constic shared a similar monomer composition and Raman mapping features, which differed from the RMGIC Activa. As an alternative to these marketed materials, a novel bioactive and antibacterial flowable resin composite containing a functional monomer and antibacterial/remineralising components is presented.

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Surface treatments of Y-TZP: Effects on optical properties after staining

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Purpose/aim: Clinical adjustments are frequently necessary to better fit the ceramic monolithic restorations. This in vitro study evaluated the effect of surface bur-grinding and finishing treatments after grinding (polishing and glaze) on color stability, translucency and opalescence of a translucent zirconia after immersion in red wine.

Materials and methods: 32 discs (0.8 mm thickness × 10 mm diameter) of Y-TZP ceramic (Zenostar–Ivoclar/Vivadent) were manufactured and allocated ($n = 8$) according to surface treatment procedure: Control–Ctrl (as-sintered + glaze); Grinding–Gr (grinding with diamond burs–#4219/medium); Grinding followed by polishing–Gr + Pol (Gr + OptraFine Polishing); Grinding followed by glaze–Gr + Gl (Gr + Ivocolor glaze). After surface treatment, surface roughness parameters (Ra and Rz) were evaluated using a contact profilometer. Then, they were subjected to daily immersions in red wine for 30 min during 36 d at 37 °C. Specimens were maintained in distilled water during the remaining time. The CIE $L^*a^*b^*$ coordinates were measured with a spectrophotometer (SP60–X-Rite, Grand Rapids, EUA) at baseline and after 9, 18, and 36 d of immersion. Color changes (ΔE00) were calculated using CIEDE2000. Translucency through Contrast Ratio (CR) and opalescence (OP) were calculated in all immersion times. Data of optical properties parameters were analyzed by repeated measures ANOVA and Tukey's tests. Roughness data were submitted to Kruskal–Wallis test, and the correlation between roughness and color change were evaluated by Spearman's correlation.

Results: In all immersion times, Gr showed the greatest ΔE00 values whereas the other groups presented similar behavior. All groups reached the unacceptable threshold (ΔE00 > 1.8) after 36 days (Table 1). Gr and Gr + Pol groups presented the highest Ra and Rz values, which were statistically similar. Only polishing affected the ceramic translucency and opalescence after 36 d. Correlation between roughness and color change was moderate and significant ($P = 0.02$, $r = 0.42$).

Conclusions: Grinding with diamond bur generated a rough surface and intensified the staining caused by wine. Procedures that aim to achieve greater smoothness surface, such as glaze, should be performed after adjustments with diamond burs in Y-TZP ceramic, in an attempt to reduce color alterations. However, regardless of the

Table 1 – Color change (ΔE00) and surface roughness (Ra and Rz) means (SD) of different groups.

Group	ΔE00 9d	ΔE00 18d	ΔE00 36d	Ra	Rz
Ctrl	1.19(0.30)Bb	1.34(0.40)Bb	1.99(0.40)Ab	0.18(0.03)c	1.59(0.72)c
Gr	2.65(0.36)Ba	2.94(0.34)Ba	4.16(0.24)Aa	2.21(0.38)a	12.83(2.05)a
Gr ± Pol	1.29(0.35) Bb	1.65(0.65)ABb	1.86(0.42)Ab	1.37(0.40)ab	7.90(2.17)ab
Gr ± Gl	0.65(0.11)Cb	1.66(0.46)Bb	2.53(0.18)Ab	0.57(0.19)bc	2.93(1.05)bc

Within rows, similar capital letters denote no statistically significant difference, while similar lowercase letters within columns reveal no statistically significant difference ($p < 0.05$).

surface treatment the material was susceptible to color changes.

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Anticariogenic potential and quantification mineral the enamel around restorative materials

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Purpose/aim: The aim of this in vitro study was to evaluate the anticariogenic potential and quantification of the enamel mineral elements around restorative materials after pH-cycling, through the analysis of the microhardness of the enamel as well as the evaluation of Ca/P/F ratio by Energy-dispersive X-ray spectroscopy analysis (EDS).

Materials and methods: Ninety blocks of bovine enamel after polishing and analysis of composition in EDS were submitted to surface microhardness analysis and sequentially randomly divided into six groups according to the treatment used ($n = 15$): F IX (Fuji IX Extra–GC Corporation); IZ (Ion Z–FGM); F II (Fuji II LC GC Corporation); B II (Beautifil II–Shofu); F250 (Filtek Z250 XT–3 M ESPE) and C (Control–no treatment). The specimens were subjected to pH-cycling for 7 days. Subsequently, they were analyzed by EDS, and the final evaluations of the microhardness at standard distances from the treatment material.

Results: The EDS findings revealed that there was a significant increase in FluorIDE concentration and decrease in Calcium in Group BII after pH-cycling. The values of the surface microhardness in F IX, IZ and F II were higher than those in B II, F250 and C at different distances of the materials.

Conclusions: According to the methodology used, it can be concluded that restorative materials F IX, IZ and F II were able to partially inhibit enamel demineralization under a dynamic pH cycling model. The giomer B II system demonstrated an intermediate anticariogenic potential and incorporation of fluoride in the enamel with statistical difference between Z250 and C, which did not show difference between them.

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Ceramics glossiness by different polishing methods

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Purpose/aim: Because the color of ceramics is similar to that of the natural tooth crown, they are frequently used in clinical cases due to increases in requests for esthetically satisfactory treatment. These restorations are usually inserted in the oral cavity after occlusal adjustment and polishing. Therefore, we investigated the influence of polishing methods on the glossiness of restorations, and evaluated simple polishing methods.

Materials and methods: As ceramic materials, we used VITA BLOCS MarkII (VITA) (VITA Co.), IPS e.max Press (IPS), (Ivoclar vivadent Co.), Initial LiSi Press (LiSi), (GC Co.), CEREC BLOCS (CER), (Dentsply Sirona) and Lava Esthetic Zirconia (Lava) (3 M Co.). VITA, CER, and Lava were cut to a thickness of 3 mm as a measurement specimen. For IPS and LiSi, wax was used to fill a silicon mold of $13 \times 10 \times 3$ mm, and a wax pattern was produced. Specimen rods were softened and pressure forming was performed to produce measurement specimens. These specimens were polished using #600 water-resistant polishing papers. Polishing appliance was used porcelain ceramic polisher (Cp) (Kerr Co.), Meisinger LiSi Twist (Li)(GC Co.), and CERASHAIN(Ce)(GC Co.). At each polishing stage, glossiness was measured using a glossimeter (GV-2000, NIPPON DENSYOKU Co.). In each specimen, polishing was performed at a polishing pressure of 150 g for 20 s. Three measurements of each specimen were evaluated using two-way analysis of variance.

Results: The glossiness of ceramics in final polishing was 36.2 in VITA, 76.4 in IPS, 74.1 in LiSi, 36.0 in CER, and 106.0 in Lava. Although a significant difference was noted between VITA and LiSi, IPS, Lava, no significant difference was present between IPS and LiSi. Regarding the glossiness at polishing appliances, it was 79.8 at Cp, 108.3 at Li, and 96.8 at Ce. The glossiness of ceramics was highest 152.3% when Lava was polished using Ce, and lowest 22.2% when IPS was polished using Cp. Significant difference was noted between Li and Cp.

Conclusions: Differences in the glossiness were noted among the types of ceramics and polishing systems. The glossiness of ceramics increased with decreases in the roughness of polishing materials. Therefore, it is necessary to polish

up to final polishing. Clinical application should be performed on considering of the types of ceramics and polishing systems.

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MDP-based bonding system and interactions with demineralized dentin substrate

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Purpose/aim: In clinical practice, the most frequent dental substrates are morphological and structural modified, as carious and eroded dentin, which requires subsequent restorative procedures. Bonding approaches are currently the more reliable strategies, even their long-term performance still is a challenge. To minimize intrinsic degradation of the resin-dentin interface, the adhesive system has been addressed to allow chemical bonding to dental structure, likely more resistant. These systems are mostly based on bifunctional monomer 10-methacryloyloxy-decyl-dihydrogen phosphate (MDP) by the local formation of salts MDP-Ca when applied on dentin. Simultaneously, chlorhexidine (CHX) has been used to decrease enzymatic degradation at the adhesive interface by calcium chelation. Thus, due to a common calcium-dependent mechanism of action, MDP and CHX can compete among them, which can impair their goals, especially on substrates with lower concentration of these ions as carious or eroded dentin. The purpose this study was to explore the possible interaction between MDP and CHX on substrates artificially modified by caries and erosion, with reduced calcium availability.

Materials and methods: Flat dentin surface were obtained from 120 specimens ($n = 20$/group) prepared from extracted sound human third molars and randomly divided into three groups according to the dentin substrate: sound-control (S), artificial carious (C) and artificial eroded (E). Half of these specimens were pre-treated with distilled water (W) and other half with 2% digluconate chlorhexidine (CHX), constituting six subgroups: S-W, S-CHX, C-W, C-CHX, E-W, E-CHX. After, all the specimens were restored with a universal adhesive system (Apder Single Bond Universal) using self-etching mode and two increments of composite resin (Filtek Z-350), following manufacturer's instructions. Sticks (0.64 mm^2) were obtained and evaluated by means of microtensile bond strength test (μTBS) in universal testing machine (500 N/0.5 mm/min) after 24 h. Data was statistically analyzed by two-way ANOVA and Tukey tests ($p < 0.05$).

Results: Means and standard deviation (MPa) was: S–W 39.27 (10.16), S-CHX 40.55 (15.75), C-W 27.67 (13.09), C-CHX 24.09 (7.21), E-S 25.73 (12.64), E-CHX 25.83 (10.71). The substrate type was the only significant factor ($p < 0.001$), whereas the pretreatment ($p = 0.737$) and the interaction between factors ($p = 0.638$) were not significant.

Conclusions: Carious and eroded dentin substrates negatively interfered on the bond strength of an MDP-based universal adhesive systems, regardless its use with CHX. Likely, the reduction of available calcium from these substrates impaired the interaction of this system.

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Zirconia-ceramic versus metal-ceramic: Thermal expansion mismatch and residual stresses

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Purpose/aim: Title: Zirconia-ceramic versus metal-ceramic: thermal expansion mismatch and residual stresses (Está igual ao artigo) Keywords (recomend minimum3, separated by commas): dental porcelain; stress, mechanical; finite element analysis. (Maximum of 2000 characters, including spaces) The objective of this study was to test the hypothesis that the thermal expansion mismatches (Δα) of veneered-zirconia systems could be responsible for high thermal residual stresses, which could justify the greater frequency of chipping.

Materials and methods: A finite element analysis was performed on flat specimens with 0.7 mm-thickness of framework and 1.5 mm-thickness of porcelain veneer. The models simulated eight Δα conditions, resulting from the combination of two framework materials (zirconia and metal) and six veneering porcelains (diferentes CTE values). Four of the models presented Δα considered thermally compatible for metal (Δα of 0.4 and 0.9 ppm C^{-1}) and for zirconia (Δα of 1.3 and 1.7 ppm C^{-1}), two presented the same Δα for metal and zirconia (1 ppm C^{-1}) and two presented negative Δα (−2.6 and −3.1 ppm C^{-1}), simulating zirconia framework combined with porcelain for metal. The simulation was consisted of two steps: (1) heat conduction analysis, in which a slow cooling of the specimen between 600 °C and 25 °C was represented, generating the result of temperature variation along the cooling for each point of the model, and (2) mechanical analysis, in which residual thermal stresses were analyzed from the temperature variations obtained in the first analysis. The distributions of the maximum principal stress (σ1), the minimum principal stress (σ3) and the stress in the parallel direction along the long axis of the specimen (σx) were analyzed.

Results: When zirconia frameworks were combined with metal-compatible-porcelains (cases of negative Δα), the residual stresses values were even higher, with inversion of the distribution pattern. When the Δα of metal-based and zirconia-based models were similar, there was no difference in thermal residual stresses pattern or magnitude.

Conclusions: A possible solution to avoid chipping on veneered-zirconia prosthesis would be to enhance the ther-

mal contraction adjustment of the materials, so that the $\Delta\alpha$ becomes zero.

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Challenges in measuring fracture toughness of dental ceramics: SEPB method

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Purpose/aim: The fracture toughness is an intrinsic material property that is not affected by the superficial and internal defects present in the material in contrast to the fracture strength. It can be obtained by various methods such as precracked beam, chevron-notched beam, and surface crack in flexure (ASTM C1421). This study aimed to determine the fracture toughness of two widely used dental ceramics using the single edge precracked beam (SEPB) method (ISO 15732).

Materials and methods: Eight rectangular beam specimens were prepared from blocks for each of two dental ceramic prosthetic materials: lithium disilicate glass-ceramic (e.max CAD, Ivoclar Vivadent) and yttria-stabilized tetragonal zirconia polycrystal (Y-TZP) (e.max ZirCAD, Ivoclar Vivadent). These specimens were subjected to crystallization and sintering processes, respectively, per manufacturer instructions. The specimens were polished to final dimensions of 4 mm width, 3 mm thick, and ~29 mm length followed by creation of a notch on the 4 mm face using a diamond disk. Specimens were placed in a precracking fixture with the notch on the tensile side and loaded at a rate of 300 N/s until a pop-in sound was detected using a stethoscope. The precracked specimens were subjected to 4-point bending in water at room temperature at 9.3 N/s until completely fractured. The load at fracture was also recorded. Fractured specimens were examined under the scanning electron microscope (Supra 40, Zeiss, USA), and the average length of precrack was measured followed by fracture toughness calculation according to ISO 15732.

Results: The mean fracture toughness of lithium disilicate glass-ceramic was calculated as $2.09 \pm 0.04\ \mathrm{MPa}\sqrt{\mathrm{m}}$. Lithium disilicate specimens that had too large of precracks were rejected ($n = 4$). For the Y-TZP group, 7 out of 8 specimens were rejected because of the following reasons: complete fracture during precracking ($n = 3$), too large of a precrack ($n = 1$), and no pop-in sound by 22 kN load ($n = 3$).

Conclusions: The SEPB method produces sharp precracks, but it is difficult to produce a stable precrack consistently across the specimens making it an impractical and unpredictable method for calculating the fracture toughness of the material, especially in the case of Y-TZP ceramic. Another method should be used for fracture toughness determination of Y-TZP ceramic.

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Newly identified peptides against Candida biofilm formed on acrylic resin

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Purpose/aim: Preview study demonstrated that in vivo-acquired enamel pellicle is a sophisticated biological structure containing a significant portion of naturally occurring salivary peptides. From a functional aspect, the identification of peptides in the acquired enamel pellicle is of interest because many salivary proteins exhibit functional domains that maintain the activities of the native protein. Among the in vivo acquired enamel pellicle peptides that have been newly identified, 5 peptides are derived from statherin. It is well-kwon that salivary proteins can retain multiples functions in your amino acid chain. For example, histatin 1, a phosphoprotein, is able to prevent enamel demineralization and promote the killing of Candida albicans. It is important because biofilm formation of *Candida albicans* is the first important step responsible for opportunistic infections as oral candidiasis. For this, the aim of this study was evaluate the ability of statherin and its peptides (DR9, DR9-2, GE-12, GQ-19, IT-32, IP-18) to inhibit the biofilm formation of Candida albicans on acrylic denture base resin.

Materials and methods: Sample discs (Lucitone 199, Dentsply, York, Pa, USA) were prepared ($N = 72$) by short cycle according to the manufacturer's recommendations. After samples disinfection, the acrylic resin discs ($n = 3$) were randomly placed on a 24-well polystyrene plate (Corning Inc., Corning, NY, USA) and 2 ml of the solution containing IC_{50} of the proteins was added for the pellicle formation. Then, Candida albicans biofilm (48 h) was formed thereon. Biofilm formation after peptides treatment was evaluated by counting the colony forming units (CFU). To assess the results, analysis of variance was applied, followed by Tukey test, with 5% significance level for decision-making.

Results: The results of this study are described in Table 1. Films incorporated with statherin and peptides (DR9, DR9-2, GE-12, GQ-19, IT-32, IP-18) provided a reduction around one log

Table 1 – CFU mL^{-1} (log 10) and standard deviation of the values obtained for each group.

Treatment	CFU		
	$\log_{10}$ (CFU/mL^{-1})		% Viability
Statherin	7.3 (0.06)	b	87.5
DR9	7.4 (0.05)	b	88.3
DR9-2	7.5 (0.03)	b	88.8
GE-12	7.4 (0.09)	b	88.3
GQ-19	7.6 (0.02)	b	90.3
IT-32	7.5 (0.09)	b	89.1
IP-18	7.4 (0.02)	b	88.4
Control Ca	8.4 (0.03)	a	100.0

Means followed by the same letter according with the test, were not significantly different (Tukey test: $p > 0.05$).

cycle in the growth of *C. albicans* relative to the control (biofilm without the presence of peptides).

Conclusions: Preliminary findings suggest that statherin and peptides (DR9, DR9-2, GE-12, GQ-19, IT-32, IP-18) reduce *C. albicans* biofilm on acrylic resin samples. The clinical applications of this study could involve a novel antifungal treatment based on statherin peptides to control *C. albicans* biofilm formation and consequently avoiding opportunistic infections as oral candidiasis.

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Physical–mechanical characterization of nanotechnology into conventional GIC

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Purpose/aim: The aim of this in vitro study was characterize the physical and mechanical performance of TiO_2 nanotubes incorporated into conventional glass-ionomer cement (GIC).

Materials and methods: Nanotubes (size ~20 nm; diameters ~10 nm), synthesized by the alkaline route were added at 0% (control), 3%, 5% and 7% (w/w) to GIC's (Ketac Molar EasyMix™) powder component. Specimens were prepared to the following assessments: (1) X-Ray Diffraction (XRD) ($n = 2$)–Cu-Kα radiation reflection, 35 kV, 30 mA, 0.075° 2θ, 4 s/peak; (2) Fourier-transform Raman (FT-Raman) ($n = 4$) (2 × 5 mm)–backscattering configuration and Ar-ion laser beam (785 nm; 10 mW; 3 cm^{-1}; 50 ×); (3) Water Sorption (WS) and Solubility (SO) ($n = 9$) (2 × 5 mm) using daily cycle that specimens were weighed before/after immersion in water and desiccation. WS and SO were calculated using the equations (M2–M3)/V and (M1–M3)/V ($\mu g/mm^3$), respectively; (4) Compressive (CS) and Flexural Strengths (FS) ($n = 10$) (4 × 6 mm and 25 × 2 × 2 mm, respectively)–using a universal testing machine (200 kgf, 1.0 mm/min). Data were submitted to Shapiro–Wilk, ANOVA and Tukey tests ($\alpha \leq 0.05$).

Results: XRD analysis showed TiO_2 to be found in the anatase crystalline phase. FT-Raman analysis indicated that GIC and TiO_2 nanotubes presented physical, rather than chemical, interaction. TiO_2 nanotubes shape was not modified at concentration of up to 5%, whereas at 7% GIC's matrix was characterized by TiO_2 nanotubes agglomeration. While no significant difference was detected between the experimental conditions regarding WS ($p \leq 0.05$), the addition of 5% TiO_2 significantly improved WS of conventional GIC compared to other experimental groups ($p \leq 0.05$). GIC-containing 5% TiO_2 improved the CS and FS compared to the unmodified GIC, 3% TiO_2 and 7% TiO_2.

Conclusions: In conclusion, the incorporation of 5% (w/w) TiO_2 nanotubes to conventional GIC represents a promising strategy to improve the GIC's physical and mechanical properties.

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Bond strength of experimental adhesives with 10-MDP and diphenyl-iodonium salt

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Purpose/aim: The objective was to evaluate the bond strength of six experimental adhesive systems containing camphorquinone/amine and camphorquinone/amine/DPIHFP photoinitiator systems, associated with three different concentrations of 10-MDP (0% 6% or 12%) after 12 m of storage in distilled water at 37 °C.

Materials and methods: Fifty-four sound human molars crowns were included in PVC cylinders with self-cured acrylic resin. Six experimental adhesives were prepared containing CQ/amine or CQ/amine/DPIHFP as photoinitiator and three different concentrations of 10-MDP (0%, 6% or 12%). The adhesive systems were applied following the etch-and-rinse protocol. Transparent cylindrical molds were placed on the

Table 1 – Mean and standard deviations for the bond strength of the adhesives tested.

		Bond strength (MPa)		
Photoinitiator	% 10-MDP	24 h	6 months	12 months
Without DPIHFP (CQ/amine)	0%	10.04 ± 7.91^{a}	6.15 ± 2.89^{abcd}	3.86 ± 2.87^{bcd}
	6%	5.05 ± 4.07^{abcd}	9.37 ± 5.04^{abc}	5.17 ± 32.6^{abcd}
	12%	4.92 ± 2.87^{abcd}	5.24 ± 3.65^{abcd}	5.95 ± 3.65^{abcd}
With DPIHFP (CQ/amine/DPIHFP)	0%	4.15 ± 3.1^{bcd}	3.77 ± 1.79^{d}	3.52 ± 2.07^{d}
	6%	9.56 ± 7.44^{ab}	2.78 ± 1.40^{d}	3.72 ± 2.29^{d}
	12%	6.29 ± 4.35^{abcd}	7.80 ± 4.92^{abcd}	5.59 ± 3.48^{abcd}

Values followed by the same superscript letters are statistically similar ($p > 0.05$).

hybridized dentin filled with composite resin and photoactivated. The specimens were stored in distilled water at 37 °C for 24 h, 6 m or 12 m and submitted to a micro-shear bond strength test ($n = 15$) at a crosshead speed of 0.5 mm/min. Data were statistically analyzed by three-way ANOVA (10-MDP concentration, addition of DPIHFP and storage time) and Tukey's test ($\alpha = 5\%$).

Results: The bond strength results are shown in Table 1. It can be observed that statistically significant differences were found in groups MDP 0% without DPIHFP at 24 h (10.04 ± 7.91 MPa) and 12 months (3.86 ± 2.87 MPa); and in groups MDP 6% with DPIHFP at 24 h (9.56 ± 7.44 MPa), 6 months (2.78 ± 1.40 MPa) and 12 months (3.72 ± 2.29 MPa). Significant differences were also seen at 24 h for MDP 0% with DPIHFP (10.04 ± 7.91 MPa) and without DPIHFP (4.15 ± 3.1 MPa).

Conclusions: The addition of DPIHFP in the photoinitiator system and the concentration of MDP did not influence the bond strength to dentin. For all groups evaluated, the bond strength decreased after 12 months of storage in distilled water.

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Reinforcement of fast-prototyping resin by Nb_2O_5 nanoparticles for dental application

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Purpose/aim: To boost digital workflow approach in dentistry, the improvement of the mechanical and biological properties of 3D printed materials applications is essential. Niobium pentoxide nanoparticles (Nb_2O_5) have shown bioactive properties, such as hydroxyapatite crystal growth, high mechanical properties and similar optical characteristics to the dental structure. Therefore, the purpose of this study is to evaluate mechanical properties of a composite for 3D printer reinforced with Nb_2O_5.

Materials and methods: Nanoparticles of Nb_2O_5 in orthorhombic crystallographic phase (Nb_2O_5) was milled for 1 h in a high-energy planetary ball mill. It was used zirconia vial/beads. The resulted functionalized nanoparticles were then mixed into fast-prototyping resin (Next DentTM C&B) (ND) varying concentrations by weight: 0.3%, 0.5%, 1% and 5%. Controls for comparison were fast-prototyping resin without nanoparticles. Knoop hardness surface (H, $n = 6$) was conducted by the arithmetical average of 3 indentations per specimen using a microhardness instrument (Buehler, USA). Flexural strength (σ, $n = 5$) was measured in specimens (2 × 2 × 6 mm) by the 3-point bending test in a universal testing machine (INSTRON 3334). The nanostructures were characterized by Scanning Electron Microscopy (SEM). To evaluate the nanostructure's dispersion into the resin, SEM images were also conducted in fractured specimens for all tested groups. Quantitative data were analyzed with one-way ANOVA and Tukey's test ($\alpha = 0.05$).

Results: The distribution of Nb_2O_5 particles was homogeneous throughout the resin matrix in all specimens. For H, the inclusion of Nb_2O_5 showed higher values for 0.3 and 0.5% of Nb_2O_5, differing from the control group ($p < 0.05$). For σ, 0.3 and 0.5% of Nb_2O_5 presented higher values than 1 and 5% (Table 1).

Conclusions: Lower concentrations of Nb_2O_5 particles seem to be promising to improve the mechanical properties of fast-prototyping resins.

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Influence of veneering technique on the fit of metal-ceramic crowns

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Purpose/aim: The objective was to evaluate the influence of ceramic veneering technique on the marginal and internal fit (MIF) of metal-ceramic crowns.

Materials and methods: One acrylic resin master model was used, representing a preparation for metal-ceramic crowns in a lower molar. Co–Cr copings were prepared using CAD-CAM milling of sintered block (Ceramill Sintron, Amann Girrbach). The MIF was analyzed using the silicone replica technique in four assessment points: marginal gap (MG), axial wall adaptation (AW), adaptation in the occlusal–occlusal angle (AO) and adaptation in the centro-occlusal area (OC). After this initial analysis, veneering ceramics (HeraCeram and HeraCeram Press, Heraeus-Kulzer) were applied using two techniques (vibration–condensation–conventional method, and heat-pressing). MIF was again evaluated in the

Table 1 – Mean values with SD for Flexural strength and Hardness.

Analysis	Control	Niobium nanoparticles (%)			
		0.3	0.5	1	5
Flexural strength (MPa) (n = 5)	76.5 ± 3.4BC	102.4 ± 13.2AB	101.6 ± 14.6AB	62.9 ± 18.4CD	40.6 ± 7.0D
Hardness (Kgf) (n = 5)	36.8 ± 10.8BC	44.0 ± 3.1A	43.0 ± 4.3A	36.2 ± 2.84BC	29.18 ± 2.71D

Values in the same line with different superscript upper-case letters significantly differ from each other ($p < 0.05$)

Table 1 – Effect of veneering techniques.

Assessment points	Coping	Vibration-condensation	Coping	Heat-pressing
MG	104.18 ± 8.80^{a}	97.94 ± 9.78^{a}	111.23 ± 13.19^{a}	101.89 ± 19.08^{a}
AW	106.06 ± 14.90^{a}	93.25 ± 11.70^{a}	112.98 ± 20.03^{a}	100.18 ± 10.52^{a}
AO	116.3 ± 9.64^{a}	108.54 ± 9.26^{b}	129.38 ± 16.63^{a}	118.63 ± 12.96^{a}
CO	137.98 ± 16.71^{a}	127.65 ± 9.82^{a}	142.43 ± 18.52^{a}	129.23 ± 10.29^{a}

For each point and application technique, values followed by the same superscript are statistically similar ($p > 0.05$).

four assessment points. Data were statistically analyzed by paired Student's *t*-test ($\alpha = 5\%$).

Results: For vibration-condensation technique, there was a statistically significant difference only at AO ($p < 0.001$). For the heat-pressed technique, there was no statistically significant difference for any of the evaluated points (Table 1).

Conclusions: It can be concluded that the two ceramic veneering techniques did not negatively influence the marginal and internal fit of Co-Cr milled copings.

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Color alteration promoted by violet led for in-office bleaching

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Purpose/aim: This study evaluated the efficacy of a novel violet LED light (LED) associated or not with high-concentrated carbamide (CP) or hydrogen (HP) peroxide bleaching agents on the immediate and short-term tooth color alteration.

Materials and methods: Sixty bovine incisors specimens were stained with black-tea solution and submitted to bleaching with ($n = 10$): violet LED light (LED); LED associated with 35% HP (LED/HP); LED associated with 37% CP (LED/CP); 35% HP (HP); 37% CP (CP) and control–no treatment group (C). In-office bleaching with violet LED (Bright Max Whitening, MMOptics) was performed with 20 irradiations of 1 min at 30-s intervals among irradiations in ten sessions. In-office bleaching with HP (HP, FGM) or CP (SuperEndo, FGM) was carried out for 30-min and all bleaching protocols were performed in three sessions, even when associated with LED. Specimens were stored in artificial saliva among intervals at 37 °C. Color alteration (ΔE) was evaluated with a hand spectrophotometer (Vita EasyShade, VITA) after staining (Ts), after bleaching (Tb) and 7 d after bleaching (T7) based on the CIE Lab parameters (L^*, a^*, b^*). Data were statistically analyzed by ANOVA and Tukey test ($\alpha = 5\%$).

Results: LED/HP, LED/CP and HP treatments exhibited similar ΔE, regardless the evaluation time ($p > 0.05$). CP and LED treatments displayed significantly lower ΔE than the other treatments ($p < 0.05$), but all bleaching procedures presented higher ΔE than C group ($p < 0.05$). Enamel luminosity (L^*) was maintained between Tb and T7 for all groups ($p > 0.05$), but LED/CP promoted higher L^* than CP at Tb and T7 ($p < 0.05$). LED/PH and PH were the only groups to decrease b^* values 7 d after bleaching.

Conclusions: Violet LED associated with chemical agents was more effective in promoting bleaching than violet LED alone; yet, LED was capable of enhancing the efficacy of CP. Enamel luminosity was preserved 7 days after bleaching and LED/HP and HP were able to reduce enamel yellowish (*b), even 7 d after treatment.

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Use of recycled zirconia for thermoactivated PMMA reinforcement

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Purpose/aim: This study evaluated the effects of the addition of recycled ZrO_2 particles on characteristics, such as flexural strength and roughness, of thermoactivated PMMA.

Materials and methods: 60 specimens were prepared according to ADA specification #12 (67 mm × 12.60 mm × 3.00 mm). The test specimens were divided into 5 groups ($n = 12$) according to the zirconia type and the percentage added to PMMA (PMMA control group, PMMA + commercial ZrO_2 group 2.5%, PMMA + commercial ZrO_2 group 5%, PMMA group + Recycled ZrO_2 2.5%, recycled PMMA + ZrO_2 group 5%). The commercial zirconia particles used had 99.9% purity with 100 nm particle size and the recycled ones were from the cut of pre-sintered YTZP zirconia blocks. The specimens were analyzed in a Digital Optical Profilometry Taylor Hobson–CCI MP the surface roughness evaluation. The measurements of the 3D parameters were performed with an increase of 20×, covering an area of 0.8 × 0.8 mm over the central portion of the specimen, with a 0.25 mm cutoff. The software (TalyMap Lite) provided a plot of the surface roughness profile for each sample using three-dimensional images. For each test specimen a mean surface roughness (Sa) in micrometers (μm) was obtained. The three-point bending test was performed using a universal test machine with a load cell of 5 kN at a constant speed of 5 mm/min. The flexural strength (MPa) is calculated by the formula S = 3FL/2bd2. The statistical tests used were Kruskal–Wallis *F* test (ANOVA) or *F* (ANOVA), at 5% significance.

Results: The results show that the control group had a higher roughness (0.19) and the commercial PMMA + ZrO_2 group 5% (0.13) showed the lowest, which were significant ($p < 0.05$). The highest value of flexural strength was found for the control group (92.99) and the commercial group PMMA + ZrO_2 5% (92.35), with no statistical difference between them ($p < 0.05$). The PMMA + ZrO_2 group recycled 5% with the lowest flexural strength value.

Conclusions: The addition of recycled zirconia particles decreased the flexural strength of PMMA, however it has reduced its roughness. In addition, they presented lower values compared to the commercial zirconia particles, for the evaluated properties.

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Biological properties of experimental poly (E-caprolactone) nanofibers scaffolds

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Purpose/aim: The aim of this study was to develop experimental nanofibers scaffolds and to evaluate their biological effects on cultured human dental pulp cells (hDPCs).

Materials and methods: Poly (E-caprolactone) (PCL) solutions of 10, 12.5 and 15% were submitted to electrospinning technique to obtain scaffolds with nanofibers disposed randomly. The morphological characterization of these scaffolds was performed by SEM. Then, the hDPCs were seeded on the scaffolds to assess the viability and proliferation (AlamarBlue; Live/Dead) of these cells as well as their adhesion and spreading (F-actin) on the substrates (1, 3 and 7 d). In control group, cells were seeded on round-shaped cover glasses. Data were submitted to ANOVA/Tukey test's ($\alpha = 5\%$).

Results: Experimental scaffolds exhibiting uniform nanofibers with thicknesses directly proportional to the polymer concentration were observed. Scaffolds formulations with 10 or 12.5% PCL were cytocompatible throughout the time-points ($p > 0.05$). However, the hDPCs seeded on the 12.5% PCL scaffolds presented lower viability compared to the control group at 7-day period ($p < 0.05$). Reduced amount of viable cells was observed on the 15% PCL scaffolds for all time-points. The best results of cell adhesion and spreading were determined for the 10% PCL scaffolds.

Conclusions: According to the methodology used in this laboratorial study and based on the scientific data obtained, it is possible to conclude that nanofibers scaffolds synthesized with 10% poly (E-caprolactone) induce proliferation, adhesion and spreading of human dental pulp cells cultured, being considered as a biologically acceptable biomaterial.

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Y-TZP ceramic flexural strength: Extrinsic pigmentation and surface treatments influence

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Purpose/aim: Evaluate the influence of extrinsic pigmentation on the biaxial flexural strength and surface topographic of translucent Y-TZP (InCoris TZI–Sirona–USA) submitted to several surface treatments.

Materials and methods: Sintered zirconia discs-shaped specimens ($n = 120$) (ø: 12 mm; thickness: 1.2 mm; ISO 6872) were prepared and divided ($n = 15$) according to the factors "extrinsic pigmentation" (*n*: without; *p*: with) and "surface treatment" (C: control–as sintered; R: Silica-coated abraded (30 μm); G: Glaze with a thin film of low-fusing porcelain glaze; GA: Glaze and acid etch with hydrofuoridic acid 10%/60s). Mechanical cycling (1.2 × 106 cycles, 200 N, 3.8 Hz) and flexural strength test (1 mm/min–1000 kg cell) were performed. Two-way ANOVA and Tukey's were used as statistical test ($\alpha = 0.05$). Weibull analysis was used to evaluate the strength reliability. Samples were analyzed via (1) optical profilometer to determine the surface roughness (Ra); (2) X-ray diffraction (XRD) to evaluate phase transformations; (3) Morphological and chemical analysis was performed using SEM equipped with energy dispersive X-ray (EDX) device.

Results: Regardless the surface treatment ($p = 0.5459$) (Cn: 560.16 MPa; Gn: 573.36 MPa; Rn: 643.51 MPa; GAn: 542.94 MPa; Cp: 628.04 MPa; Gp: 641.90 MPa; Rp: 554.47 MPa; GAp: 602.84 MPa) and extrinsic pigmentation ($p = 0.1280$) there was no difference in the flexural strength among the experimental groups. According to DRX analysis, phase transformation occurred in the Rn group (T→M) and in Rp group (T→C). Surface roughness was affected by surface treatment (Rn ($p = 0.001$)) and extrinsic pigmentation (Gp ($p = 0.001$)).

Conclusions: The biaxial flexural strength of the tested samples was not affected neither by surfaces treatments nor by pigmentation, although it can cause phase transformation and promote surface roughness.

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Influence of novel plant-derived monomers on bonding to dentin

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Purpose/aim: This study aimed to evaluate the influence of novel monomers on the biomodification of resin–dentin bond strength, nanoleakage, and micropermeability in sound and caries-affected dentin.

Materials and methods: Human dentin segments were assigned to five groups according to the following dentin pretreatment solutions: absolute ethanol (control), 2 wt% grape seed extract, 2 wt% cardol (from cashew nut shell liquid), 2 wt% cardol-methacrylate, and 2 wt% cardanol-methacrylate, for sound dentin or artificial caries-affected dentin over two storage periods (24 h and 1 year). Microtensile bond strength ($n = 6$), dentin micropermeability ($n = 3$), and interfacial nanoleakage ($n = 6$) were assessed using a universal testing machine, confocal-laser scanning microscope, and scanning electron microscope, respectively.

Results: In sound dentin, no difference was observed between the groups in both periods. In caries affected-dentin, the pretreatment with cardol-methacrylate resulted in statistically significantly higher bond strength than did all the other treatments in both storage periods. Cardol-methacrylate treatment resulted in less nanoleakage and better interfacial integrity than did the other treatments in caries-affected dentin. On the micropermeability analysis, all treatments showed deficient sealing ability when applied on caries-affected dentin, with the presence of interfacial gaps in the control group.

Conclusions: In conclusion, cardol-methacrylate is a promising monomer to reinforce the hybrid layer, since it preserved the resin–dentin bond strength up to the 1-year follow-up in both sound and caries-affected dentin.

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Bis(p-tolyl)iodonium hexafluorophosphate as co-initiator for light curing resins

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Purpose/aim: The aim of the present study was to evaluate ternary initiator systems and its influence on degree of conversion, volumetric shrinkage and flexural strength and modulus of experimental resins.

Materials and methods: Light-curing resin composites (50/50% wt BisGMA/TEGDMA + 60 wt% inorganic filler) were prepared. For all groups camphorquinone (CQ-1 mol%) and ethyl 4-(dimethylamino)benzoate (EDAB-2 mol%) were used as initiator and co-initiator. Eight experimental groups were established according to the onium salt used (Bis(p-tolyl)iodonium hexafluorophosphate-BPI or diphenyl iodonium hexafluorophosphate-DPI) with different concentrations (0.25, 0.5, 0.75 and 1 mol%). One group with thou onium salt was used as control. The real-time polymerization was monitored using a Fourrier transformed infra-red spectrometer (FTIR). The real-time volumetric shrinkage was analyzed using a linear variable displacement transducer (LVDT). Flexural strength and modulus were evaluated using the three point bending test. The obtained results were analyzed by ANOVA and Tukey's test ($\alpha = 0.05$).

Results: DPI and BPI increased the conversion at the first 10 s, however the final conversion was similar than the control. The rate of polymerization, volumetric shrinkage and maximum rate of shrinkage were significantly higher for the resins containing DPI and BPI than the control group. BPI and DPI increased the flexural strength and modulus of the resins.

Conclusions: It can be concluded that DPI and BPI can increase the rate of polymerization, volumetric shrinkage and flexural strength and modulus of the resins, without promote a higher degree of conversion compared to the control.

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Effectiveness of silane- and MDP-based primers bond to zirconia

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Purpose/aim: To evaluate the effect of different mechanical and chemical pre-treatments on modifying yttria-tetragonal zirconia polycrystal (Y-TZP) surface and enhancing resin-mediated zirconia bond.

Materials and methods: Fully-sintered Y-TZP slabs were air-abraded with 45 μm alumina particles (S–sandblasting) or with 30 μm silica-coated alumina particles (C–tribochemical treatment). Then, all specimens were ultrasonically cleaned for 10 min in distilled water and air-dried. Samples received different chemical treatments: no treatment (S or C), silane-containing ceramic primer (RCP), MDP (10-Methacryloyloxydecyl dihydrogen phosphate) and silane-containing ceramic primer (CCP), MDP-containing primer (AL) and MDP-containing adhesive (CUB). The water contact angle on zirconia surface as a function of roughness (μm) and 3D surface roughness parameter (Sdr) were measured using the Fringe Projection Phase Shifting (FPPS). Resin cement microshear bond strength (μSBS) specimens were built on the zirconia surface and tested after either 24 h or 8 months water storage (37 °C). Additionally, air-abraded Y-TZP surface was characterized by scanning electron microscope (SEM) and Energy dispersive X-ray (EDX) microanalysis. The chemical interactions of the primers to zirconia were analyzed using time-of-flight secondary ion mass spectrometry (ToF-SIMS). The original?SBS values, μm values and Sdr values were statistically analyzed using two-way Analysis of variance (ANOVA) and post hoc Sidak test ($\alpha = 0.05$).

Results: ANOVA showed that mechanical treatment, chemical treatment and the interaction between them had a significant effect ($p = 0.003$) on μm values. Chemical treatment, mechanical treatment and the interaction between them significantly influenced (0.003) the roughness parameter. Mechanical treatment ($p = 0.000$) and the interaction between chemical treatment and storage time factors had a significant effect ($p = 0.000$) on μSBS values. SEM of the alumina-blasted and tribochemically-coated zirconia indicated a similar topography for both substrates. EDX analysis revealed a scatter amount of silicon and aluminum over the Y-TZP surface after tribochemical silica treatment. All MDP-treatment groups presented PO^{-2} and PO^{-3} fragments with various proportions, while groups AL and CUB showed higher proportions of PO^{-3}.

Conclusions: Air-abrasion and primer/adhesive application on Y-TZP surface affected properties that are critical for bonding: roughness and hydrophilicity. Furthermore, chemical treatment only seems not to improve the bond strength between resin cement and Y-TZP, since μSBS results for most of the groups did not remain stable over 8 months. However, the use of MDP-containing primer combined with mechanical treatment appears to be essential to obtain stable bond durability to zirconia.

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Processing variables influence strength and reliability of a lithiumsilicate glass ceramic

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Purpose/aim: Crystallization time and temperature as well as cooling ceramic restorations from firing temperature seems to play a significant role on fracture incidence as residual internal stresses might build up. Recent research has pointed out a weak reliability (low Weibull modulus) for lithiumsilicate (LS) glassceramics (Wendler et al. Dent Mater 2017; 33:99–109). The aim of this work was to investigate the strength and reliability of LS depending on process variations during the crystallization firing.

Materials and methods: Biaxial discs (12 × 12 × 1.2 mm) were cut from a lithiumsilicate glassceramic two-step CAD/CAM block material (Vita Suprinity PC, Vita, Bad Säckingen, G) using a low speed water-cooled diamond saw. Eight experimental groups ($n = 30$ each) were prepared accounting for variations in crystallization time (groups 2, 3, 4), temperature (groups 2, 5, 6, 7), and cooling rate (groups 2, 8) (see Table). All samples were crystallized in a Vita Vacumat 4000 furnace (Vita) at selected times and temperatures. Plate specimens were finally flat finished in a precision grinding device up to surface roughness < 1 micron and tested in a universal test-

Table 1 – Characteristic strength (σ_0) and Weibull modulus (m) values.

Group	Processing parameter	Characteristic strength σ_0	Weibull modulus m
1, pre-crystallized	–	199.63	3.4
2, reference cryst.	840 °C @ 8 min	457.42	5.5
3	840 °C @ 4 min	329.22	3.7
4	840 °C @ 12 min	538.62	4.8
5	800 °C @ 8 min	435.03	4.2
6	860 °C @ 8 min	482.21	3.7
7	880 °C @ 8 min	493.67	5.9
8	Slow cooling to 550 °C	412.91	10.4

ing machine (Zwick Roell, Germany) at 1.5 mm/min using the Balls-on-3-Balls biaxial flexure set-up. The data were analyzed using Weibull statistics.

Results: The characteristic strength sigma0 at 63.2% failure probability as well as the Weibull homogeneity parameter m are listed in the table. Significant increase in strength was achieved by extending the crystallization time up to 12 min while only adjustment of the cooling protocol led to a significantly increased Weibull modulus (Table 1).

Conclusions: The strength and reliability of Suprinity can be significantly improved by adjusting the processing parameters. An extended crystallization time combined with a retarded cooling protocol will help to enhance the mechanical performance and in turn prevent spontaneous fractures of dental restorations. Extension of firing temperatures above 860 °C is leading to dimensional changes of the specimens and is thus not recommendable.

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Effect of dentin moisture protocols on cementation of fiber post

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Purpose/aim: The aim of this study was to investigate the influence of selective acid etching and simplified chemical control protocols for dentin moisture on the push-out bond strength (PBS) and nanoleakage (NL) of the post/cement/dentin interface.

Materials and methods: Thirty-two unirradicular roots were endodontically prepared and randomly distributed into 4 groups ($n = 8$). The roots received the following surface treatments: G1 (Dry technique): 5% acid conditioning, moisture control with 100% ethanol and drying; G2 (Ethanol 100% technique): acid conditioning 35%, moisture control with 100% ethanol; G3 (Ethanol 50% technique): acid conditioning 35%, moisture control with ethanol 50%; G4 (Wet technique): acid conditioning 35%, moisture control with absorbent cone. Fiberglass posts (Reforpost # 1) were cemented using the fixation system: Ambar APS adhesive system and AllCem dual resin cement (FGM). Then the photoactivation (LD Max–Gnatus) was performed using standard irradiance of 600 mW/cm^2 for 40 s, and repeated three times in the directions: perpendicular to the post and at 45 degrees by buccal and lingual. The roots with the cemented post were stored for 24 h under wet conditions at 37 °C and then were sectioned perpendicular to the long axis into 1-mm serial slices under water cooling to obtain the specimens for PBS and NL analysis. The NL was evaluated by SEM after the immersion of specimens in 50% silver nitrate (one slice of middle third of each root $n = 8$). Data were analyzed using the Kruskall–Wallis and Mann–Whitney test.

Results: The comparison of means between groups showed significant differences between groups 1, 2 and 3 with group 4. The proposed protocols did not influence the percentage of nanoleakage of the four experimental groups ($p = 0.143$). The chemical moisture control resulted in higher bond strength values (Table 1) independent of the protocol used (G1–+33%, G2–+43%, G3–+45%).

Table 1 – Mean push-out values (MPa) with SD.

Groups	Mean of push-out values (SD)	Pairwise comparisons between groups (p value)
Dry technique–G1	12.4 (3.9)	1 × 4 (0.011*) 2 × 4 (0.015*) 3 × 4 (0.012*) 1 × 2 (0.768) 1 × 3 (0.396) 2 × 3 (0.551)
Ethanol 100% technique–G2	13.4 (4.3)	
Ethanol 50% technique–G3	13.5 (6.8)	
Wet technique–G4	9.4 (3.6)	

* Mann–Whitney test with statistically significant differences.

Conclusions: The conditioning and moisture control protocols investigated in the study were promising to replace the traditional wet technique.

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Experimental adhesives containing DPHIF/10-MDP: Degree of conversion and biocompatibility

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Purpose/aim: The use of triple photoinitiators systems, in which diphenyl iodonium hexafluorophosphate (DPHIF) is added to the canphorquinone/amine system, can result in a substantial increase in the degree of conversion and the mechanical and biological properties. This study aimed to characterize through degree of conversion and biocompatibility analyses experimental adhesive systems containing photoinitiators systems canphorquinone/amine and canphorquinone/amine/DPHIF salt associated with 10-MDP, photoactivated with a conventional LED device or a broad spectrum one. This study evaluated three factors: photoinitiator system (in two levels), concentration of 10-MDP (in three levels) and curing unit device (in two levels). Two response variables were studied: degree of conversion and biocompatibility. Experimental adhesives were prepared containing canphorquinone/amine or canphorquinone/amine/DPIHP as photoinitiators and three different concentrations of 10-MDP (0%, 3% or 12%).

Materials and methods: The degree of conversion was evaluated by FTIR-ATR. The biocompatibility was evaluated by testing the cell viability, MTT and Crystal Violet. Experimental adhesives were photoactivated with two devices: broad spectrum LED curing unit and a conventional LED curing unit. The data were analyzed by ANOVA and Tukey ($\alpha = 0.05$).

Results: Significant differences were found between photoinitiator systems ($p = 0.007$) and 10-MDP concentration ($p < 0.001$). The photoactivating device was not significant

($p = 0.33$). The double photoinitiator system presented a lower degree of conversion in relation to the triple system. The degree of conversion increased with the addition of 10-MDP. All adhesives were considered biocompatible.

Conclusions: It was concluded that photoinitiator and the addition of 10-MDP influence the degree of conversion.

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Antimicrobial properties of experimental endodontic sealers containing vegetable extracts

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Purpose/aim: The aim of this study was to evaluate the physical properties and the antimicrobial effect of resin-based dual-cure experimental sealers after the incorporation of extracts obtained from Bixa orellana, Mentha piperita and Tagetes minuta species.

Materials and methods: Essential oils from Tagetes minuta and Mentha piperita and an ethanolic extract from seeds of Bixa orellana (10 wt%/vol) were obtained and characterized to determine their mains constituents and minimum inhibitory concentration (MIC) against Streptococcus mutans, Enterococcus faecalis and Candida albicans. After MIC determination, the vegetable extracts of *T. minuta*, *M. piperita*, and *B. orellana* were added to a dual-cure experimental sealer at a mass concentration of 0.5 wt%. RealSeal® (RS; SybronEndo, Glendora, CA) was used as a commercial reference. Materials were evaluated regarding flow, film thickness, dimensional stability, degree of conversion, radiopacity, and antimicrobial effect using the modified direct contact test. Data were analyzed using analysis of variance followed by the Tukey test in SigmaPlot 12.0 (Systat Software, Inc, Point Richmond, CA) ($\alpha = .05$).

Results: Main constituents for *T. minuta* and *M. piperita* were terpenoids, while for *B. orellana*, the main constituents identified were carotenoids and phenolic compounds. The tested essential oils exhibited antimicrobial activity against all tested microorganisms. The MICs of the vegetable extracts ranged from 0.25 to 12.5 μl/mL. All experimental sealers demonstrated antibacterial activity against *E. faecalis* after 1 h and 24 h of contact ($p < 0.05$). Furthermore, none of the materials demonstrated antifungal activity against *C. albicans* after 1 h of contact. However, at 24 h of contact, only *T. minuta* demonstrated antifungal activity. For *S. mutans*, only *T. minuta* and *B. orellana* groups demonstrated considerable antibacterial activity when compared to the positive control group after 24 h of contact ($p < 0.05$). None of the mechanical properties evaluated were negatively influenced by the addition of the essential oils ($p > 0.05$).

Conclusions: It could be concluded that incorporation of essential oils from of *T. minuta*, *M. piperita* and *B. orellana* in experimental sealers promoted antimicrobial effect against microorganisms associated with endodontic infections.

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Wettability of monolithic Y-TZP ceramic submitted to different surface treatment

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Purpose/aim: The objective of this study was to characterize a monolithic Y-TZP and evaluate its contact angle after several surface treatments (ST).

Materials and methods: Cube-shaped specimens were produced from monolithic Y-TZP (Lava Plus, 3 M ESPE) presintered blocks and randomly divided into five experimental group ($n = 5$), according to the ST performed in one of their largest surface area. The ST performed in the Y-TZP were: (a) without surface treatment (CO, Control); (b) tribochemical silicatization with 30 μm silica-coated alumina particles (ROC, Rocatec Soft™) after sintering; (c) application of metal primer (SZB, Signum Zirconia Bond) after sintering; (d) sandblasting with 45 μm Al_2O_3 particles (JAT B) before sintering and (e) sandblasting with 45 μm Al_2O_3 (JAT A) after sintering. Microstructural and chemical characterization, along with a topographic analysis, was made in all experimental groups by means of scanning electron microscopy and dispersive energy spectroscopy. The wettability of the experimental groups was defined by the contact angle formed by a drop of water on the treated surface of the specimens. The contact angle was measured for all specimens of the using a goniometer. The obtained data were submitted to a 1-way ANOVA and Tukey's test ($\alpha = 0.05$).

Results: The lowest contact angle or best wettability ($p = 0.000$) was presented by the ROC group ($30.85 \pm XX$ d3.85). The CO (30.83 ± 7.48 degrees) and JAT B (25.89 ± 4.90 degrees) groups presented higher wettability when compared to JAT A (50.27 ± 2.59 degrees). However, JAT A presented better wetting than the SZB group (105.58 ± 2.43 degrees).

Conclusions: In conclusion, the use of silica-coated alumina particles as a surface treatment seems to improve the wettability of Y-TZP suitable for monolithic restorations.

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Is it necessary to photoactivate bonding agents inside ceramic crowns?

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Purpose/aim: The aim of this study was to analyze the effect of the application and previous photoactivation of different adhesive systems on lithium dissilicate ceramics, with emphasis on the bond strength of cement-ceramic interface and the analysis of the mechanical properties (nanohardness and elastic modulus) of different adhesives systems and resin cement used.

Materials and methods: Forty-nine composite resin blocks (Z350XT A6B) and ceramic tablets (e.max CAD LT D3) which were divided into seven experimental groups ($n = 7$), according to the adhesive systems and photoactivation techniques of the materials inside the ceramic crown: Group 1: control (without adhesive system); Group 2: SBMP with no light-curing; Group 3: light-cured SBMP; Group 4: SB2 with no light-curing; Group 5: light-cured SB2; Group 6: SBU with no light-curing; Group 7: light-cured SBU. After the luting procedure with RelyX Ultimate, all specimens were submitted to thermocycling procedure (10,000 cycles). Sticks were then obtained for the analysis of microtensile bonding strength and nanohardness and elastic modulus of the resin componentes of the adhesive interface. Data were submitted to statistical analysis (ANOVA) and Fisher's test ($\alpha = 0.05$).

Results: The results showed that the SBMP with no light-curing and SB2 with no light-curing groups had the lowest values of bonding strength, while the highest values of the mechanical properties were achieved for the light-cured SBMP group, showing that the bonding strength as well as the mechanical properties was influenced by the interaction of materials. For mechanical properties analyzed, the light-curing of the adhesive systems did not present a statistically significant diference in the comparison between groups. In general, the application of adhesive systems on the silanized ceramic surface showed needless.

Conclusions: Among the adhesives studied, SBU was the only system that showed effectiveness with or without previous light activation. For the other adhesive systems, SBMP and SB2, the previous light activation was necessary to optimize the bonding strength of the adhesive interface.

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Y-TZP reinforced with reduced graphene oxide: Evaluation of processing conditions

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Purpose/aim: To develop a processing method for yttrium stabilized zirconia pollycrystal (YTZP) reinforced with reduced graphene oxide (rGO) and to verify the effect of rGO concentration on hardness and fracture toughness of the material.

Materials and methods: The composite production included several steps: (a) synthesis of Y-TZP powder by coprecipitation route, (b) synthesis of graphene oxide from chemical exfoliation of graphite (modified Hummer's method) followed by reduction with ascorbic acid, (c) sonication of reduced graphene oxide in Y-TZP suspension followed by drying (d) uniaxial pressing in metal device with diameter of 5 mm and (e) sintering in a conventional tubular furnace (Argon/4%hydrogen atmosphere) or spark plasma sintering (SPS). The concentration of rGO in Y-TZP was fixed between 0.01 and 2.0 wt%. Sintered samples were characterized by X-ray diffraction, scanning electron microscopy, density measurements, and Vickers method for hardness and fracture toughness determination (indentation fracture). Data were analyzed by ANOVA and Tukey's test with global significance level of 5%.

Results: Results (Table 1) showed that the procedure stablished for dispersion of rGO in the Y-TZP resulted in good physical homogeneity of rGO and Y-TZP. Regarding the sintering procedure, it was observed that conventional sintering in a controlled atmosphere was not effective for ceramic densification due to microcrack formation at the ceramic surface. For conventional sintering, the hardness obtained for the rGO concentration of 2% was significantly lower than those obtained for all other concentrations, however, for this processing method, fracture toughness was not affected by rGO concentration. For SPS, both fracture toughness and hardness were

Table 1 – Results about concentration of rGO in Y-TZP and sintering condition (Conventional sintering – CS and Spark plasma sintering – SPS): Density Theoretical (DT%), Hardness Vickers (GPa) and fracture toughness (MPa m$^{1/2}$).

Concentration (wt%)	Sintering condition	DT (%)	Hardness Vickers (GPa)	Fracture toughness (MPa m$^{1/2}$)
0	CS	96.76	8.83 ± 0.39 a	7.16 ± 0.69 a
0	SPS	94.99	12.35 ± 0.19 a	7.16 ± 0.48 ab
0.01	SPS	98.30	12.21 ± 0.21 a	6.10 ± 0.51 b
0.05	CS	93.15	9.41 ± 0.48 a	8.33 ± 2.11 a
0.05	SPS	95.52	11.44 ± 0.16 b	7.78 ± 0.38 a
0.10	CS	89.05	8.23 ± 1.56 a	7.11 ± 0.59 a
0.50	SPS	98.73	12.10 ± 0.23 a	7.77 ± 1.17 a
2.00	CS	86.73	6.13 ± 0.69 b	7.06 ± 0.59 a

affected by rGO concentration, with the lowest hardness mean value measured for the concentration of 0.05% and the lowest fracture toughness value measured for specimens with addition of 0.01% of rGO.

Conclusions: The production of the composite Y-TZP/rGO was proved possible, and sintering via spark plasma resulted in higher mechanical properties of the composite material compared to conventional sintering. rGO concentration affected the hardness of the composite for both processing methods (conventional and SPS), however fracture toughness was only affected by rGO concentration for specimens processed via SPS.

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A network meta-analysis of different light-activation to dental bleaching

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Purpose/aim: A systematic review with a network meta-analysis were performed to answer the following research question: "Is there any light-activation protocol capable of improving color change efficacy when associated to an in-office bleaching gel in adults?"

Materials and methods: Search was performed in PubMed, Scopus, Web of Science, LILACS, BBO, Cochrane Library and SIGLE, without restrictions date and/or language in April 23 2017 (updated on March 30 2018). IADR abstracts (1990–2018), unpublished and ongoing trials registries, dissertations and theses were also searched. Only randomized clinical trials conducted in adults that included at least one group treated with in-office dental bleaching with light-activation were included. The risk of bias (RoB) was evaluated used Cochrane Collaboration tool. A random-effects Bayesian mixed treatment comparison (MTC) model was used to combine light-activated vs. light-free in-office bleaching with direct light-free comparison trials. Meta-analysis with independently analysis (high- and low-concentrate hydrogen peroxide [HP]) was conducted for color change (ΔE^*, ΔSGU).

Results: After removal of duplicates, title and abstract screening, 28 studies remained. Nine were considered to be at low RoB; five were at a high RoB, the remaining were at an unclear RoB. The MTC analysis showed no significant difference in color change (ΔE^* and ΔSGU) between light-activation protocols and light-free in-office bleaching, regardless of the HP concentration in the efficacy of the bleaching.

Conclusions: No type of light-activated in-office bleaching was superior to light-free in-office bleaching for both high- and low-concentrate in-office bleaching gels (PROSPERO–CRD42017078743).

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File-splitting multilayer vs Y-TZP: Fatigue strength and finite element analysis

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Purpose/aim: To evaluate the flexural fatigue strength of ceramic structures obtained by the file-splitting techniques (fused and cemented) with both veneer and framework under tension in comparison with monolithic Y-TZP. In addition, finite element analysis (FEA) of the ceramic systems was performed to compare the model predictions with the experimental flexural fatigue strength values.

Materials and methods: Disc-shaped (diameter: 14.4 mm; thickness: 1.4 mm) monolithic Y-TZP (IPS e.max ZirCAD–Ivoclar Vivadent) and trilayer specimens with Y-TZP framework (IPS e.max ZirCAD), intermediate layer of fusion ceramic (IPS e.max CAD Crystall./Connect) or resin cement (Multilink Automix) and lithium disilicate veneer (IPS e.max CAD) were prepared according to ISO 6872:2008 and divided into five groups ($n = 20$): monolithic Y-TZP (M), fused file-splitting with framework under tension (F-FT), cemented file-splitting with framework under tension (C-FT), fused file-splitting with veneer under tension (F-VT) and cemented file-splitting with veneer under tension (C-VT). Fatigue flexural strength was determined (piston-on-three ball) by the staircase approach (750,000 cycles; 20 Hz). The first specimen of each group was tested at approximately 60% of the flexural strength determined in a previous monotonic test ($n = 3$). Increments adopted were approximately 10% of the initial strength. Mean and confidence intervals (CI) were calculated. FEA maximum principal stress was evaluated under the application of the experimental mean fatigue load.

Results: The fatigue strength was statistically different for all groups. Means and CI (MPa) were: M–405.92 (CI

Table 1 – Mean values with SD.

Group	Description	Material under tension	Monotonic strength (SD)	Fatigue initial stress	Step	Fatigue strength (CI)	FEA
M	Monolithic Y-TZP	–	689.86 (18.94)	413.92	40	405.92 (CI 397.58–414.26)	403
F-FT	Fused trilayer	Y-TZP framework	575.26 (11.03)	345.15	34.5	377.73 (CI 374.59–380.88)	367
C-FT	Cemented trilayer	Y-TZP framework	525.06 (0.53)	315.04	31.5	346.54 (CI 340.62–352.46)	366
F-VT	Fused trilayer	Lithium disilicate veneer	308.64 (22.11)	185.18	18.5	154.79 (CI 151.86–157.72)	147
C-VT	Cemented trilayer	Lithium disilicate veneer	160.83 (19.42)	96.5	9.6	100.34 (CI 97.42–103.26)	106

397.58–414.26), F-FT–377.73 (CI 374.59–380.88), C-FT–346.54 (CI 340.62–352.46), F-VT–154.79 (CI 151.86–157.72) and C-VT–100.34 (CI 97.42–103.26). The veneering technique and material under tension affected FEA stresses. FEA tensile stresses were similar to the mean experimental values (up to ≅10 MPa of variation), with the most discrepant calculated stresses for C-FT (≅20 MPa higher than experimental result). Table 1 shows the experimental groups, mean (standard-deviation) of the monotonic flexural strength, fatigue flexural strength and FEA calculated stresses (MPa).

Conclusions: Monolithic Y-TZP showed superior flexural fatigue strength than the fused and cemented file-splitting methods. Fused file-splitting could be an option for multilayer Y-TZP, since it had higher fatigue strength than the cemented technique. The ceramic under tension affected the flexural fatigue strength.

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Zinc phosphate with red propolis antimicrobial effect and tensile strength

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Purpose/aim: The aim of this study was to evaluate the tensile strength (TS) of metal copings cemented using zinc phosphate cement (ZPC) containing Alagoas Red Propolis (ARP) at different concentrations and the antimicrobial activity of the cement when tested against *C. albicans* and *S. mutans*.

Materials and methods: Sixty sound molars prepared for complete crowns were divided into 6 groups ($n = 10$): control (no ARP) and ARP concentrations of 0.5, 1, 2, 3, and 5%. The metal copings were made using CAD/CAM and, after cementation underwent TS test. The minimum inhibitory concentration (MIC) method was used to test antimicrobial activity of ZPC with different concentrations of ARP ($\alpha = 0.05$).

Results: One-way ANOVA indicated that the 0.5% ARP concentration had significantly higher TS than the 1 and 5% groups, although all the groups were not different from the control group ($p = 0.002$). As to MIC, one-way ANOVA showed statistically significant difference among the groups, both in the presence of *S. mutans* ($p < 0.001$) and of *C. albicans* ($p < 0.001$). Specifically, for *S. mutans*, the Tukey test showed that when ZFC had a 5% ARP concentration the result obtained did not differ from that seen for chlorhexidine. For C. albicans the 5% e 3% concentrations promoted significantly better inhibitory effect than 0.5% of ARP.

Conclusions: It was concluded that ARP did not change the tensile mechanical property of zinc phosphate cement and promoted antibacterial effect in 5% concentration.

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Biological properties of universal adhesives containing zinc-oxide and copper nanoparticles

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Purpose/aim: Evaluate the effect of addition of zinc-oxide and copper nanoparticles (ZnO/Cu Np) at different concentrations into two universal adhesive systems, on antimicrobial activity (AMA) and cytotoxicity (CTx).

Materials and methods: Six universal adhesives were formulated adding ZnO/Cu Np (0% [control]; 5/0.1 and 5/0.2 wt%) in Ambar Universal adhesive (AMU; FGM) and Prime&Bond Active (PBA; DentsplySirona). For AMA, disk diffusion method was used to measure S. mutans sensitivity to the experimental adhesives and to an aqueous solution of nanoparticles in the same concentrations described for the experimental adhesives. Sterile filter paper discs were impregnated according to the following: (1) with 20 μL of each of the aqueous solution and placed immediately over the plates; (2) with 20 μL of each of the experimental adhesives, evaporating the solvent and placed immediately over the plates; and (3) with 20 μL of each of the experimental adhesive, evaporating the solvent and light-cured for 20 s, and placed immediately over the plates. The plates were incubated for 24 h at 37 °C. The inhibition zones were measured after 96 h with a digital caliper. For CTx analysis, experimental adhesives and aqueous solution of nanoparticles were used such described for AMA test. Osteoblast-like cell line SaOS-2 was used. Cell line was incubated with three different dilutions (0.01, 0.1, and 1%) of experimental adhesive systems and aqueous solutions in 100 μl cell culture medium for 24 h at 37 °C. As viability control was used culture medium and as apoptosis control methanol 20% was used. CTx was determined using the Vybrant® MTT Cell Proliferation Assay Kit. Cell viability was calculated and normalized to control experiments (=100%). Statistical significance was defined in $\alpha = 0.05$.

Results: AMA: for aqueous solution, all ZnO/Cu-containing solutions showed AMA higher than control ($p < 0.05$). For the universal adhesives, all experimental ZnO/Cu-containing adhesives, when non-polymerized, showed AMA higher than control ($p < 0.05$). On the other hand, when polymerized, only 5/0.2 groups showed AMA higher than control. CTx: For aqueous solution only the 5/0.2 group showed higher cytotoxicity when compared to the control in the three dilutions ($p < 0.05$).

When nanoparticles were incorporated into the PBA, only difference between 5/0.2 group and control was observed, at the dilution of 0.01 v/v% ($p < 0.05$). When incorporated into AMU, no differences in cytotoxicity were observed between experimental groups and control ($p > 0.05$).

Conclusions: Addition of ZnO/Cu Np at 5/0.1 wt% in universal adhesive systems may be an alternative to provide antimicrobial activity, without higher their cytotoxicity.

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Phytic acid as a conditioning dentin agent

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Purpose/aim: Phytic acid (PA) is an organic acid found in cereals and plant seeds, widely used as an antioxidant and depigmenting agent. The objective was to evaluate the use of PA in different concentrations as a dentin conditioning agent in the adhesive procedure.

Materials and methods: 16 extracted human molars were used and a flat surface was then prepared by removing the occlusal one-third. The teeth were randomly assigned into four groups–Group I 37% phosphoric acid (Control) for 15 s was applied and Groups II, III, IV were pretreated with 1% PA, 2% PA, and 3% PA for 60 s, before the application of Single-Bond adhesive (3 M) and construction of composite build-ups. The μTBS was evaluated using a universal testing machine. Data were analyzed using two-way analysis of variance followed by Tukey's test ($p < 0.05$). Scanning electron microscope nanoleakage was also performed.

Results: There was a statistical difference between the groups tested. Control (20.52 ± 9.8 B) PA1 (25.32 ± 10.5 AB) PA2 (40.16 ± 14.8 A) and PA3 (39.35 ± 18 A). In relation to the nanoleakage, it is possible to observe little presence of silver in the union interface treated with PA.

Conclusions: It is concluded that PA may be a potential conditioning agent for phosphoric acid substitution, however, more experiments are needed to evaluate the effect of PA on long-term bond strength, mechanical properties of PA-treated dentin and its effect on pulp cells.

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Clinical evaluation of violet led (405–410 nm) bleaching: Preliminary results

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Purpose/aim: The objective of this clinical study is to evaluate the effect of the whitening treatment performed with a violet LED light source (405–410 nm), with or without a bleaching gel, on the tooth color changes (immediate and long-term).

Materials and methods: Twenty volunteers (out of 100 that will be selected for the main study) were randomly divided into four treatment groups ($n = 5$): G1–35% hydrogen peroxide (4 sessions, 1 session/week); G2–Violet LED (405–410 nm, 4 sessions, 1 session/week); G3–Violet LED (405–410 nm, 4 sessions, 2 sessions/week); G4–hybrid technique HP (Violet LED + 35% HP + violet LED) (4 sessions, 1 session/week). The color evaluation based on a Shade Guide Unit (SGU) was performed at predetermined times (before and 14 days after completion of tooth bleaching), and quantitatively evaluated by colorimetric tests (objective and subjective). Differences on mean values of color changes (ΔSGU) were subjected to One-way ANOVA and Tukey post-hoc tests ($\alpha = 5\%$).

Results: For both objective and subjective colorimetric tests, G1 and G4 groups did not reveal statistical significant differences for ΔSGU. For the objective test, the results were: G1 (8.0 ± 2.5) A, G2 (2.4 ± 1.1) B, G3 (3.5 ± 1.5) B and G4 (1.5 ± 0.6) A. For the subjective tests, the results were: G1 (9.2 ± 1.4) A, G2 (1.6 ± 2.6) C, G3 (3.6 ± 3.7) BC and G4 (7.8 ± 1.3) AB.

Conclusions: In conclusion, violet LED hybrid technique showed to be an alternative for tooth bleaching with the advantage of reducing the tooth time exposure to 35% hydrogen peroxide. Violet LED technique (2 sessions/week), in which the tooth is not exposed to 35% HP, can be considered a promising option for tooth bleaching.

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Effect of benzalkonium-chloride (BAC) on dentin bond-strength and MMPs activity

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Purpose/aim: Benzalkonium chloride (BAC) is a quaternary ammonium compound able to disinfect and inhibit dentin matrix metalloproteinases (MMPs) activity. Aim of the study was to investigate bond strength and the MMPs expression on dentin treated with a multi-mode universal adhesive (All-Bond Universal ABU; Bisco) with or without BAC blended within its formulation (either linked to methacrylate monomers or not) employed in etch-and rinse (E&R) or self-etch (SE) mode at baseline and after 12 m of storage in artificial saliva.

Materials and methods: 40 intact molars were selected and a smear layer was created using a 180-grit silicon-carbide paper on middle/deep human dentin surface. Specimens were assigned to the following groups according to the adhesive protocol: (G1) ABU SE; (G2) ABU E&R; (G3) ABU + 0.5% BAC SE; (G4) ABU + 0.5%BAC E&R; (G5) ABU + 1%methacrylate BAC SE; (G6) ABU + 1%methacrylate BAC E&R. Composite buildups were created on the bonded surfaces, then specimens were cut for microtensile bond strength test and stressed to failure at a

crosshead speed of 1 mm/min after 24-hour and 12 months of storage in artificial saliva. Additionally, adhesive/dentin interfaces were obtained for interfacial nanoleakage analysis and samples were tested at baseline and after aging. In situ zymographic assay was performed to investigate endogenous MMPs activity within the hybrid layer in accordance with previous research. Results were statistically analysed with three-way ANOVA test or Chi Square test. Statistical significance was set at $\alpha = 0.05$.

Results: For microtensile bond-strength statistical analyses of variance (Anova) showed that only the variables adhesive and aging significantly affected the results, but not the variable application mode. Nanoleakage expression percentages showed a better behavior both at T0 and T12 for the groups treated in the ER mode, independently from the adhesive employed. In situ zymography quantification analyses revealed that all the experimental formulations tested seemed to decrease MMPs gelatinolytic activity, however, all the groups showed a general trend of enzymatic activity increase after aging.

Conclusions: Experimental adhesives with BAC blended within their formulation seem to reduce endogenous enzymatic activity both immediately and over time. However, independently from the adhesive employed, there is an increase in the gelatinolytic activity over time. Bond-strength results do not reflect the in situ zymo results when 1%BAC methacrylate is added to the adhesive formulation. Further studies are needed to better understand the influence of BAC blended within the adhesive formulation in improving bond longevity and dentin MMPs inhibition.

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Etch-and-rinse adhesive containing silver nanoparticles: Preliminary study of antibacterial effects

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Purpose/aim: To evaluate the antibacterial effect of silver nanoparticles (NAg) at concentrations of 0.05% and 0.1% incorporated into the primer, the adhesive or both bottles of an etch-and-rinse adhesive system.

Materials and methods: NAg was prepared by reducing silver nitrate. To characterize the NAg, the following tests were performed: X-ray diffractometry (XRD); total reflection X-ray fluorescence (TXRF) and transmission electron microscopy (TEM). Dispersions of 0.05% and 0.1% NAg were directly incorporated into the primer, bond or both bottles of SBMP (Scotchbond Multi-Purpose, 3M ESPE). Antibacterial activity (against S. Mutans) was examined using agar diffusion assay. Bacterial suspension with 0.5 McFarland was used to inoculate. Sterile swabs were used to seed bacteria onto the Petri dishes. The template was positioned over each dish and 10 μL were added to each group. The dishes were incubated at 37 °C for 48 h. The growth diameter inhibition zones were horizontally and vertically measured with a digital caliper (Mitutoyo Corp., Kawasaki, Japan). The results were statistically analyzed ($p < 0.05$).

Results: TEM results showed crystalline and spherical NAg and average diameter ranged from 18 to 23 nm. TXRF and XRD results indicated the presence of silver mainly in face centered cubic (FCC) crystalline phase (planes 111 at 38.20; 200 at 44.20 and 220 at 64.40). Incorporation of 0.05% NAg to the primer showed superior antibacterial effect compared to the control ($p < 0.01$), and similar antibacterial effect compared to specimens with addition of 0.1% NAg. No effect was observed when NAg was added to the adhesive ($p = 0.14$). When added to the primer and the adhesive, both NAg concentrations (0.05% and 0.1%) exhibited superior antibacterial effect compared to that observed for the control ($p < 0.01$ and $p < 0.05$, respectively).

Conclusions: The addition of NAg to both the primer and the adhesive showed superior antibacterial effect compared to commercial etch-and-rinse adhesive system without NAg.

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Simulation of bone resorption around implants by finite element analysis

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Purpose/aim: The mechanical stimuli can modulate the rate of bone resorption and bone formation, adapting this tissue to the mechanical demands. The mechanostat theory of Frost determines four zones of bone remodelling, in which values above 3000 μstrain correspond to the bone pathological resorption zone. The objective of this study was to verify, by the finite element method, the best combination of implant diameter and length in cases of a fine maxillary process, using a failure criterion coherent with the Frost theory.

Materials and methods: Six models were simulated resulting from the combination of two lengths (10 and 12 mm) and three diameters (3, 3.5 and 4 mm) of the implant in the upper central incisor region. A load of 100 N was applied to the incisal third of the palatal aspect of the crown, 45° of the long axis of the implant-crown assembly. For a preliminary analysis, the predominant deformations (εM) in the cortical and trabecular bone of the whole model and the implant-bone interface were analyzed. According to this criterion, when the absolute value of the maximum tension (ε1) was greater than that of the maximum compression (ε3), the tensile strain value of that point was presented; when the absolute value of ε3 was higher, the compressive strain value was presented. For the synthesis of the results, the peak of εM in the peri-implant cortical bone was considered in the buccal crest (under compression) and palatine (under tension).

Results: Tensile strain peaks at the palatine crest were between 2553 μstrain and 7641 μstrain, while the compressive strain peaks at the buccal crest were between 2693 μstrain and 6144 μstrain (Table 1). All models reached the critical bone resorption threshold of 3000 μstrain, except for the model with an implant 12 × 4 (length × diameter).

Table 1 – Maximum tension and compression values (μstrain).

	Max tension (μstrain)		Max. compression (μstrain)	
	10 mm	12 mm	10 mm	12 mm
3 mm	6.157	5.890	−6.144	−4.677
3.5 mm	7.641	5.602	−5.244	−3.959
4 mm	2.860	2.553	−3.284	−2.693

Conclusions: The results suggest a lower risk of peri-implant bone resorption for implant 12 × 4 (length × diameter). The strategy of increasing the length of the implants to compensate a small diameter seems to be ineffective.

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Failure probability and stress distribution of silica-infiltrated bioinspired zirconia crowns

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Purpose/aim: The objective was to evaluate the failure probability and stress distribution on traditional or bioinspired zirconia crowns, with and without silica infiltration, using Weibull and Finite Element Analysis.

Materials and methods: One hundred anatomical preparations were made in epoxy resin (Nema G10) and divided into four groups: Traditional–zirconia coping (Incoris ZI, Sirona, Brazil) and porcelain veneer (Cerec Blocks); Graded–silica infiltrated zirconia coping and porcelain veneer; Bioinspired–porcelain coping and zirconia top (Incoris TZI, Sirona, Brazil); and Graded Bioinspired–porcelain coping and silica infiltrated zirconia top. A vitreous connector was used to unite the CAD-CAM milled zirconia and porcelain and the external portion of all crowns was coated with a glaze layer. The specimens were then mechanically cycled in a sliding machine for 2 × 106 cycles at 4 Hz of frequency, and at 100 N loading. Every 500 k cycles the crowns were evaluated in a stereomicroscope for the presence of failures (cracks, chipping, detachment between porcelain and zirconia, or catastrophic fractures).

Results: The predominant failure types for the Traditional and Graded crowns were delamination and cracking, respectively. The Weibull parameters (beta and eta, 95%IC) for each group were: Traditional–1.29 and 0.23 E + 07 cycles; Graded–1.95 and 0.23 E + 07 cycles; Bioinspired–1.00 and 1.67 E + 07 cycles and Graded Bioinspired–1.00 1.67 E + 07 cycles. The Traditional and Graded crowns presented great susceptibility to failure due to fatigue (increasing failure rate over time) while Bioinspired and Graded Bioinspired crowns presented none. Also, through the finite element analysis, it was verified that the Bioinspired and Graded Bioinspired crowns presented more favorable stress distribution on both crown and dental structure.

Conclusions: The different configurations presented different failure probabilities after the sliding fatigue test. Under the testing conditions, Bioinspired and Graded Bioinspired crowns had the lowest failure probability, better stress distribution and may be considered robust long lasting restorations.

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Ethanol-wet-bonding and collagen cross-linkings: Physico-chemical properties on bonding to dentin

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Purpose/aim: To evaluate the association between ethanol wet bonding (EWB) and collagen cross-linking agents (CLA) on the mechanical properties of collagen and on the physico-chemical properties of an etch-and-rise adhesive to dentin.

Materials and methods: Demineralized dentin bars ($n = 10$) were immersed, for 1 min or 1 h, according to the respective groups: distilled water (DW, control); absolute ethanol (AE); absolute ethanol with the incorporation of proanthocyanidins 6.5% (PAC + AE); absolute ethanol with the incorporation of1-ethyl-3-(3-dimethylaminopropyl) carbodiimide 0.3 M (EDC + AE); absolute ethanol with the incorporation of 5% glutaraldehyde (GA + AE). Three-point bending test was performed to evaluate the modulus of elasticity [ME] ($n = 10$) and mass change [MC] ($n = 10$) of collagen treated with the respective solutions, at different times of application (1 min and 1 h). For in situ degree of conversion [DC] ($n = 3$), microtensile bond strength testing [μTBS] ($n = 6$) and nanoleakage evaluation [NE] ($n = 3$), all solutions were used as dentin primer per 1-min of application prior the bonding and restorative procedures. For statistical analysis, ME data were submitted to ANOVA two-way and Tukey test. Kruskal–Wallis non-parametric analysis was performed for MC and ANOVA one-way was used for DC and μTBS. All tests were performed with a significance level of 5%. For NE, a qualitative analysis was used.

Results: After 1 min and 1 h of application, it was observed that DW showed the lowest ME ($p < 0.05$). EDC + AE, GA + AE and AE presented better ME with one hour of application and no statistically significante difference was observed between the PAC + AE and DW ($p > 0.05$). Treatments did not influence GC ($p = 0.529$) and μTBS (0.194). In NE, AE presented "gaps" with large amounts of silver in its interface.

Conclusions: The association of EWB technique and CLA improved the mechanical properties of the dentin collagen, but it showed no influence on the physico-chemical properties of an etch-and-rise adhesive to dentin.

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Tribological characterization of 3Y-TZP ceramics sintered at different conditions

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Purpose/aim: 3Y-TZP is a biocompatible material that presents appropriated mechanical and tribological properties to be used as metal free prosthesis in dentistry. Processing parameters such as sintering temperature and time affect simultaneously the tribological behavior. The aim of this study was to evaluate the coefficient of friction of 3Y-TZP ceramics sintered at different temperatures and times and to relate this with average grain size and hardness of these materials.

Materials and methods: Commercial 3Y-TZP (TZ-3Y, Tosoh) ceramic powders were used in this study. All samples were uniaxially pressed at 390 MPa and then isostatically pressed at 150 MPa and then sintered in air. Five different combinations of sintering temperature (1350 °C–1550 °C) and time (4 h–12 h) were carried out to obtain materials with different average grain sizes and porosities. Coefficient of friction was measured by high frequency reciprocating rig (HFRR) tests. Phase composition of the samples was defined by X-ray diffraction (XRD). Vickers hardness (HV0.5) and Scanning electron microscopy (FEG-SEM) were performed in order to evaluate the hardness and microstructure and wear, respectively.

Results: All samples presented tetragonal phase stabilized at room temperature after sintering. The morphological characteristics of tree samples as well the wear regions are shown in Fig. 1. FEG-SEM images suggest that the main wear mechanism is the pull out of grains. Plastic deformation, micro-cracks and fragmentation of grains were also identified. The samples presented average grain sizes from 0.216 μm to 0.750 μm, hardness from 6.05 GPa to 12.52 GPa and coefficient of friction from 0.318 to 1.026. For samples sintered at low temperatures and times (1350 °C/4–12 h) the large amount of pores and relatively small average grain size and low hardness should have contributed to the low coefficients of friction. For those samples sintered at high temperatures and times (1550 °C/4–12 h), the high hardness and coefficients of friction can be related to the relatively large average grain size.

Conclusions: All samples presented tetragonal phase stabilization. Different sintering parameters resulted in samples with different average gran sizes, hardnesses and coefficients of friction. It was possible to stablish a proportional relation between average grain size and coefficient of friction.

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Effect of different pistons on resistance and damage of ceramics

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Purpose/aim: To verify the mechanic behavior of a feldspar ceramic when subjected to the monotonic and the fatigue test executed with pistons of various materials and elastic moduli.

Materials and methods: Sixty CAD/CAM discs (VITA MARK II, Vita Zahnfabrik) were divided into six groups ($n = 10$), according to the test (monotonic-M and fatigue-F) and the piston material (tungsten-T, steel-S and epoxy resin-G). ANOVA and Tukey tests were used as statistical tests ($p < 0.05$). FT, FS and FG samples were submitted to mechanical cycling (2×106 cycles, 4 Hz, 45 N). The fatigue data were evaluated with Weibull analysis and the parameters η (eta), β (beta) and the mean time to failure (MTTF) were obtained. Fractographic analysis and FEA (finite elements analysis) were made.

Results: MG presented a significant lower bending strength (75.6 MPa) compared to MT (87.8 MPa) and MS (84.4 MPa). Six FT (MMTF: 8.3×106; β: 0.60; η: 5.6×106), four FS (MMTF: 1.9×106; β: 1.2; 2.0×106) and one FG (MMTF: 1.3×106; β: 0.48; η: 0.64×106) samples survived the fatigue test. According FEA, the stress peak on the tension surface were close to steel (42.06 MPa) and tungsten (41.60 MPa), but these were lower than epoxy resin (44.99 MPa). The SEM imagens show the failure origin on the tensile surface; in the fatigued specimens the failure surface is softer compared to the monotonic; and on the F groups the compression surface presented a defect caused by the piston tip.

Conclusions: The epoxy resin pistons were able to generate a more homogeneous tension stress distribution in the samples, reaching the tension surface more evenly, causing the failure in a shorter period with a lower load.

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Crystallized e-max CAD response to several surface modifications

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Purpose/aim: To evaluate percentile of e.max CAD particle sizes using imaging capabilities after six surface modifications for bonding purposes.

Materials and methods: Four crystalized e-max CAD plates ($10 \times 10 \times 1$ mm) were sandblasted with aluminum oxide 50 μm. Each sample had tapes placed on one of the surfaces dividing it into six equals zones. Each zone was then etched

Table 1 – Average Area (%) and SD.

	Average		% Area	
HF5%90s	64.17	24.8	16.17	4.4
HF10%45s	61.08	5.4	16.09	1.0
HF10%60s	61.34	7.4	16.88	1.7
HF10%90s	65.16	6.1	17.52	1.1

with: (a) hydrofluoric acid (HF) 5% for 45 s; (b) etched HF 5% for 60 s; (c) etched HF 5% for 90 s; (d) etched HF 10% for 45 s; (e) etched HF 10% for 60 s; (f) etched HF 10% for 90 s. After etching all samples were rinsed for 5 min and gold sputtered for Scanning Electron Microscopic (SEM) read-ings. Three SEM images were taken from each plate and evaluated using Image J software in which percentage area of particles sizes were averaged (Size 20 μm^2, Circularity 0–1, Show bare outlines). The groups had their images cropped and resized, equalized and thresholded for comparisons.

Results: Table 1 shows the obtained results. Image J was not able for analyzes for Groups HF 5% 45 s and HF 5% 60 s.

Conclusions: STD suggests a uniformity of etching treated surfaces with hydrofluoric acid 10% at the time of 45, 60 and 90 s. On the other hand, the data suggest that with a lower concentration (HF 5%) for a greater period of time the conditioning effects cannot be controlled.

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Phosphoric acid concentration affects dentinal MMPs activity

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Purpose/aim: The purpose is to evaluate the influence of different concentrations of phosphoric acid (1%, 10% and 37%) on the collagenolytic/gelatinolytic activity of sound human dentin.

Materials and methods: The demineralized samples with phosphoric acid (PA) were used for measurement of released calcium content and evaluation of MMP-2 activity by zymography. The immunological identification of MMP-2 was conducted by western blot. Demineralized dentin powder was also evaluated by spectrophotometry to measure the concentration of the released hydroxyproline. Demineralized dentin slices conditioned with the same previous solutions were evaluated for the enzymatic activity of MMPs by in situ zymography. The results were submitted to ANOVA and Tukey test ($p < 0.05$).

Results: The enzymatic activity of MMP-2 was statistically higher when the dentin was demineralized with 1% or 10% PA. The use of 37% PA reduced the activity of this enzyme. The identity of MMP-2 was confirmed by immunoblotting. The MMP-2 expression was higher when 1% or 10% PA was used and considerably less with 37%PA. PA 37% statistically released more calcium, in μg/mL, than the other groups. A higher concentration of HYP, in μg/ml, was obtained with 10%PA. The lowest concentration of HYP was detected with 37%PA. A higher concentration of HYP per mg of dentin was obtained with 10%PA. The lowest values of HYP per mg of dentin were detected with 37%PA. PA10% showed the higher degradation rate of exposed collagen (20.13%). The lowest degradation rate of exposed collagen (0.68%) was detected with 37%PA. Images obtained by confocal microscopy in the in situ zymography demonstrated higher activity of MMP-2 with 10%PA and a considerable reduction of MMP-2 activity with 1%PA and 37%PA.

Conclusions: The use of 37%PA in dentin hybridization can minimize the degrading effects of endogenous proteases on the dentin collagen.

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Efficacy of desensitizing agents in the treatment of dentinal hypersensitivity

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Purpose/aim: The aim of this study was to evaluate the clinical efficacy of two desensitizing agents used in the in-office technique for the treatment of dentinal hypersensitivity.

Materials and methods: Forty five patients ($N = 15$) were selected according to the inclusion and exclusion criteria and divided into the following groups: G1 = Painless Nano (PN; BM4) × Placebo (PL); G2 = UltraEZ (EU; Ultradent) × Placebo; G3 = Painless Nano × UltraEZ. In each quadrant, the posterior teeth (premolars and molars) of the same patient were treated with different products (desensitizing agents and a placebo agent). The treatment was performed in 6 sessions of 30 min each, with three sessions per week, totaling 2 w of treatment. Hypersensitivity evaluation was performed by tactile (exploratory probe) and volatile (air) tests in the following periods: initial (T0), after the third application (T1), after the last application (T2), and after 6 m (T3). The dental hypersensitivity index was assessed using an adapted VAS scale. Data were analyzed using repeated measures ANOVA and Fisher's exact test ($p < 0.05$) considering the mean hypersensitivity scores and the prevalence of change in scores.

Results: In group G1, a reduction of dentinal hypersensitivity (DH) was observed on the tactile test (PN: 3.3 to 1.7, $p < 0.01$; PL: 3.3 to 1.6, $p < 0.01$) and volatile test (PN: 2.8 to 1.5, $p < 0.01$; PL: 3.0 to 1.2, $p < 0.01$) after six months of treatment. In group G2, after six months of treatment, a reduction of DH

was observed for UE (tactile: 2.8 to 2.0 $p < 0.01$; volatile: 3.2 to 1.9; $p < 0.01$) and PL groups (tactile: 2.5 to 1.6; $p < 0.05$; volatile: 3.0 to 1.5; $p < 0.01$). There was no difference between UE and PL for all time ($p > 0.05$). When analyzed PN and UE (G3) regarding the treatment period, a reduction of DH from baseline to six months in both groups (PN: tactile–3.0 to 1.4, $p < 0.01$; volatile: 3.7 to 1.8, $p < 0.01$; and UE: tactile–3.2 to 1.7, $p < 0.01$; volatile: 3.4 to 1.8, $p < 0.01$) was verified.

Conclusions: Considering the proportion of change in DH during the treatment, no significant differences were found for all the groups ($p > 0.05$). Therefore, the two desensitizing agent evaluated were effective in reducing the dentine hypersensitivity with the in-office technique.

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Influence of TiO_2 nanosctructures on properties of flowable resin

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Purpose/aim: The addition of TiO_2 nanostructures in resin-based materials has been found to increase mechanical properties. This factor may be associated with the photocatalytic potential of TiO_2 when visible light is irradieted on them. The aim of this study was to evaluate the influence of the addition of APTMS-functionalized TiO_2 nanotubes and nanoparticles on the knoop microhardness and double-bond conversion of flowable resin-based materials.

Materials and methods: Both nanostructures were characterized by X-ray diffraction, transmission electron microscopy and Fourier transformed infrared spectroscopy. Two flowable resin composites were evaluated (Filtek Z350 XT Flow and Filtek Bulk Fill Flow Z350XT, both from 3 M Espe) and 0.3 wt% of APTMS-functionalized TiO_2 nanotubes and nanoparticles was added. Forty-two disc-shaped samples ($n = 7$) were made and distributed in groups according to resin type, nanostructure and time after light-activation. The specimens were light-activated (1000 mW/cm^2) according to the time recommended by the manufacturer. The double-bond conversion was evaluated through FTIR-ATR immediately and 24 h after light-activation. The knoop microhardness was used to estimate the crosslink density by evaluating the initial hardness of the top surface (HK1) and after immersion of the samples in 100% ethanol for 24 h (HK2). Data were analyzed by three-way Anova with repeated measures and Tukey's HSD ($\alpha = 0.05$).

Results: For the double-bond conversion test, there were significant differences between resins ($p < 0.003$), time ($p = 0.00$) and interaction time and nanoestructures ($p < 0.05$). The Filtek Z350 XT Flow presented higher values of double-bond conversion in both periods, however the higher values of double-bond conversion were found in period of 24 h. In the immediate time, the TiO_2 nanoparticles presented higher values of conversion. However, in the period of 24 h TiO_2 nanotubes and nanoparticles decreased the double-bond conversion. For knoop microhardness, there were also differences between resins ($p = 0.00$) nanostructures ($p < 0.001$) and time ($p = 0.00$). The only non-significant interaction occurred between resins and nanostructures ($p = 0.31$). The Filtek Z350 XT Flow showed higher hardness values, both at initial and final time. For both resins, the addition TiO_2 nanotubes and nanoparticles increased hardness when compared to the control group. Even though the hardness decreased after alcohol immersion, the hardness was even higher when nanotubes and nanoparticles were added compared to the control group.

Conclusions: It is concluded that the addition of TiO_2 nanostructures may influence the photocatalytic and mechanical properties of the Filtek Z350 XT Flow resin.

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Effect of different ceramic-primers and silanization-protocols on glass-ceramic bond strength

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Purpose/aim: The purpose of this study was to evaluate the effect of different ceramic-primers and silanization protocols on the tensile bond strength of lithium dissilicate-based glass-ceramic.

Materials and methods: Two hundred and forty lithium dissilicate sticks (1.3 × 1.3 × 4 mm) were milled from CAD/CAM blocks (IPS emax CAD, Ivoclar Vivadent). One extremity of each stick was polished with 600-grit sandpaper. Specimens were divided into three groups according to the ceramic primer: (1) RelyX Ceramic Primer (RLX) (3 M ESPE), (2) Clearfil Ceramic Primer (CCP) (Kuraray), and Monobond Etch and Prime (MBEP) (Ivoclar Vivadent). Sticks from groups RLX and CCP were etched with 5% hydrofluoric acid (Condac Porcelana, FGM) for 20 s. Specimens from each group were then distributed into 4 sub-groups according to additional protocols after silane primer application ($n = 20$): (1) Treated as recommended by manufacturer (no additional step (MR)), (2) MR silanization plus additional drying with hot air for 30 s (HA), (3) MR silanization plus additional drying with air at room temperature for 30 s (RTA), (4) MR silanization plus additional surface rinsing with water for 10 s and drying with air at room temperature for 30 s (WA). The resin cement Rely X Ultimate (3 M ESPE) was applied with a microbrush on ceramic surface and light cured for 20 s (Bluephase, Ivoclar Vivadent) with 1110 mW/cm^2 of irradiance. Specimens were placed in a silicon mold (1.3 × 1.3 × 8 mm) and the remaining empty space was filled with resin composite (Filtek Bulk Fill Flow, 3 M ESPE). After light curing, ceramic-resin bars were gently polished with 600-grit sandpaper in order to remove any excess of resin composite at the interface. Specimens were stored in deionized water at 37 °C for 24 h prior to tensile bond strength

(TBS) testing. Failure pattern was analyzed on SEM. Statistical analysis was performed using 2-way ANOVA and Tukey test ($\alpha = 0.05$).

Results: Two-way ANOVA showed that both factors and their interaction were statistically significant ($p < 0.05$). RLX and MBEP presented higher bond strength, except for RLX when received additional treatment MR. HA and WA protocols significantly increased bond strength on specimens treated with RLX. Silanization protocols were not significantly different ($p > 0.05$) for specimens treated with CCP and MBEP. The mixed failure pattern was predominant for all groups, except for CCP and RLX used in conjunction with MR treatment.

Conclusions: RLX and MBEP presented the highest bond strength values. No difference was detected on bond strength produced by different silanization protocols, except for RLX ceramic primer.

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Monolithic zirconia prosthesis vs bilayer prosthesis: A systematic review

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Purpose/aim: The increasing demand for prosthetic restorations in metalfree and the use of computer-aided design and computer-aided manufacturing (CAD/CAM) technology, monolithic ceramics were introduced in the market with the aim of reducing the fractures in chips that happened in the union between the framework and the ceramics venner. Therefore, the objective of this study is to show a systematic review of the clinical performance of prostheses produced in monolithic zirconia as well as its clinical characteristics due to the higher bite forces, lower incidence of fracture, reduced time in the preparation of prosthetic pieces, shorter time clinical and thus better cost-effective.

Materials and methods: A comprehensive study was conducted in MEDLINE through PubMed, Scopus, Web of Science, LILACS, BBO, BVSalud and Cochrane Library, unpublished and ongoing studies were also searched, as well as dissertations and theses. Randomized clinical trials comparing prostheses in monolithic zirconia with prostheses in zirconia and cover ceramic (bilayer) and studies showing the longevity and characteristics of prostheses in monolithic zirconia were included.

Results: The results show that in relation to the wear rates in the antagonists, whether in natural enamel or ceramic are acceptable clinically and similar to other ceramics considered less resistant, being justified the use of monolithic zirconia. The time and workflow became smaller when compared to the two techniques of prosthetic preparation, increasing the cost-benefit of using monolithic prostheses. The CAD/CAM system allows prostheses to be reproduced more quickly and accurately, reducing clinical time and offering greater patient comfort. The roughness of monolithic zirconia is similar with conventional zirconia, and also shows flexural strength similar to conventional. The aesthetic features are still being improved, but the monolithic zirconia are well seen and used in the posterior region and are already in use in the anterior region. Because there was no ceramic coating layer, the fractures decreased significantly.

Conclusions: Monolithic zirconia prostheses are increasing in use, since of all materials it has the best properties such as fracture strength and flexural strength, in addition to not having a layer of ceramic coating, making the previously existing fractures between these interfaces no longer exist, also allowing a greater thickness of material, giving resistance also in fixed partial prosthesis where the connectors can have a greater thickness.

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Effect of propolis on removal of biofilm of maxillofacial elastomers

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Purpose/aim: The aim of this study was to evaluate the antibacterial effect of *Baccharis dracunculifolia* solutions on the removal of Staphylococcus aureus biofilm from maxillofacial elastomers.

Materials and methods: Two maxillofacial elastomer types, MDX4-4210 (Room Temperature Vulcanization Silicone) and MED-4014 (High Consistency Rubber Silicone) were evaluated. A total of 212 disk-shaped specimens (3×10 mm) were fabricated from each elastomer. The specimens were sterilized and subjected to growth and development (37 °C/48 h) of *S. aureus* biofilm. Next, the specimens were randomly assigned (unit sample $n = 21$) to one of five disinfectant treatments: *B. dracunculifolia* propolis extract solutions (aqueous-PAQ and alcoholic-PAL), Daro Brand antimicrobial agent (DBA), distilled water (H_2O) and 4% chlorhexidine (CHX). Disinfection treatments were performed by immersion for 10, 15 and 30 min. All assays were performed independently 2 times in triplicate. After the treatments, the specimens were vortexed to disrupt the biofilm and residual cells were counted (cell/mL). The topography of the specimens after treatment with the disinfectants was analyzed by scanning electron microscopy (SEM). Data were analyzed by parametric analysis of variance and by multiple comparison tests ($\alpha = .05$).

Results: No CFU were detected in the biofilm after the PAL and CHX treatments of both elastomers. PAQ and DBA showed significantly lower CFU values compared to H_2O for MDX4-4210, regardless of the immersion period. However, treatment with PAQ and DBA did not differ significantly from treatment with H_2O for MED-4014. SEM for PAQ and PAL showed an impregnated layer suggestive of waxes, and CHX showed a modified surface for both elastomers.

Conclusions: According to the results of the present PAL assays, the substances tested showed a broad spectrum of activity in removing *S. aureus* biofilm from maxillofacial elastomer surfaces similar to that of CHX.

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Clinical performance of 168 screw free implants: Prosthetic complications

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Purpose/aim: To evaluate the clinical performance of 168 screw free implants with particular attention to documenting the incidence of prosthetic complications.

Materials and methods: The records of all patients who had been treated with screw free implants (FGM®, Joinville/Brazil) in the Center on Education and Research on Dental Implants (CEPID) from the Federal University of Santa Catarina (UFSC) (Florianópolis, Santa Catarina, Brazil) during the period between 2017 and 2018 were revisited. These records included implant-related (date of insertion, site/location, length/diameter, immediate placement, bone regeneration), and restoration-related (immediate loading, date of delivery of the provisional and final crown) information. Patients enrolled in this study (55) were those who had implants rehabilitated with definitive prosthesis that had been in function for at least six months. All patients enrolled were recalled for a follow-up, signed a informed consent and information about any implant failure and prosthetic complication (abutment loosening, abutment fracture, screw loosening, screw fracture, loss of retention/decementation, ceramic chipping/fracture, fracture of the framework) that occurred were recorded. Descriptive statistics were used to describe the distribution of patients, implants and restorations, for calculating the incidence of implant failures and prosthetic complications.

Results: The restorations involved 109 fixed reconstructions (89 single crowns and 20 multiple protheses), supported by 168 screw free implants. The cumulative implant survival rate was 99.40% (1 loosened implant in the posterior maxilla). A few prosthetic complications were reported (6.55%) (6.76% or 10 prosthetic screw loosening, ceramic chipping/fracture of 3 prostheses and decementation of 1 single crown). All mechanical complications were reported in the posterior area.

Conclusions: The use of screw free implants represents a successful procedure for implant rehabilitation, with a cumulative implant survival rate of 99.40% and a very low incidence of prosthetic complications (6.55%) due to a high mechanical stability.

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Evaluation of dentinal conditioning with natural acids in dentin-resin interface

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Purpose/aim: To evaluate the use of phytic acid (IP6), tannic acid (TA) and gluteraldehyde as biomodifier agents during dentin conditioning, using dry and wet techniques, and to evaluate bond strength, sealing and nanoleakage in interface.

Materials and methods: Seventy-two third molars were prepared to expose the dentin surface, microtensile bonding strengh ($n = 6$), nanoleakage evaluation ($n = 1$) and the micropermeability ($n = 2$), and divided into 8 groups according to the etched acid and technique, dry or wet, used in restaurative procedures. Dentin surfaces were etched 37% phosphoric acid (control) for 15 s, 37% phosphoric acid + 5% glutaraldehyde for 15 s, 1% phytic acid (IP6) (pH 1.2) for 30 s and 20% tannic acid (TA) (pH 2.8) for 30 s, rinsed, air dried 10 s, dry technique. Wet technique, after air dried, the dentin was rewetted for 60 s. The adhesive was applied and a subsequent 5-mm-thick resin crown was built up. Bonded teeth were longitudinally sectioned to obtain sticks with a cross-sectional area of 1.0 mm^2. Half of the specimens were immediately tested, while the remaining specimens were tested after six months for the microtensile bonding strengh and nanoleakage evaluation. For the micropermeability were only immediately tested. For the statistical analysis, the Anova and Tukey tests were used.

Results: After 24 h and 6 m, mean bond strengths of tannic group was significantly lower than those found for the other groups, in both technique ($p < 0.05$). In the nanoleakage evaluation, in dry technique, the gluteraldehyde and the TA groups presented a higher concentration of the ammonium silver nitrate in the interface. The IP6 group showed superior sealing and less infiltration. In the wet dentin, the IP6 group showed higher silver infiltration and less sealing of the adhesive interface. The TA group maintained interface sealing after 6 months. The micropermeability test images, in the dry and wet techiniques, showed a best sealing and less infiltration of fluorescein in the IP6 and TA groups.

Conclusions: The etched with IP6, in dry technique, preserved the interface dentin-resin after six months of storage equally well as control group. In wet technique, the TA group, although lower values of μTBS, preserved the adhesive interface similar to control group.

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Development and study of cytotoxicity of calcium oxide nanocrystals

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Purpose/aim: In vitro evaluation of calcium oxide (CaO) in the form of crystalline nanoparticles has been little explored. The objective of this study was to develop, characterize and evaluate the cytotoxicity of pure CaO nanocrystals in cultures of osteoblasts and macrophages.

Materials and methods: The CaO nanocrystals were synthesized via aqueous solution and their structural and vibrational properties were investigated, respectively, using X-ray diffraction and Raman spectroscopy techniques. The nanocrystals were solvated in distilled water and autoclaved for culture application in osteoblasts (SAOS-2) and macrophages (RAW 264.7) immortalized cells. The samples were diluted at concentrations of 10 μg/ml, 50 μg/ml and 100 μg/ml, and applied on the cells for a period of 24 h. Cell viability was evaluated by MTT formazan.

Results: X-ray diffraction and Raman spectra confirmed the formation of CaO nanocrystals. The cell viability assays confirmed the low cytotoxicity of these nanocrystals in the two cellular models studied compared to control (non treated cells), with concentrations of 10 μg/ml and 50 μg/ml presenting better results in both assays compared to 100 μg/ml ($P < .05$).

Conclusions: These preliminary tests demonstrate the biocompatibility of this nanocrystal in the cell models used, especially in low concentrations, presenting high potential for use in dentistry as intracanal medication.

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Adhesiveness analysis of sealer plus and AH plus endodontic sealers

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Purpose/aim: The objective of this study was to compare the Sealer Plus and AH Plus endodontic cements adhesiveness to the root canal of bovine teeth previously treated with 1% sodium hypochlorite and 17% EDTA by means of the push-out test.

Materials and methods: 20 unirradicular bovine teeth were used and their roots were sectioned forming an 8 mm cylinder. A frustoconical drill to the limit of the active part prepared the root canals, ensuring that the internal dimensions of all specimens were identical. After the irrigation of the preparations with 1% Sodium Hypochlorite and 17% EDTA, the specimens were divided into two groups and filled with the cements studied, G1–Sealer Plus and G2–AH Plus. These specimens were stored in an oven at a constant temperature of 37 °C and a relative humidity of 95%, for a period corresponding to three times the cure time, for each cement (determined by previous tests). For the push-out test, the Universal Instron Test Machine calibrated with a constant velocity of 1 mm/s was used to press the trunks of cones formed by the endodontic cements from the smallest to the largest diameter until they moved from the dentin. The values obtained for the rupture of the cement with the dentin channel were recorded in Newton.

Results: The statistical analysis showed more adhesiveness of the cement Sealer Plus (1415.17 ± 102.0) than AH Plus (916.65 ± 113.7) ($p < 0.05$).

Conclusions: The two groups presented adequate adhesion to the canal walls, however G1 (Sealer Plus) presented greater adhesiveness than G2 (AH Plus).

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Evaluation of biofilm removal and antimicrobial action of denture cleansers

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Purpose/aim: This randomized clinical study evaluated the effect of chemical hygiene solutions on biofilm removal and antimicrobial action of dentures.

Materials and methods: Forty-five participants were instructed to brush their dentures (specific brush and liquid soap) three times a day and to soak them, once a day, in the solutions: Control–Saline solution; SH–Sodium hypochlorite 0.2%; Efferdent–Alkaline Peroxide; RC–6.25% Ricinus communis. In addition, the participants were also randomized to immersion ($n = 23$) or non-immersion ($n = 22$) of the specific brushes in the solutions, with the dentures, to evaluate if it would improve solutions effectiveness. Evaluations were performed before (Baseline) and after 7 d of use of each solution. For the biofilm removal, the dentures were disclosed (1% neutral red), photographed and the biofilm area was measured (Image Tool 3.00). The antimicrobial action was evaluated by counting *Candida* spp. To collect denture biofilm, dentures were brushed (Tek brush and saline solution) for 2 min, and the suspension transferred to test tubes. Decimal dilutions (100 to 10^{-3}) with aliquots (50 μL) of each dilution were grown in Petri dishes containing suitable culture medium, for further incubation (aerobiose) for 48 h and counting the number of colonies. The differences between brushes immersion and non-immersion were evaluated by the Mann–Whitney test ($\alpha = 0.05$). The properties of biofilm removal and antimicrobial action were evaluated by Friedman test, followed by the Wilcoxon test ($\alpha = 0.05$).

Results: The results showed that, for biofilm removal, in both groups (brush immersion or non-immersion), 0.2% sodium hypochlorite [immersion: Mean-Rank (MR) = 1.41;

non-immersion: MR = 1.48], Efferdent® (immersion: MR = 2.41, non-immersion: MR = 2.25) and 6.25% Ricinus communis (immersion: MR = 2.48; non-immersion: MR = 2.77) were effective and similar ($p < 0.001$). Results showed antimicrobial action against *Candida* spp. for all solutions (0.2% sodium hypochlorite: immersion: MR = 2.22, non-immersion: MR = 2.09; Efferdent®: immersion: MR = 2.24, non-immersion: MR = 2.57; 6.25% Ricinus communis: immersion: MR = 2.20, non-immersion: MR = 2.75).

Conclusions: It was concluded that all tested solutions were effective for biofilm removal and reduction of *Candida* spp.

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Zn^{2+} containing glass ionomer cement inhibits root dentin demineralization

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Purpose/aim: Increased life expectancy and higher proportions of preserved or retained teeth in the elderly have led to greater prevalence of root caries nowadays. We have focused on the bioactive effect of Zn^{2+} which has been known to have an effect of antimicrobial activity, inhibitory effect of dentin demineralization and matrix metalloproteinase (MMP) activity.

We developed the new Glass Ionomer Cement (ZIF-C10) for root caries containing BioUnion Filler. BioUnion Filler is the new ionomer glass which releases Zn^{2+}, F^- and Ca^{2+}. The purpose of this study is to evaluate what level ZIF-C10 inhibits dentin demineralization after pH-cycling.

Materials and methods: Fuji VII (GC, Tokyo, Japan), and ZIF-C10 were used in this study. The root of bovine teeth was cut horizontally and embedded dentin pieces in UniFast II. The test surface was flattened with # 1200 waterproof abrasive paper. A teflon seal (thickness 0.1 mm), windowed with a diameter of 3 mm was attached to the dentin surface, and half of the test window was filled with each material. The specimens were stored at 37 °C, R.H. 95% for 1 h. The pH cycle was defined as follows: demineralizing solution (0.2 M lactic acid, 1.8 mM KH_2PO_4, 3 mM $CaCl_2 \cdot 2H_2O$, pH 4.5) for 6 h, remineralizing solution (0.02 M HEPES, 1.8 mM KH_2PO_4, 3 mM $CaCl_2 \cdot 2H_2O$, 0.57 M KCl, pH 7.0) for 18 h, pH value was adjusted using NaOH (5 N) solution. After 5cycles, the test window was sliced to a thickness of 1 mm, and the mineral loss (vol%μm) was calculated by image analysis method using μCT.

Results: Mineral loss of Fuji VII and ZIF-C10 of root dentin was lower than control, and ZIF-C10 was the lowest of the three after pH-cycling. ZIF-C10 is known to release Zn^{2+} and F- in demineralizing solution. It is expected that zinc phosphate is precipitated by replacing Ca^{2+} of hydroxyapatite to released zinc ion. Ca^{2+} and F^- is known to promote forming fluorapatite.

Conclusions: ZIF-C10 highly inhibited root dentin demineralization after pH-cycling, and it was shown to be useful as a preventive and restorative material for root caries.

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Evaluation of surface roughness of alginate impression materials

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Purpose/aim: Recently, GC Corporation had developed a new alginate impression material. In daily practice at dental clinic, Surface roughness of the alginate impression material influences the accuracy of the prostheses. The purpose of this study was to evaluate the surface roughness of the alginate impression materials by 3D laser scanning microscope.

Materials and methods: The alginate impression materials used in this study were GC Pas/Cion (PC, GC), CAVEX Normal (CA, CAVEX), and Avagel (AG, DENTSPLY). These impression materials were mixed according to the manufacturer's instructions, and the test molds were prepared by the way of detail reproduction in accordance with ISO 21563: 2016. The surface roughness (R_a) was measured at five areas randomly in the range using a laser microscope (Kyence, VK-X210). The surface roughness value was tested by ANOVA and multiple comparisons.

Results: The lowest R_a roughness value (μm) of the mold was obtained by Pas/Cion (0.71), then CAVEX Normal (1.37) and Avagel (1.95). Significant differences were found between Pas/Cion and the other two products.

Conclusions: The GC's new alginate impression material, Pas/Cion showed the highest detail reproductivity and smoothest surface. The use of Pas/Cion is expected to lead to the creation of accurate model.

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Effect of toothbrushing on the surface of esthetic restorative materials

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Purpose/aim: Investigate the effects of toothbrushing on the gloss (GL), surface roughness (SR), roughness profile (RP) and microhardness (MH) of four esthetic restorative materials.

Materials and methods: Samples ($n = 10$ per material) 2 mm think from a regular direct composite resin (Filtek Z350XT – Z350), two hybrid resin/ceramic materials (Lava Ultimate – LAV and VITA Enamic – ENA) and a feldspathic

ceramic (Vita Blocs Mark II – VMA) were prepared. The bovine enamel (BEN) was used as a control. All surfaces were wet-ground and polished in accordance with manufacturer's instructions. Samples were analyzed regarding SR, RP and surface topography using confocal microscopy. GL and MH were measured before and after toothbrushing (60,000 cycles). GL was evaluated every 20,000 cycles. Data were analyzed by two-way repeated measures ANOVA and Tukey test ($\alpha = 0.05$).

Results: Evident morphologic alterations of Z350 and LAV surfaces after toothbrushing were identified. For VMA (Feldspathic ceramic) no surface change was observed. The GL means after toothbrushing ranged from 89.5 to 53.9, VMA showed the highest GL, while Z350 the lowest one. The SR values ranged from 0.41 to 1.24. SR significantly increased after toothbrushing for all materials, except for VMA. BEN presented the highest RP and VMA exhibit the lowest one. MH changes following the toothbrushing were detected only for LAV.

Conclusions: Toothbrushing promotes surface alterations in all material tested and bovine enamel, except feldspathic ceramic. These changes were more evident in the materials with resin matrix.

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Double-blind clinical trial of satisfaction in patients undergoing dental bleaching

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Purpose/aim: Tooth whitening is the most conservative and inexpensive way to improve patient satisfaction with your smile. However, there are few studies that correlate the whitening efficacy with patient satisfaction and how they perceive the change of colors. To investigate the relationship between color change and satisfaction and perception of color change by patients and trained operator compared to an instrumental method.

Materials and methods: A double-blind randomized clinical trial was conducted with 100 patients who met the inclusion and exclusion criteria. They were divided into five randomized groups: Hydrogen peroxide 4%, 15% carbamide peroxide, 16% carbamide peroxide, 16% carbamide experimental and placebo. It was made the base color of the teeth through objective taken with Vita Easyshade and subjective with the Vita BleachGuide 3D scale. They underwent therapy Clarifying getting a whitening gel syringe per week for 3 weeks and completed evaluation of its sensitivity and reviews of satisfaction and perception of color change. There were a total of 11 visits per patient: initial interview and sorting, forming and prophylaxis, making color and delivery bleaching 7 controls 14, 21, 30, 60, 90, 120 and 180 days. In returns all steps taken and color control by the patient and by the same trained operator, objective and subjective were repeated.

Results: A double-blind randomized clinical trial was conducted with 100 patients who met the inclusion and exclusion criteria. They were divided into five randomized groups: hydrogen peroxide 4%, 15% carbamide peroxide, 16% carbamide peroxide, 16% carbamide experimental and placebo. It was made the base color of the teeth through objective taken with Vita Easyshade and subjective with the Vita BleachGuide 3D scale. There were a total of 11 visits per patient: initial interview and sorting, forming and prophylaxis, making color and delivery bleaching 7 controls 14, 21, 30, 60, 90, 120 and 180 days. In returns all steps taken and color control by the patient and by the same trained operator, objective and subjective were repeated.

Conclusions: Patient satisfaction increases with all the groups, including the placebo, but declines in the period post therapy. Patients tend to see the darker teeth than they really are and create expectations for lighter colors.

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Ultimate fracture load of CAD-CAM crowns with different thicknesses

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Purpose/aim: Evaluate in vitro the effect of different thicknesses on the ultimate fracture load (UFL) of posterior prosthetic full crowns confectioned by CAD-CAM materials.

Materials and methods: Forty-five upper human molars were prepared to receive prosthetic full crowns. Three types of CAD-CAM materials were tested (e-max CAD/Ivoclar Vivadent, Enamic/Vita and Suprinity/Vita) in three different thicknesses of 0.5, 1.0 and 1.5 mm ($n = 5$). CAD/CAM blocks were milled at CEREC MCXL (Sirona Dentsply) and final processing, as well as treatment of the intaglio surface occurred according to manufacturer's instructions. Crowns were placed using Panavia V5 (Kuraray Noritake) and tested after 24 h in a universal testing machine (Instron). Teeth were submitted to axial loading until failure using a stainless steel sphere (3 mm diameter), in order to determine the UFL. Data were expressed in Newton (N) and analyzed by two-way ANOVA and Tukey test (pre-set alpha = 5%).

Results: Means of UFL are presented in Table 1. The 2-way ANOVA demonstrated that both thickness ($p < 0.0001$) and CAD/CAM material ($p < 0.0001$) significantly influenced the UFL results.

Conclusions: Prosthetic Crowns of 1.5 mm-thick resulted in significantly greater UFL than 0.5 mm-thick crowns, for all materials. Suprinity crowns showed the lowest UFL compared to other materials, regardless the thick-

Table 1 – Means of UFL (SD), in N, according to thickness and material ($n = 5$).

Thickness	e-Max CAD	Enamic	Suprinity
0.5	1628.6 (449.2) A b	1110.5 (400.9) A b	325.1 (107.9) B b
1.0	1680.9 (449.2) A b	1494.7 (413.1) A ab	433.5 (142.3) B a
1.5	2126.4 (750.5) A a	1828.7 (446.8) A a	477.8 (125.4) B a

Capital letters compare materials within the same thickness and lower case letter compare thicknesses within the same material.

ness. Intermediate results were observed in 1.0 mm-thick crown.

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Influence of increment thickness on microhardness of bulk-fill resin

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Purpose/aim: The incremental technique aims to reduce the effects of polymerization contraction and stress in restoration interface, however, this procedure prolongs clinical care, which led to the development of a new generation of resin composites, named "Bulk-Fill", which can be photoactivated in increments up to 5 mm. These conditions concern the actual efficacy of polymerization, developing studies that evaluate the amount of light which arrives at the base of the increment, where is more critical for promoting cervical sealing in restoration. The purpose of this study was to evaluate the influence of increment thickness (2 and 4 mm) of a Bulk-Fill and a Bulk-Fill Flow and the time of photoactivation (20 and 40 s) in the relative microhardness of these materials. Five samples of Filtek One Bulk-Fill-3M (BO) and Filtek Bulk Fill Flow-3M (BF) with 2 mm and 4 mm were prepared, resin Filtek Z250 XT-3M (FZ) was group control with 2 mm.

Materials and methods: A split matrix was used and the samples were photoactivated for 20 and 40 s, with Valo Cordless – Ultradent, 1000 mW/cm^2 in continuous mode. For 24 h, the samples were saved in a dental stove at 36 °C and analyzed by hardness of the upper and lower surface using a Knoop pyramid with 25 g load and 5 s of indentation time in a Microhardness Machine.

Results: The 10 groups were submitted to statistic and presented normal distribution, being evaluated by the variance analysis (ANOVA) with one factor demonstrating a significant difference ($p < 0.05$) and by the Tukey test with significance level of 5%. The values of mean and standard deviation (±) of relative hardness for groups FZ-2 mm-20 s, FZ-2 mm-40 s, BO-2 mm-20 s, BO-2 mm-40 s, BO-4 mm-20 s, BO-4 mm-40 s, BF-2 mm-20 s, BF-2 mm-40 s, BF-4 mm-20 s, BF-4 mm-40 s were respectively: 0.85 (±0.01); 0.92 (±0.01); 1.05 (±0.08); 0.95 (±0.04); 0.93 (±0.04); 0.97 (±0.04); 0.92 (±0.05); 0.89 (±0.04); 0.79 (±0.04); 0.90 (±0.03). The resin BO of 2 mm (20 s) and 4 mm (40 s) had the highest values of relative hardness, statistically significant compared to other groups. The lowest values of relative hardness were presented by resin BF 4 mm (20 s), without significant difference in relation to group control FZ (20 s).

Conclusions: It was concluded that resin Filtek One Bulk showed the best values of relative hardness in 2 and 4 mm thicknesses, independent the time of 20 or 40 s of photoactivation.

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Compression strength and fractographic analyses between two indirect veneers materials

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Purpose/aim: This study aimed to evaluate the residual compression strength of CAD/CAM lithium disilicate and indirect composite veneers submitted to 1,000,000 thermomechanical cycles and inspect their fracture patterns by fractographic analysis.

Materials and methods: Lithium disilicate – IPS e.max CAD – (LD) and an indirect composite resin – VITA Enamic – (VE), shade A2, were prepared by CEREC In-Lab and then cemented with light-curing cement (Variolink Esthetic LC) on resin composite central incisors replicates (A2) ($n = 12$). They were submitted to a thermomechanical cycling according to ISO TR11405. After 1,000,000 cycles, the axial compression load test was performed in a universal testing machine (Kratos) until fracture. The most representative fracture patterns from each material were subjected to the fractographic analysis. The data was submitted to Levene test followed by Kolmogorov–Smirnov test and Tukey ($\alpha = 0.05$).

Results: LD veneers presented higher residual compression strength (63.51 MPa), compared to the VE ones (33.30 MPa). In the fractographic analysis, LD showed a brittle pattern while VE showed a plastic deformation pattern and chipping edges.

Conclusions: Lithium disilicate veneers presented higher residual compression strength and a brittle behavior compared to VITA Enamic, which had the lowest compression strength and higher plastic deformation.

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Influence of laminate veneers on behavior of gingival margin

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Purpose/aim: To evaluate, through a longitudinal and prospective clinical study, the influence of very thin laminate veneers cemented over natural teeth without finish line and cervical margin placed within the gingival sulcus on the behavior of the gingival margin.

Materials and methods: 70 lithium disilicate laminate veneers were evaluated (restored group). Neighboring unrestored teeth were used as control (control group). The study factors were the treatment and the time analysis (T) on 7 levels [T0 (prior to treatment), T7 (7 days after cementation), T15 (15 days after cementation), T30 (30 days after cementation), T60 (60 days after cementation), T120 (120 days after cementation) and T180 (180 days after cementation)]. The response variables were plaque index (PI), gingival index (GI) and gingival recession (GR). Digital photographs were taken using a DSLR camera and 100 mm macro lens and a side point flash, with focal length, lighting, and white balance standardization, in an orthostatic view, for each tooth in each time, supporting the clinical data interpretation. Statistical analyses were performed using appropriate tests and the significance level considered for difference between averages was $p < 0.05$.

Results: The analysis of the restored and control groups within each time analysis showed a higher prevalence of reputable elements "Alfa" for PI variable ($p > 0.05$ time analysis). Lower records in "Beta" and "Charlie" were observed in the restored group, showing less plaque build-up in the restored surfaces ($p < 0.05$ between groups). The analysis of the restored and control groups within each time analysis showed a higher prevalence of reputable elements "Alfa" for GI variable ($p > 0.05$ time analysis), with a significantly better condition for this variable in the control group ($p < 0.05$ between groups). The horizontal over contouring of restorations did not increase the occurrence of inflammation of the gingival margin in the restored group compared to the control group ($p > 0.05$ between groups) and 100% of the sample obtained concept "Alfa" to the variable gingival recession after 180 days of clinical follow-up ($p > 0.05$ time analysis).

Conclusions: The presence of horizontal over contour did not change the vertical position of the gingival margin and did not cause a clinically perceptible periodontal inflammation.

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Resin-cement adhesion to zirconia: Effect of adhesion technique and aging

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Purpose/aim: This study investigated the influence of different moulding techniques on the macroshear bond strength of resin cements to zirconia without and with aging.

Materials and methods: Zirconia specimens ($N = 180$, $n = 15$ per group) ($12 \times 12 \times 2\,mm^3$) were randomly assigned to three different molding protocols: Protocol 1 – incremental build up using mould, Protocol 2 – incremental build up using mould and subsequent removal of the mould, Protocol 3 – non-incremental build up using mould (bulk). Five different luting cements, namely Variolink Esthetic (Ivoclar); Tetric (Ivoclar); Panavia 21 (Kuraray); TheraCem (Bisco); RelyX UniCem2 (3M ESPE) were bonded to non-conditioned zirconia using polymerization protocol for each cement. After luting procedures, the specimens were randomly divided into 3 groups to be subjected to aging: 1 – dry, 2 – thermocycling (5000×; 5–55 °C) and 3 – water storage (6 months, distilled water). Bonded specimens were loaded under shear in the Universal Testing Machine (1 mm/min). Digital microscope and SEM photos were made from substrate surfaces. The data were analysed using Univariate ANOVA and Tukey's tests (alpha = 0.05).

Results: Moulding technique ($p < 0.05$), luting cement ($p < 0.05$) and aging ($p < 0.05$) significantly affected the results. In dry conditions, in all Protocols TheraCem (16 ± 3; 11 ± 1; 16 ± 3) presented the highest bond strength ($p < 0.05$). After 5000× thermocycling, TheraCem (7 ± 2) and Tetric (7 ± 2) showed the highest results using Protocol 1 ($p > 0.05$). In Protocol 2, RelyX (8 ± 2) delivered the highest result followed by TheraCem (5 ± 2) and Tetric (5 ± 1) ($p < 0.05$). In Protocol 3, RelyX (10 ± 6) delivered the highest result followed by Theracem (7 ± 2) and Panavia 21 (7 ± 2) ($p < 0.05$). After 6 months water storage, in Protocol 1, TheraCem showed significantly the highest results (10 ± 2), in Protocols 2 and 3, Tetric (10 ± 2;15 ± 5) showed the highest followed by TheraCem (6 ± 2; 8 ± 3), respectively. When incremental build up using mould was practiced (Protocol 1), the least decrease after 6 months water storage aging was observed with TheraCem ($p < 0.05$). After incremental build up using mould and subsequent removal of the mould (Protocol 2), the least decrease after 6 months water storage aging was observed with Tetric followed by TheraCem ($p < 0.05$) compared to other cements. When non-incremental build up (bulk, Protocol 3) using mould was used, after 6 months water storage aging even increase was observed with Tetric (50%) while the least decrease was observed with Variolink (22%).

Conclusions: Adhesion tests using incremental or bulk method with the polyethylene mould showed the highest results but except for Tetric, removing mould and subsequent

aging decreased the adhesion results of resin cements tested on zirconia most probably due to water absorption.

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Effect of silver-coated silica nanoparticles associated to PMMA

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Purpose/aim: The aim of this study was to synthesize and characterize silver-coated silica nanoparticles, and to evaluate the influence when incorporated into chemically activated acrylic resin, soft reliner, and glaze, in their microbiological, microstructural and mechanical characteristics.

Materials and methods: A solution containing silica nanoparticles coated by silver nanoparticles in two proportions, 10 mmol and 30 mmol, where they were characterized, was prepared by the hydrolysis and controlled condensation method (Stober method). Silica nanoparticles incorporated with silver were analyzed by integrated X-ray dispersive energy (EDS), scanning electron microscopy (SEM), and dynamic light scattering (DLS). For the microbiological analysis, 10 cylindrical samples (2 mm × 10 mm) were made in chemically activated acrylic resin VIPI Flash (Dental VIPI Ltda) where the particles were incorporated in two concentrations: 2.5% and 5% with two different molarities of 10 mM and 30 mM. In another situation, 10 cylindrical samples (2 mm × 10 mm) of soft reliner were made, with concentrations of 2.5% and 5% with the two different molarities 10 mM and 30 mM, in the third case the particles were added to a glaze in the two concentrations and molarities and applied under a sample of soft reliner Soft Confort (Dencril). A suspension of Candida albicans and Streptococcus mutans was used for analysis of minimal inhibitory concentration. The samples were made in acrylic resin ($n = 6$) of 30 × 10 × 3 mm and were made to perform the three-point flexural strength test of EMIC (Model DL-1000, EMIC Equipamentos e Sistemas Ltda – Brazil), with a speed of 1 mm/min. Samples without the presence of nanoparticles were made as a control group.

Results: The silica initially presented as a fine white powder after its characterization with the silver nitrate particles, there was a change of coloration to a yellowish tone, increase of its density and the size of its nanoparticles. The results of antimicrobial action were positive for the soft reliner and glaze samples with 5% and 30 mMol of nanoparticles, whereas in the mechanical assay there was no statistically significant difference between groups.

Conclusions: This in vitro study showed that silver-coated silica nanoparticles promoted an antimicrobial action when associated to soft reliner and glaze.

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Analysis of voids using different restorative techniques

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Purpose/aim: To analyze the voids existence inside and between the layers of class II composite resin restorations made using incremental technique compared with voids inside restorations made using bulk fill technique.

Materials and methods: Twenty-four human teeth were divided into 2 groups ($n = 12$) and 2 class II cavities (2 mm × 4 mm × 2 mm) were made per each tooth. The cavities were restored using: Filtek Z350XT, shade A2B (3M ESPE), associated to incremental technique using 4 oblique layers, and Filtek One Bulk Fill, shade A2 (3M ESPE), associated to bulk fill technique using one single portion. Materials were handled according to manufacturer's instructions, immersed into distilled water and stored in a hot air oven at 37 °C. After 48 h, the specimens were thermocycled (5000 cycles, 5–55 °C). Optical Coherence Tomography was used to analyze the existence and the number of voids by visual analysis of the captures during the scanning. Data was submitted to Kruskall–Wallis and Fisher's exact tests (α: 0.05).

Results: Regarding number of voids, no significant statistical difference was observed within restorative techniques ($p \geq 0.05$). Also, qualitative analysis showed no statistical difference for the presence of voids within restorative techniques.

Conclusions: Within the limitations of this study, bulk fill restorative technique do not reduce the presence and/or quantity of voids compared to incremental restorative technique.

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Withdrawn

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Marginal adaptation of ceramic fragments reconstructing the canines tip

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Purpose/aim: The aim of this study was to assess the marginal adaptation and integrity of ceramic fragments bonded to the incisal tip of canines after mechanical cycling.

Materials and methods: Twenty-four teeth were divided into three groups ($n = 8$) accordingly to the restorative material to be used: (G1) leucite-reinforced glass-ceramic (Empress CAD Multi, Ivoclar Vivadent); (G2) lithium disilicate-reinforced

glass-ceramic (E.max CAD, Ivoclar Vivadent) and (G3) hybrid ceramic (Shofu Block HC, Shofu). All teeth were measured and perpendicularly sectioned to simulate the wear in the incisal tip of the canines. The ceramic fragments were fabricated with the CAD/CAM technology. After cementation, the specimens were submitted to 250,000 mechanical cycles in a chewing simulator (Chewing Simulator CS-4, SD Mechatronik) with a 20 N load and frequency of 2 Hz. Then, the specimens were analyzed under a stereomicroscope and scanning electron microscope (SEM). The statistical analysis was performed using ANOVA and Tukey's post hoc tests ($p > 0.05$).

Results: It was observed statistical significant difference in the marginal adaptation mean values ($p < 0.001$), ranking the ceramic materials in three distinct groups: G3: 60.40 μm (±21.34)c; G2: 99.31 μm (±13.61)b; G1: 137.71 μm (±25.47)a. Furthermore, epoxy resin replicas were made in order to compare the margin before and after the mechanical cycling.

Conclusions: It was possible to conclude that the ceramic fragments presented survival rate of 91%, where the hybrid ceramic showed the most favorable wear pattern after the mechanical cycling. This material also showed better marginal adaptation compared to the other materials after SEM analysis.

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Effects of graft biomaterials and topical glucocorticoid on preosteoblastic cells

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Purpose/aim: In order to identify the osteogenic potential of some biomaterials currently used in bone grafts, associated or not with a glucocorticoid recommended for pre and post operative use in maxillary sinus surgeries, the present study evaluated cell viability/proliferative capacity and mineral matrix production of pre-osteoblastic (MC3T3-E1) cell cultures cultivated in conditioned media.

Materials and methods: MC3T3-E1 Subclone-4 cells (ATCC® CRL-2593™) were thawed and seeded at 2.0×10^4 cells/well over a collagen membrane (Surgidry Dental F®) or direct on the bottom of 96-microplates. After cell plating, cells were cultivated in a cell culture media conditioned with synthetic hydroxyapatites (HA) (1%, w/v), associated or not with a topical glucocorticoid (budesonide, 0.8 mcg) The experimental groups were: M (solely membrane), 91 (HAP-91®) or 91M; OG (Osteogen®) or OGM; BS (Biosynth®) or BSM; NC – negative control, PC – positive control. All groups were cultivated in regular or osteogenic medium, with and without budesonide. Cell viability was assessed by using the MTT assay (48, 96 and 144 h) and extracellular calcium deposits were quantified after 21-days of culturing by using the Alizarin Red Staining. Data was analysed by one-way ANOVA followed by Tukey's test at a significance level of 5% ($p < 0.05$).

Results: Cell viability was close to 100% in all experimental groups and time-points evaluated, except when the membrane was used, where cell proliferation was significantly impaired ($p < 0.05$). The HAP-91 group showed an osteoinductive ability even in the absence of osteogenic medium ($p < 0.05$). The budesonide significantly improved the mineralization potential in all groups, except for the BS ($p > 0.05$). In the presence of membrane, the mineralization potential in all groups was significantly different from the NC group only when the glucocorticoid was used ($p < 0.05$).

Conclusions: All hydroxyapatite powders evaluated showed high cell viability, except in presence of the collagen membrane, where cell proliferation was restricted. The HAP-91 was the only biomaterial showing osteoinductive properties similar to the positive control. In almost all cell culture conditions, the budesonide improved the cell mineralization potential. *Clinical significance:* The HAP-91 and the budesonide may be promise candidates to favor hard tissue formation.

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Dental bleaching techniques: Clinical parameters and enamel mineral content

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Purpose/aim: The aim of this study was to conduct a clinical evaluation of different dental bleaching techniques using hydrogen peroxide (HP), particularly regarding tooth sensitivity, gingival irritation, technique acceptability, patient's perception of color change, and calcium and phosphorous enamel content.

Materials and methods: Seventy-five volunteers were randomly selected and distributed according to the bleaching technique ($n = 25$): (a) HOME: 10% HP (Opalescence GO/Ultradent) for 15 days of continuous use (1 h per day); (b) OFFICE: 40% HP (Opalescence Boost/Ultradent) in three clinical sessions (40 min each session) distributed over 15 days; (c) COMBINED: one initial session with 40% HP, and then 10% HP for 15 days of continuous use. Clinical evaluations and calcium and phosphorus concentration collections were obtained before the bleaching treatment, 8 and 15 days during the treatment, and 15 days after conclusion of treatment. The color shade was evaluated with a spectrophotometer (Vita Classical guide and CIE Lab). Evaluations were made of tooth sensitivity, patients' acceptance of the bleaching technique, and their perception of color change by visual analog scales. The absence or presence of gingival irritation was also observed. Mineral content was evaluated by spectrophotometer-assisted colorimetric analysis of calcium and phosphorous concentrations.

Results: The data showed that color change was similar for all groups at 8 and 15 days of treatment, and at 15 days after conclusion of treatment (Tukey test; $p > 0.05$). The

OFFICE group presented the lowest intensity of tooth sensitivity (Fisher's exact test; $p < 0.05$). All techniques presented similar acceptability by the volunteers (Fisher's exact test; $p > 0.05$). However, gingival irritation was found to be higher at the 8th and 15th day of bleaching for the HOME and COMBINED technique group. Regarding the patient's perception of color change, the HOME group remarked that it took longer to initiate dental color change with this technique than with that of the COMBINED group (Fisher's exact test; $p < 0.05$). Calcium concentrations did not differ significantly among the treatments (Fisher's exact test; $p > 0.05$), but phosphorus concentration at the 7th day was higher for the OFFICE group, com-pared with the others (Fisher's exact test; $p < 0.05$).

Conclusions: All the bleaching techniques were well accepted by the patients and promoted whiter teeth, but the OFFICE treatment caused less tooth sensitivity.

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Effects of exposure to grape juice during bleaching: Clinical study

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Purpose/aim: The objectives of this randomized clinical trial were to evaluate the different parameters of overall color change of teeth exposed to grape juice during both in-office (35%HP with and without calcium) and at home bleaching (7.5%HP and 10%CP); and to compare the effectiveness of different bleaching agents for each technique.

Materials and methods: Forty-seven participants with A2 shaded (or darker) incisors that attended the inclusion and exclusion criteria were selected and randomly assigned to experimental or control group (with and without exposure to grape juice, respectively). A split-mouth design was selected, in which the same patient was submitted to different bleaching protocols in the right and left sides of the maxillary (in-office bleaching) and mandibular arch (athome bleaching); thus resulting in 8 groups: WHPc (in-office with calcium-containing 35%HP); WHPe (in-office with calcium-containing 35%HP and exposure to grape juice); WGOc (in-office with 35%HP); WGOe (in-office with 35%HP and exposure to grape juice); PDc (athome with 7.5%HP); PDe (at-home with 7.5%HP and exposure to grape juice); WGHc (at-home with 10%CP); and WGHe (at-home with 10%CP and exposure to grape juice). Only participants from the control group were instructed to avoid intake of foods and beverages containing pigments, while no dietary restrictions were applied to the experimental group, in which participants also instructed to mouth rinse 50 ml of grape juice, for 30 s, three times per day during three weeks. Color parameters were measured at baseline, during bleaching and one month post-bleaching, using a spectrophotometer. Tooth sensitivity was registered by using a VAS scale. Data were analyzed by a repeated measures ANOVA and post hoc Bonferroni test ($\alpha = .05$).

Results: No significant difference was observed between the control and experimental groups for both at-home and in-office bleaching at all evaluation times. Regarding bleaching agents, WHP was more effective than WGO, while PD was more effective than WGH.

Conclusions: Exposure to grape juice did not interfere on the final bleaching outcomes and on the color parameters (L*, a* and b*); this, regardless of the technique or the bleaching agent composition.

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Effect of glass-ceramic associated to natural primers on dentin-adhesive interface

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Purpose/aim: This study evaluated the effect of the use of Biosilicate solution associated with natural therapeutic primers (propolis) on bond strength (BS) of composite resin restorations to the dentin.

Materials and methods: One-hundred and sixty healthy human molars were selected and Class I cavities (5 mm length, 4 mm width and 4 mm depth) were prepared in the central area of the tooth surface using carbide burs. All teeth were randomly separated into eight groups ($n = 20$) according to the treatment received before adhesive system (Adper Single Bond Universal – 3M ESPE) be used: Control Group: Adhesive System; CHX Group – Chlorhexidine (CHX) 0.12%; Bio Group – Biosilicate solution at 10%; P16 Group – Propolis extract with low levels of polyphenols; P45 Group – Propolis extract with high levels of polyphenols; CHXBio Group – CHX + Biosilicate; P16Bio – Propolis extract with low levels of polyphenols + Biosilicate; P45Bio – Propolis extract with high levels of polyphenols + Biosilicate. After restorative procedures, the samples were sectioned into sticks following the "non-trimming" technique and were stored in distilled and deionized water at 37 °C for 24 h. The beams were submitted to microtensile test (0.5 mm/min), and the fracture patterns were analyzed by stereomicroscope (40×).

Results: According to the results (ANOVA, Tukey, $p < 0.05$), there was no statistical difference ($p > 0.05$) on BS between all the groups. Groups Bio, P16, P45 and P45 + Bio presented more prevalence of mixed than adhesive fracture pattern.

Conclusions: It was concluded that the dentin pretreatments did not interfere with BS of the dentin-adhesive interface.

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Self-adhesive pit and fissure sealant modified with metallic monomers

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Purpose/aim: The aim of this study is to evaluate the effect of incorporation of zinc methacrylate and di-n-butyldimethacrylate-tin on an experimental self-adhesive light-curable pit and fissure sealant.

Materials and methods: The zinc (Zn) and tin (Sn) containing methacrylates were incorporated at 2.5 or 5 (wt%) in experimental self-adhesive resin-based sealants. The pit and fissure sealants were formulated with the inclusion of acid monomer in a monomer blend with nanometric silica. A composition without the incorporation of metal-based monomers was tested as a control (C). Five groups were tested; Control, Sn 2.5%, Sn 5%, Zn 2.5%, Zn 5%. The degree of conversion, microshear bond strength, translucency parameter, flexural strength, elastic modulus, cytotoxicity assay using Mouse fibroblasts of the L929 immortalized cell line, and Sn leached in water was obtained after 24 h, 7 and 14 days was determined by inductively coupled plasma mass spectrometry (ICP-MS). The statistical analysis was performed using one-Way ANOVA and Tukey's post hoc method ($p < 0.05$).

Results: The experimental groups showed means for shear bond strength, Translucency parameter, degree of conversion, flexural strength, Young's modulus and depth of cure were similar to control (10.6 [±2.8] MPa, 70.2 [±4.5], 50.24 [±8.7]%, 1.4 [±0.2] GPa and 5.6 [±0.14] mm respectively). The Sn leached was detected in statistically higher levels after 7 (6.8 ± 3.9 μg) and 14 d (9.7 ± 4.9 μg) when compared to 24 h (0.36 ± 0.26 μg).

Conclusions: According to present findings, the experimental formulation of pit and fissure sealant showed suitable immediate bond strength to enamel as a requirement to be used in the self-adhesive technique. Moreover, the incorporation of amounts of 2.5 and 5% of metallic methacrylate (Sn or Zn) in experimental self-adhesive pit and fissure sealant did not impair the mechanical properties of the sealants.

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Physicochemical properties of dental adhesives doped with zinc compounds

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Purpose/aim: To evaluate the influence of addition of different concentrations of zinc chloride ($ZnCl_2$) and zinc oxide (ZnO) on the degree of conversion (DC), flexural strength (FS) and modulus of elasticity (ME) of dental adhesives.

Materials and methods: Two etch-and-rinse dental adhesives [Adper Single Bond 2 (SB) and Ambar (AM)] were zinc-doped by mixing them with 5, 10, or 20 wt% of ZnO powder, or with 1, 2, or 4 wt% $ZnCl_2$. The DC of the resulting blends was measured using FT-IR spectroscopy ($n = 5$), whereas FS and ME were determined by three-point bending test of bar-shaped specimens ($n = 10$). Data were subjected to one-way ANOVA and Student–Newman–Keuls post hoc test ($\alpha = 0.05$).

Results: For both SB-blends and AM-blends, the higher the concentration of $ZnCl_2$ the lower the DC and flexural properties, except for 4% $ZnCl_2$-doped AM-blend that presented FS similar than AM-control, and ME statistically higher than AM-control. Different concentrations of ZnO had no effect or very slight reduction of DC in AM-blends and SB-blends, respectively. When 5% and 10% ZnO were incorporated into SB, it was observed higher FS and ME values than SB-control and 20% ZnO-doped SB-blend. For AM-blends, there was reduction of flexural properties with the addition of 10 and 20% ZnO, whereas 5% ZnO-doped AM-blend presented similar FS and ME than AM-control.

Conclusions: Some physicochemical properties were jeopardized when doping simplified dental adhesives with $ZnCl_2$. Incorporation of 5% ZnO into SB and AM did not negatively affect DC, FS, and ME.

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Influence of etching procedures on surface wettability of CAD/CAM materials

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Purpose/aim: The aim of this study is to analyze the surface wettability caused by etching procedures on ceramic and polymer-based CAD/CAM materials.

Materials and methods: The CAD/CAM ceramic Vitablocs Mark II (VM) (Vita Zahnfabrik) was chosen as control group and

Table 1 – Contact angle among the conditions tested for each material within this study.

Treatment	Material		
	VM	LU	VE
CT	46.60 (±2.94)[a]	59.08 (±4.07)[a]	55.88 (±1.93)[a]
HF30	36.17 (±1.97)[b]	67.66 (±5.13)[b]	38.53 (±3.43)[b]
HF90	36.19 (±4.86)[b]	71.69 (±4.32)[b]	33.91 (±1.88)[bc]
SB	43.96 (±4.70)[a]	84.58 (±6.24)[c]	72.32 (±5.33)[d]
SB30	36.51 (±2.79)[b]	61.57 (±4.67)[a]	32.89 (±1.88)[c]
SB90	37.53 (±4.20)[b]	40.43 (±5.48)[d]	31.37 (±3.17)[c]

Same letters (columns) no statistically significant difference was found among the conditions ($p < 0.05$).

compared against two other polymer-based CAD/CAM materials; Lava Ultimate (LU) (3M ESPE) and Vita Enamic (VE) (Vita Zahnfabrik). Forty-eight specimens for each material ($n = 8$) were prepared with the dimensions of 3 mm × 2.5 mm × 7 mm (width × height × thickness). Each material had 6 different surface treatment as follows: (CT) control – polished surface; (HF30) hydrofluoric acid 9.6% for 30 s; (HF90) hydrofluoric acid 9.6% for 90 s; (SB) sandblaster with aluminum oxide for 10 s (50 μm – 2 bar pressure); (SB30) sandblaster aluminum oxide for 10 s followed by hydrofluoric acid 9.6% for 30 s; (SB90) sandblaster aluminum oxide for 10 s followed by hydrofluoric acid 9.6% for 90 s. The contact angle (wettability test) was assessed on the treated surfaces; subsequently scanning electron microscopy (SEM) was utilized to identify the superficial alterations in relation to the data acquired.

Results: Means considering materials and conditions tested were below 90° (Table 1). VM was the most hydrophilic material followed by VE and LU. The VM CT (46.60 ± 2.94) did not present statistically significant difference from the SB (43.96 ± 4.70) ($p < 0.05$). Within the conditions where the hydrofluoric acid was applied on the surface of the VM they were not significantly different ($p < 0.05$). The LU CT (59.08 ± 4.07) was not significantly different from the SB30 (61.57 ± 4.67), likewise LU HF30 (67.66 ± 5.13) was not significantly different from the HF90 (71.69 ± 4.32). The VE CT (55.88 ± 1.93) showed statistically significant difference from all the other treated surfaces. The VE HF30 (38.53 ± 3.43) did not show significant difference from HF90 (33.91 ± 1.88), in addition HF90 was not significantly different from SB30 (32.89 ± 1.88) and SB90 (31.37 ± 3.17). Although morphological surface characterization through SEM showed different etching patterns for each one of the surface treatments applied the CAD/CAM materials showed similarities in the etching pattern within these treated surfaces.

Conclusions: All the materials tested presented hydrophilicity to the wettability test. The surface treatments applied to the CAD/CAM materials in this study were sufficient to enhance the surface wettability. However, some of the surface treatments applied will increase the contact angle decreasing the surface wettability when compared to a polish surface.

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Cyclic load-to-failure of hydrofluoric acid etched lithium disilicate restorations

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Purpose/aim: To investigate the effect of etching with distinct hydrofluoric acid (HF) concentrations on the cyclic load-to-failure (CLF) of machined and simplified lithium disilicate restorations (e.Max CAD, Ivoclar Vivadent) adhesively cemented to a dentin analogue material. Besides, the present study aimed to compare machined crowns vs. simplified bilayer assemblies.

Materials and methods: Pairs of dentin analogue prosthetic preparations and lithium disilicate ceramic crowns with simplified geometry were machined as well as pairs of dentin analogue discs (G10; Ø = 10 mm; thickness = 2.0 mm) and lithium disilicate discs (Ø = 10 mm; thickness = 1.5 mm) were produced. For luting, the dentin analogue preparations/discs were etched (10% HF for 60 s) and received a primer coating. The inner surface of the ceramic crowns/discs was treated as follows: non-etched/control (CTRL), or etched for 20 s with HF acid at 3% (HF3), 5% (HF5), or 10% (HF10). A silane coating was then applied onto the treated ceramic surfaces. Fatigue tests followed the staircase approach (initial load = 720 N; step-size = 70 N; 500,000 cycles per sample; 20 Hz) using a hemispheric stainless-steel piston (Ø = 40 mm) under water. The CLF data were analyzed using the Dixon and Mood method. Topographic and fractographic analyses were also conducted.

Results: For the machined crowns, all groups showed similar CLF (in N) (CTRL = 805.00 ± 91.23; HF3 = 781.25 ± 29.87; HF5 = 755.00 ± 154.49; HF10 = 833.75 ± 100.74); meanwhile for the cemented discs HF3 (1355.00 ± 32.00) and HF5 (1335.00 ± 58.80) groups (Table 1) were the highest and statistically similar; HF10 presented an intermediate CLF (1175.00 ± 132.90), while the non-etched/CTRL group had the lowest one (965.00 ± 145.00). The topographical analyses of the machined crowns depicted a quite similar surface for all groups, being preponderant the pattern established by CAD/CAM machining; for the discs, the higher the HF acid concentration, the more pronounced the topographical changes. For all groups, all the failures (radial cracks) started from the inner surface of the cemented assemblies.

Conclusions: When considering a simplified assembly on cemented discs without the topography introduced by CAD/CAM milling, the importance of surface treatment for enhanced performance is depictable, and intermediary acid concentrations (3 and 5%) led to the best performance. Although, when considering a complex scenario (machined and cemented crowns) the machined topography proved to be

Table 1 – Experimental design, surface treatments and cyclic loads-to-failure (in N; mean, standard deviation and 95% confidence intervals) of the tested lithium disilicate restorations (cemented machined crowns and discs) submitted to 500,000 load pulses at 20 Hz.

Group	Surface treatment	Lithium disilicate cemented crowns		Lithium disilicate cemented discs	
		C_{LF} (SD)	95% CI	C_{LF} (SD)	95% CI
CTRL	Non-etched control (only silane application)	805.00 (91.23)^{Ad}	738.77–871.23	965.00 (145.00)^{Cc}	872.53–1057.50
HF3	3% HF acid* (20 s) + silane application	781.25 (29.87)^{Ad}	758.13–804.47	1355.00 (31.06)^{Aa}	1332.91–1377.09
HF5	5% HF acid* (20 s) + silane application	755.00 (154.49)^{Ad}	661.13–848.87	1335.00 (58.80)^{Aa}	1294.50–1375.50
HF10	10% HF acid* (20 s) + silane application	833.75 (100.74)^{Acd}	766.03–901.47	1175.00 (132.90)^{Bb}	1080.50–1269.50

* Experimentally formulated (FGM Produtos Odontológicos, Joinville, SC, Brazil).
Similar uppercase letters indicate statistically significant equality among the columns based on confidence interval overlapping; while similar lowercase letters indicate statistical similarity comparing all the tested groups based on the same statistical methodology.

a preponderant factor related to the fracture origin, and the surface treatment became irrelevant to fatigue performance.

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Correlation of calcium-phosphate, laser and adhesive on dentin-permeability and bond-strength

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Purpose/aim: Dentin permeability and hybrid layer degradation are the two challenges encountered in composite restoration durability. The objective of this study was to develop a technique to reduce the dentin permeability through calcium phosphate (F) using a laser-assisted process (LAP), to correlate these effects on microtensille bond strength (MTBS) and to evaluate the hybrid layer.

Materials and methods: Sixty dentin discs (±6 mm in diameter and ±1.5 mm height) were obtained from human molars. The specimens were divided into two groups according to the prior application of calcium phosphate (TeethMate Desensitizer – Kuraray Noritake Dental Inc.). Each group was divided into three subgroups according to the treatment performed: A – Adhesive (Single Bond Universal – 3M-ESPE), AL – Adhesive + Laser (Nd:YAG 60 mJ) (Nd:YAG Pulse Master 600 IQ Laser, American Dental Tech.) and LAL – Laser + Adhesive + Laser. The percentage of the initial and final (after treatment) dentin permeability was calculated in relation to the maximum permeability using the machine THD-02b (Odeme Equip. Med. e Odont.). After dentin treatments the composite resin was applied (Filtek Z350 XT, 3M-ESPE). The specimens were cycled to 5000 thermal cycles and 120,000 mechanical cycles (ER 37000 – ERIOS Equipamentos), and MTBS test was performed. Additionally specimens were observed in scanning electron microscopy (SEM) and transmission electron microscopy (TEM). Gelatinolytic activity within the hybrid layers created by these different treatments was examined using in situ zymography in confocal laser scanning microscopy (CLSM).

Results: The results were analyzed by ANOVA and Tukey test (5%). The results of permeability percentage (%) showed significant differences for all groups ($p = 0.00$) between initial permeability (34.67 ± 14.21) and after treatment (54.48 ± 9.17). The MTBS (MPa) results showed that the groups FLAL (31.10 ± 3.69), LAL (30.14 ± 2.28) and FA (30.69 ± 1.02) presented the highest results ($p = 0.044$). The correlation test between MTBS and dentin permeability presented no significant ($p > 0.05$), but the higher results for MTBS were obtained on dentin permeability below the 45%. The ultrastructure of the resin-dentine interface showed presence of calcium phosphate in dentinal tubules and the LAP does not affect the hybrid layer. The different treatments (P and LAP) had no influence on gelatinolytic activity in hybrid layer.

Conclusions: The present study concluded that all treatments were effective in reducing dentin permeability; MTBS was affected by treatments and dentin permeability less than 45% showed the highest MTBS results. The different treatments did not affect resin-dentine interface ultrastructure and gelatinolytic activity on hybrid layer.

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Effect of a nanochitosan solution on tooth color

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Purpose/aim: The preventive potential of chitosan in the loss of enamel submitted to wear condition has been evaluated in the literature. The purpose of this pilot study was to analyze the effect of a nanochitosan solution applied on the enamel in the tooth color.

Materials and methods: Extracted molars ($n = 4$) cleaned with ultrasonic bath in distilled water and stored in thymol

Table 1 – Results of tooth color before and after application of a nanochitosan solution to different tested groups.

Sample	Color		
	Before	With acid	Without acid
1	3m3	2m3	4L1.5
2	3m3	B3	2m3
3	5m3	3m3	4m3
4	5m3	4L2.5	4m3

were used. The analyzed enamel surfaces were divided into two groups according to the following experimental parameter: a, previous application of phosphoric acid during 15 s (with and without). The solution was applied using a microbrush. Before and after application, color analysis was performed by spectrophotometry in the same spot. Teeth were then cut with a diamond disk in perpendicular direction to verify the presence of the nanochitosan inside the enamel (with and without previous application of acid) by FTIR.

Results: It was observed that the tooth color obtained a slight hue reduction after the use of the nanochitosan solution for all tested groups (Table 1). FTIR showed the presence of chitosan inside the enamel for both tested groups.

Conclusions: The nanochitosan solution infiltrated in the enamel and did not have negative impact in the tooth color.

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Can low temperature degradation influence conventional and monolithic zirconia crowns?

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Purpose/aim: Analyze the influence of aging on the degree of adaptation of Y-TZP based crowns as well as the influence of cementation (Rely X U200, 3M Espe) on the fit of the restorations.

Materials and methods: Monolithic (Z-CAD HTL, Metoxit AG, Tayngen, Switzerland) and ceramic coating (Z-CAD HD, Metoxit AG, Tayngen, Switzerland; E-max, Ivoclar Vivadent) were analyzed. Forty-eight standardized dies were prepared from stainless steel, to receive a ceramic crown. The specimens were randomly divided into 4 groups of 12 specimens each: (1) bilaminar crown (zirconium structure with ceramic coating) cemented; (2) bilaminar crown (zirconium structure with ceramic coating) without cement; (3) monolithic zirconia crown without cement; (4) cemented monolithic zirconia crown. All groups were treated as a function of aging, in 2 different times: T1: No aging treatment and stored in a dry place at room temperature; T2: Treatment of artificial aging (hydrothermally), in autoclave, under a humid atmosphere at 131 °C and pressure of 1,7 bar for 5 h. Marginal adaptations were evaluated by measuring the absolute marginal discrepancy of the ceramic crowns on the specimens, using a scanning electron microscope. The monoclinic-to-tetragonal (m/t) peak intensity ratio measured by X-ray diffraction was used to calculate the monoclinic phase fraction and monitor LTD.

Results: Both zirconia groups showed similar vertical marginal discrepancies, however, no significant differences ($p = 0.41$) in marginal adaptation were observed among the experimental groups. Moreover, no differences were observed in either group in marginal discrepancies between cementation process neither artificial aging ($p = 0.17$). The relative XRD peak intensity of the monoclinic to tetragonal phase increased for 1.2 to 3% for bilayer crowns and from 0.8 to 1.6% for monolithic crowns. Monolithic and bilayer CAD/CAM zirconia crowns showed marginal gaps that were within an acceptable range of marginal discrepancy.

Conclusions: Cementation was not found to have a statistically significant influence on the marginal fit. Marginal adaptation was not influenced by aging, and this did not lead a significant transformation from tetragonal to monoclinic phase.

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Bioactive glasses improve dentin adhesion and conversion of experimental adhesives

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Purpose/aim: The objective was to investigate dentin adhesion, interfacial nanoleakage and in situ degree of conversion of adhesives containing bioactive glasses 45S5 (with calcium) or strontium substituted 45S5 (Sr-45S5).

Materials and methods: Commercial two-step etch-and-rinse adhesive Ambar Universal (FGM) was used with bioglass addition (Control) or with 10 wt% 45S5 or 10 wt% Sr-45S5. Extracted third molars were cut to expose a flat dentin surface and were bonded with one of the three adhesives. Bonded teeth were cut into resin-dentin sticks for microtensile bond strength test ($n = 6$), which was realized after 24 h water storage. Further sticks ($n = 3$) were surveyed by Micro-Raman spectroscopy to assess in situ degree of conversion by the ratios of 1608/1638 cm^{-1} peaks and by scanning electron microscopy to observe silver nanoleakage along the interface. The results were analyzed with one-way ANOVA and Tukey's test ($p < 0.05$).

Results: The bond strength of control adhesive (23.3 ± 1.8 MPa) was significantly lower than 45S5 (33.0 ± 4.8 MPa) and Sr-45S5 (34.3 ± 4.9 MPa) ($p = 0.008$ and $p = 0.003$ respectively). The degree of conversion was sta-

tistically higher ($p = 0.006$) for Sr-45S5-containing adhesive (83.4 ± 5.6%) in comparison with control (67.7 ± 6.5%), and 45S5 (76.0 ± 2.9%) attained intermediate outcomes without significant difference from control and Sr-45S5. Nanoleakage was among all adhesives.

Conclusions: The addition of bioactive glass 45S5 with calcium or fully substituted by strontium may enhance dentin bonding, but with polymerization improvement only with Sr-45S5. Nevertheless, further studies with long-term analysis are necessary to further elucidate the potential therapeutic effects of such innovative adhesives.

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Survival rate of restored premolars: Evaluation of inlay fabrication methods

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Purpose/aim: The purpose of this in vitro study was to compare the survival rate and fracture load of premolars restored with inlays fabricated using different methods.

Materials and methods: Thirty maxillary premolars were selected, embedded, and prepared to receive inlays fabricated using different methods ($n = 10$): LaCom – digital impression with Lava C.O.S. scanner (3M ESPE), followed by milling of composite resin block (Lava Ultimate; 3M ESPE) in a milling unit; CeCom – digital impression with Cerec 3D Bluecam scanner (Dentsply Sirona), followed by milling of a Lava Ultimate block in Cerec (Dentsply Sirona); PresDis – impression with polyvinyl siloxane, inlay made using the lost wax technique, and IPS e.max Press (Ivoclar Vivadent AG) pressed ceramic (lithium disilicate). A dual-polymerizing resin cement system was used to lute the inlays. The inlays were mechanically cycled (2 Hz, 106 mechanical pulses, 80 N) after 24 h, and the specimens were stored in distilled water at 37 °C for 11 m. Then, a fatigue test was conducted using a 10 Hz frequency and 400 N load on the inner inclines of the cusps. The test was complete when the specimen fractured or when the specimen reached 1.5 × 106 cycles. The specimens that survived fatigue testing were submitted to a single-load fracture test in a universal testing machine and analyzed under a stereoscope for failure classification. Survival rates were estimated using the Kaplan–Meier method and log-rank test (Mantel-Cox). Fracture load data were analyzed using 1-way ANOVA ($\alpha = .05$).

Results: No significant difference was detected among the groups for the survival rate ($P = .87$) or for the load to fracture ($P = .78$) (Table 1). The survival rates for the experimental groups were 0.8 for LaCom and CeCom groups, meaning that the probability of the premolars from these groups to exceed 1.5 million cycles without showing failure (event/primary outcome) was 80%; and for PresDis the survival rate was 88%. Most failures were longitudinal, catastrophic fractures.

Conclusions: The premolars restored with inlays fabricated using the tested methods had similar survival rates and loads to fracture.

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Staining susceptibility of resin infiltrated white spot lesions after bleaching

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Purpose/aim: The aim of this study was to evaluate the staining susceptibility of resin infiltrated natural white spot lesions (RIWSL), subjected or not to dental bleaching.

Materials and methods: Fifty extracted human teeth containing natural white spot lesions on smooth surfaces received the resin infiltration using Icon (DMG), according to the manufacturer's instructions. The teeth were randomly assigned into two groups ($n = 25$). On the first group none additional treatment was performed. The color of RIWSL and a surround area of sound enamel (SE) was evaluated by the photographic method, obtaining the L*, a* and b* coordinates. On the second group the teeth received dental bleaching (DB) using a 35% hydrogen peroxide bleaching gel (Whiteness HP, FGM), applied according to the manufacture's recommendations, being then immersed in ultra-pure water for 7 days. After that color of RIWPL and SE areas were evaluated again. All the samples were immersed in the staining broth proposed by ADA for 14 days. After that color was evaluated again. The color change (Delta E) was analyzed for SE and for RIWSL.

Results: The data was analyzed using two-way ANOVA and the results were: For enamel status (SE × RIWSL) – $p = 0.000$; for dental bleaching (yes × no) – $p = 0.44$. The results of Tukey's test for enamel status were: SE – 6.42a, RIWSL – 10.74b. The means

Table 1 – Mean ± standard error number of cycles for failure of fatigue test and mean ± standard error load for failure (N) after monotonic test for tested groups.

Groups	Number of cycles for failure	No of specimens survived fatigue test	Load to fracture
CeCom	1,500,000 ± 0 A	8	1581.1 ± 541.4 a
LaCom	1,389,204 ± 94,430 A	8	1519.6 ± 398.9 a
PresDis	1,384,055 ± 109,313 A	8	1687.3 ± 423.6 a

Similar uppercase letters indicate no statistical difference between number of cycles for failure according to log rank. Similar lowercase letters indicate no statistical difference between load for failure after monotonic test according to 1-way ANOVA.

of Delta E for all groups were: None DB/SE – 5.36a, DB/SE – 7.12ab, DB/RIWSL – 10.63bc, None DB/RIWSL – 10.85c.

Conclusions: It was concluded that infiltrated white spot lesions were more susceptible to staining than sound enamel, although dental bleaching does not increase this susceptibility.

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Fatigue of lithium-disilicate crowns: Processing technique and surface treatment effects

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Purpose/aim: It evaluates the fatigue performance of lithium-disilicate monolithic crowns manufactured by 2 processing techniques (pressed Vs CAD/CAM milling) and adhesively cemented to a dentin analogue material considering 2 protocols of surface treatments for enhanced adhesion (conventional vs simplified).

Materials and methods: 40 monolithic crowns were manufactured considering two specific processing techniques for each ceramic system ($N = 20$ for each material): LDCAD – CAD/CAM milled lithium-disilicate (IPS e.max CAD, Ivoclar Vivadent); LDPRESS – pressed lithium-disilicate (IPS e.max Press, Ivoclar Vivadent). The crowns were randomly allocated ($n = 10$) and adhesively cemented into standardized epoxy resin preparations (dentin analogue material) considering 2 different protocols of surface treatments: conventional – hydrofluoric acid etching + silane application [HF]; or simplified – etching with one-step primer (Monobond Etch & Prime, Ivoclar Vivadent) [EP]. Adhesive cementations were executed using Multilink Automix System (Ivoclar Vivadent), followed by light-curing for 20 s in different surface directions (top, interface at 0°, 90°, 180°, 270°). Then, the cemented assembly was stored in distilled water at 37 °C for 3 days, and the fatigue tests were run (step-stress approach: load ranging from 400 to 2000 N, step-size of 100 N, 15,000 cycles/step, 20 Hz). Data from fatigue failure load and number of cycles until fracture were subjected to survival analysis (Kaplan–Meier and Mantel–Cox tests), 2-way ANOVA and Weibull. Additional surface topography analysis (after surface treatment of intaglio cementing surface) and fractography were executed. The oclusal cement space was measured, after crown manufacturing/prior to surface treatments and adhesive cementation) using the replica technique and a polyvinyl siloxane impression material (Scan regular body, Yller) under stereomicroscope.

Results: Pressed crowns depicts higher fatigue failure load, number of cycles until fracture and survival probabilities in comparison to milled crowns. The different surface treatment protocols prior to cementation did not affected the previously mentioned outcomes, although a higher Weibull modulus (mechanical reliability) was observed on simplified technique (one-step etching primer) for both materials. The different processing techniques led to similar oclusal space (for cement filling) and there was no correlation between fatigue failure load and oclusal space ($r = 0.074$, $p = 0.654$), as also for number of cycles until fracture and oclusal space ($r = 0.057$, $p = 0.732$).

Conclusions: Pressed lithium-disilicate monolithic crowns present better fatigue performance in comparison to CAD/CAM milled ones. Besides, the adhesive cementation after surface treatment with a one-step etching primer leads to higher mechanical reliability for both systems.

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Results (mean, 95% confidence intervals – CI, and standard deviation – SD) from fatigue data (fatigue failure load – FFL, cycles until fracture) and from oclusal space measurements through replica technique.

Groups	Survival analysis		Weibull analysis				Internal fit measurements (μm)
	Fatigue failure load (N) Mean (95% CI)	Cycles until fracture Mean (95% CI)	Characteristic FFL Mean (95% CI)	Weibull moduli Mean (95% CI)	Characteristic cycles Mean (95% CI)	Weibull moduli Mean (95% CI)	Oclusal space (Mean ± SD)
$LD^{CAD}HF$	1220 (1077–1362)^{AB}	144,500 (120475–168,524)^{AB}	1288 (1193–1392)^{AB}	7.64 (5.94–9.53)^{A}	154,283 (139,034–171,205)^{AB}	5.70 (4.47–7.28)^{A}	99.12 ± 41.67^{A}
$LD^{CAD}EP$	1200 (1134–1265)^{A}	140,000 (130,200–149,800)^{A}	1242 (1193–1293)^{A}	13.68 (9.59–19.53)^{B}	146,255 (138,832–154,076)^{A}	10.55 (7.35–15.16)^{B}	
$LD^{PRESS}HF$	1400 (1189–1610)^{BC}	170,000 (138,395–201,604)^{BC}	1518 (1356–1699)^{BC}	4.84 (3.24–7.23)^{A}	186,623 (161,979–215,016)^{BC}	3.85 (2.56–5.79)^{A}	103.00 ± 49.10^{A}
$LD^{PRESS}EP$	1460 (1328–1591)^{C}	180,500 (159,006–201,993)^{C}	1546 (1441–1659)^{C}	7.79 (5.19–11.68)^{AB}	193,761 (176,737–212,425)^{C}	5.98 (4.07–8.78)^{AB}	

Different letters in each column indicate statistical differences for each considered outcome [Kaplan–Meier and Mantel–Cox tests for Survival Analysis; Maximum-likelihood estimations for Weibull analysis; independent samples t test for Internal fit measurements (oclusal space)].

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Biogenic synthesis and characterization of silver nanoparticles coated with silica

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Purpose/aim: The purpose of the present study was to describe the biogenic synthesis and characterization of silver nanoparticles (AgNPs) coated with silicon dioxide (SiO_2) for future application in esthetic dental materials.

Materials and methods: AgNPs were synthesized using green tea extract (Camelia Sinensis) as a reducing agent of silver nitrate solution (Ag@GT group). The AgNPs were coated with SiO_2 (Ag@SiO_2 group) by the Stöber process. TEOS (tetraethyl orthosilicate) was used as a silica precursor and ammonium hydroxide solution was used as catalyst in alcoholic solvent. The nanoparticles were rinsed, freeze and lyophilized until a powder was obtained. The AgNPs (Ag@GT and Ag@SiO_2) were characterized by X-ray diffraction (XRD), dynamic light scattering (DLS), Fourier-transformed infrared spectroscopy (FTIR), surface area (BET), thermogravimetric analysis (TGA) and scanning electronic microscopy (SEM). The antimicrobial activity of Ag@SiO_2 nanoparticles against *Streptococcus mutans* was determined according to CLSI guidelines, using concentrations between 100 and 600 μg/mL.

Results: The nanoparticles synthesized in this study were characterized using powder XRD to confirm the particles as silver. FTIR measurements were carried out to confirm the presence of SiO_2 covering the surface of biogenically synthesized AgNPs. The percentage of silica covering the AgNPs measured by TGA was 18%. The data from DLS and BET method are shown in Table 1. In SEM images, Ag@SiO_2 nanoparticles presented spherical morphology, with approximately 0.2 μm in diameter. In antimicrobial evaluation, a significant reduction (87%) of bacterial growth was observed with a concentration of 600 μg/mL when compared to the control group (without particles).

Conclusions: The green synthesis method is eco-friendly, cheap and useful for producing AgNP at room temperature. Ag@SiO_2 nanoparticles showed high surface area (92 m^2/g) and a high stability in aqueous suspension (−56 mV). The microbiology analysis showed that this AgNP may be promising for application in dental materials (Supported by FAPESP 2017/22999-0).

Table 1 – Data from DLS measurements (size number, polydispersity index and zeta potential) and BET method (surface area) of nanoparticles.

	Ag@GT	Ag@SiO_2
DLS		
Size number (nm)	24.3	278.0
Polydispersity index	0.28	0.28
Zeta potential (mV)	−35.5	−55.7
BET method		
Surface area (m^2/g)	48.9	91.5

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Glaze firings on veneered zirconia: Residual stresses and optical aspects

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Purpose/aim: Previous literature stated that chipping of feldspathic ceramic in veneered zirconia restorations may be associated to tensile residual stresses. In this context, this study aimed to evaluate the effect of conventional and extended glaze firings followed by slow or fast cooling on veneer fracture toughness, residual stresses, roughness and optical properties of a Y-TZP veneered with feldspathic ceramic.

Materials and methods: Disc-shaped specimens were prepared using zirconia as the framework (0.7 mm) (Vita InCeram YZ) and a feldspathic ceramic as veneer (0.7 mm) (Vita VM9). Specimens were divided in five groups, according to the thermal treatment that they were submitted after veneer sinterization for reproduction of: conventional glaze firing followed by slow (furnace opening only when the material reaches 200 °C) (G-S) or fast cooling (immediately furnace opening at the end of the heating) (G-F), extended glaze firing (heating bath dwell time 15 min) followed by slow (EG-S) or fast cooling (EG-F), or no thermal treatment (CTRL). Veneer surface roughness (Ra and Rz) and CIEL*a*b* coordinates were measured before and after glaze firings. After that, they received Vickers indentations on feldspathic ceramic for fracture toughness and residual stress calculation. Color alteration (ΔE00) was calculated by CIEDE2000 formula, translucency was calculated by contrast ratio (CR), and gloss (ΔE*) was calculated by the difference from measurements with included and excluded specular component. Statistical analyses were carried out by ANOVA and Tukey's tests ($\alpha = 0.05$).

Results: Despite all glaze firings have led to tensile stresses in feldspathic ceramic, conventional glaze followed by fast cooling reached the highest values (9.65 MPa). Extended glaze firings followed by fast (0.76 MPa) or slow (0.77 MPa) cooling presented greater fracture toughness than G-F (0.67 MPa). Ra and Rz parameters decreased after all firings. Rz mean values of extended glaze groups were significantly lower than G-F. Regarding optical properties, color changes produced by EG groups were significantly greater than G-F. However, these differences are not clinically perceptible (ΔE00 > 0.8). EG-S showed significantly greater gloss values than CTRL and G-F. Translucency was not affected by the thermal treatments.

Conclusions: Extended glaze firings have promoted about 60% less tensile residual stresses than conventional glaze followed by fast cooling and significantly increased fracture toughness of feldspathic ceramic compared to G-F. Moreover,

as EG did not produce perceptible color changes, it may be an alternative treatment when glosser and smoother surfaces are needed in veneered zirconia restorations.

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Adhesion and strength properties of air-abraded Y-TZP: Distinct silica-coating concentrations

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Purpose/aim: To test a new approach (sol–gel method) to obtain a substitute material for air-abrasion (silica-coated aluminum oxide) and evaluate the effect on the bond strength, surface characteristics (topography and roughness), contact angle, structural stability (t-m phase transformation) and fatigue performance (biaxial flexure fatigue strength) of a Y-TZP ceramic, considering two experimental silica concentrations (7 and 20%) and available materials (30 μm silica-coated aluminum oxide particles; 45 μm aluminum oxide particles).

Materials and methods: For bond strength testing, Y-TZP ceramic specimens (IPS e.max ZirCAD B40L, Ivoclar Vivadent/7 × 6.3 × 2 mm^3) were embedded in plastic molds with acrylic resin. The specimens were allocated into 8 groups ($n = 20$) considering two factors: surface treatment in four levels (SiC: silica-coated aluminum oxide particles, CojetTM System, 3M Espe; AlOx: aluminum oxide particles, Polidental; 7%Si: experimental material of silica-coated aluminum oxide particles (composed of 93% alumina and 7% silica); 20%Si: experimental material of silica-coated aluminum oxide particles (composed of 80% alumina and 20% silica) and aging in two levels (baseline: 24 h at 37 °C in a steam chamber; or aging: 90 days in a steam chamber + 12,000 thermal-cycles). The particles' air-abrasion was executed for 10 s, a silane agent (Monobond Plus, Ivoclar-Vivadent) was applied and the resin composite cylinders were cemented with Multilink Automix, followed by light-curing. The shear tests were performed using a wire loop (Ø = 0.5 mm). For biaxial flexure fatigue strength testing, disc-shaped specimens were manufactured according to ISO 6872-2015 and allocated into the 4 groups, using the aforementioned method ($n = 30$). The fatigue tests (staircase method) were performed, applying 20 Hz, 20,000 cycles. Roughness analysis, phase transformation and topographic analysis were conducted.

Results: For bond strength, all baseline groups had statistically similar results. After aging, the groups SiC and 7%Si remained similar to the groups in baseline condition, while the groups AlO_x and 20%Si presented decreased bond strength values. The 7%Si group presented the highest mean flexural fatigue strength, which was similar only to the SiC group. The lowest flexural fatigue strength means were presented for 20%Si and were similar only to AlO_x. The 7%Si group presented a rougher surface and the 20%Si group the lowest mean roughness (Table 1). The tested groups presented similar m-phase content and topographical characteristics.

Conclusions: The 7%Si group presented a better bond strength performance after aging and higher fatigue flexural strength, being similar in both conditions only to SiC group.

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Brushite particles synthesis: Effect of temperature and concentration of reagents

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Purpose/aim: Dicalcium phosphate dihydrate (DCPD, or brushite) is a precursor of hydroxyapatite in the formation of bones and teeth and has been studied as an osteoinductive biomaterial and on remineralization of dental tissues. The objective of this study was to evaluate the effects of temperature and concentration of precursor solutions on the synthesis of DCPD particles.

Materials and methods: Four groups were defined based on two variables: concentration of precursor's solutions (0.5 mol/L or 1.0 mol/L) and temperature (22 °C or 45 °C). Calcium nitrate and ammonium phosphate solutions were

Table 1 – Results (mean ± SD) of shear bond strength, contact angle, biaxial flexure fatigue strength (mean ± SD, and confidence interval – CI), roughness, and m-phase content.

Surface treatment	Bond strength (MPa)		Contact angle analysis (°)	Biaxial flexure fatigue strength (MPa)		Roughness data (μm)		m-phase content (%)
	Baseline	Aging		Mean	95% CI	Ra	Rz	
SiC	27.3 ± 7.4^{A}	31.4 ± 5.1^{A}	70.6 ± 13.5^{A}	880.4 ± 22.5^{C}	862.1–898.7	0.26 ± 0.04^{A}	2.0 ± 0.3^{A}	11.4 ± 1.7
7%Si	28.1 ± 8.2^{A}	26.9 ± 5.4^{A}	72.3 ± 4.5^{AB}	892.1 ± 72.3^{BC}	841.2–943.0	0.30 ± 0.09^{B}	2.3 ± 0.6^{B}	11.6 ± 0.2
AlOx	28.2 ± 7.9^{A}	19.7 ± 6.1^{B}	80.8 ± 5.7^{BC}	796.5 ± 73.2^{AB}	745.0–848.1	0.30 ± 0.05^{AB}	2.2 ± 0.4^{AB}	12.5 ± 0.3
20%Si	30.1 ± 3.6^{A}	19.5 ± 4.4^{B}	89.4 ± 4.6^{C}	777.3 ± 61.4^{A}	729.7–825.0	0.28 ± 0.06^{AB}	2.2 ± 0.4^{AB}	12.2 ± 1.3

Different uppercase letters indicate statistical differences among each column.

Table 1 – Median values for yield, density, surface area (min–max in parentheses) and particle size distribution (D_{50}, with D_{10}–D_{90} in parentheses) and average nanoparticle size (standard deviation in parentheses).

Group	Yield (%)	Density (g/cm^3)	Surface area (m^2/g)	Particle size (D_{50}, μm)	Nanoparticle long axis (nm)
0.5 mol/L					
22 °C	79.8 (77.4–83.8)	2.87 (2.68–2.90)	33 (33)	11 (6–21)	58 (23.6)
45 °C	68.7 (68–69.1)	4.12 (3.58–5.05)	60 (49–86)	21 (10–42)	138 (52.6)
1.0 mol/L					
22 °C	75.5 (75.5–83.5)	2.78 (2.74–2.79)	48 (36–60)	11 (6–21)	117 (44.5)
45 °C	73.7 (63.3–76.2)	3.32 (3.22–3.60)	48 (13–58)	15 (8–30)	133 (47.2)

combined drop-wise and kept 24 h under stirring. Syntheses were randomly repeated three times for each experimental condition. The resulting gel was freeze-dried and a white powder was obtained. Synthesis yield was determined using an analytical scale (0.1 mg). Apparent density was determined using a helium picnometer. Particles were characterized by X-ray diffraction (XRD), dynamic light scattering (DLS), surface area (BET method), transmission electronic microscopy (TEM) and scanning electronic microscopy (SEM). The long axis of the nanoparticles was measured in the TEM images using ImageJ software ($n = 50$). Due to the reduced sample size, no statistical analysis was performed and data are presented descriptively only.

Results: XRD confirmed DCPD formation in all groups. Yields were lower for synthesis conducted at 45 °C. Temperature had a consistent effect on the characteristics of particles synthesized using 0.5 mol/L solutions, with those obtained at 45 °C showing higher values (Table 1). For particles synthesized using 1.0 mol/L solutions, the effect of temperature was less evident.

Conclusions: Within the limitations of the study, it was possible to conclude that the influence of temperature on the synthesis of DCPD particles was more consistent and evident when a lower concentration of the precursor solutions was used. The fact that higher surface area and particle size were observed at 45 °C suggests the formation of agglomerates of small particles (project funded by CAPES – Coordination for the Improvement of Higher Education Personnel).

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Characterization of dental ceramics

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Purpose/aim: The objective of this study was to evaluate the surface and mechanical characteristics of feldspathic and zirconia ceramics.

Materials and methods: The materials used were: VMK Master; VM9 Enamel (Vita Zahnfabrik); Lava Plus (LP, 3M/ESPE); and Lava Frame (LF, 3M/ESPE). The glaze used was Vita Akzent on the samples of VMK and VM9 in all analyses; and LP with and without glaze in the wettability test. Specimens were prepared in disk format (1.2 × 1.0 mm) and analyzed for: roughness, wettability, microhardness and biaxial flexural strength. For roughness the samples were cleaned with 96% alcohol and placed on Vecco wyko nt1100 optical profilometer for taking 3 different areas of the disc. A drop of distilled water was used to calculate the contact angle in the wettability test, this process was repeated 5 times to obtain an average. For microhardness a diamond tip under controlled and constant pressure penetrated the surface of the samples and the diameter of defect was measured (8 points of each sample). For biaxial flexural strength the samples were placed on a surface containing 3 metal points and the force arm with a center point gradually increased the pressure until the complete failure.

Results: Statistical analysis indicated a difference between the average roughness of the materials with and without glaze, with glaze having higher values (0.997 ± 0.268 – VM9; 1.025 ± 0.259 – VMK; 0.635 ± 0.131 – LF; and 0.683 ± 0.118 – LP). For wettability there was a statistical similarity between the feldspathic ceramics with glaze (41.001 ± 3.326 VMK and 39.028 ± 2.283 VM9), being different from the other samples (33.485 ± 3.65 – LP + Glaze; 72.352 ± 7.857 – LP – Glaze; 94.530 ± 2.654 – LF), showing that water has more affinity to surfaces with glaze. The microhardness values were: 573.42 ± 35.275 – VMK; 590.715 ± 32.657 – VM9; 1153.154 ± 31.013 LP; and 1403.538 ± 53.096 – LF showing higher hardness of zirconia, being the LF the greatest hardness found. The zirconia presented values of resistance to flexion higher values than felyspathic (85.117 ± 14.1 – VMK; 81.792 ± 19 – VM9; 1192.456 ± 160.8 – LP; 1289.61 ± 265.7 – LF.

Conclusions: Therefore, there is a mechanical difference between the group of evaluated materials. Zirconia showed superior results in the mechanical issue and polishing.

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Reproducing the occlusal anatomy of temporary crowns in zirconiumoxide crowns

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Purpose/aim: A well-adjusted temporary crown is the best template for the definitive crown. The purpose of this study was to transfer the shape of the occlusal surface of a PMMA temporary to a monolithic zirconium oxide crown. The null hypothesis was that the anatomy of the ZrO-crown is identical with the occlusal anatomy of the temporary.

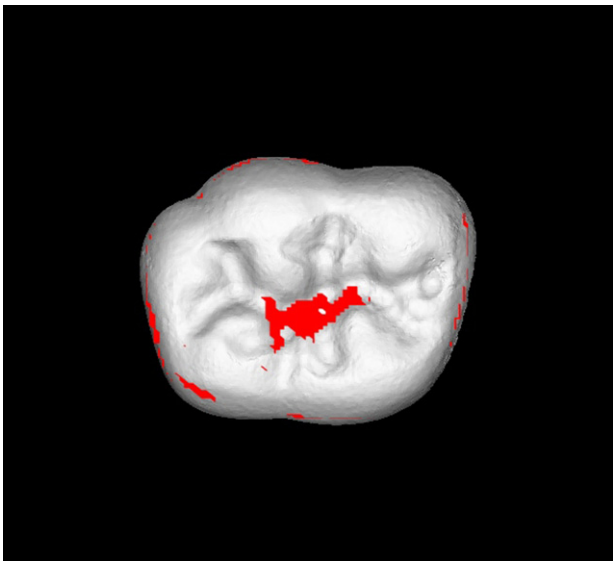

Fig. 1

Materials and methods: From a typodont crown preparation (tooth-# 36,Ivoclar Vivadent) 10 PMMA (Telio-CAD, Ivoclar Vivadent) crowns were fabricated with the E4D system (Planmeca). Every crown was individually occlusally adjusted. After polishing, the outside contour of the PMMA crowns were scanned with a E4D scanner and the STL File of the crown preparation merged with the file from the adjusted crown using the 3Shape software in order to produce 10 Zircad – MO crowns (Ivoclar Vivadent) using a Zenotec Hybrid Milling machine (Wieland) and a Programat CS-4 (Ivoclar Vivadent) for sintering. The crowns were not glazed, but polished. For comparison, the PMMA and the zirconiumoxide-crowns were scanned with a 3 M True Definition scanner. The .stl files were cleaned and aligned with Geomagic, then exported to a graphic software (Free CAD, https://www.freecadweb.org/wiki/Contributors) and converted into x, y, z coordinated mesh voxel (.obj) (Fiji, Nature Methods, National Institutes of Health, Bethesda, MD, USA). Then, the x, y, z coordinates were converted into a normalized 76×76 matrix using a data processing software (Origin Pro, OriginLab Co., Northampton, MA, USA). Data were checked for normality using Shapiro–Wilk's test, ANOVA with repeated measures was performed (Stata/MP 13, StataCorp, College Station, TX, USA) and post hoc comparisons done with Tukey's test ($\alpha = 0.05$). To obtain more details, .stl files (PMMA and ZrO) were merged with Geomagic software, which generated deviation distribution tables and difference plots.

Results: The ANOVA showed a significant difference between the PMMA and the ZrO crowns. The Tukey test revealed that the difference was mainly in the fissure area (Fig. 1). 42.4% of all data points were within ±0.022 mm with a SD of 0.005 mm. 48% of the data points deviated into the positive direction, indicating that the ZrO crowns were higher. In difference plots, the occlusal surface is in the range of ±0.022 mm or below zero, with higher negative values for the fissures. The null hypothesis was rejected.

Conclusions: Since the main differences were found in the fissures, clinically it may be expected that none or only minimal occlusal adjustments would be needed for these ZrO crowns.

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Microtensile bond strength of zirconia after surface treatments and aging

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Purpose/aim: To compare the bonding behavior by microtensile bond strength test between high-translucent zirconia and conventional zirconia when applied different surface treatments in combination with a universal adhesive, before and after hydrothermal ageing.

Materials and methods: Conventional and high-translucent zirconia specimens (Upcera; Shenzhen Upcera Dental Technology Co., Liaoning, China) were divided in six groups according to the surface treatment received: without surface treatment (ZrC e ZrT), air-borne particle abrasion with 50 μm Al_2O_3 particles (ZrC-AO and ZrT-AO), and tribochemical treatment with 50 μm silica modified Al_2O_3 particles (ZrC-T and ZrT-T). Specimens were treated using a universal adhesive containing MDP (Single Bond Universal; 3M ESPE, EUA) and cemented to resins blocks (Opallis; FGM, Joinville, Brazil) using a resin cement (RelyX Ultimate, 3M ESPE, EUA) and left undisturbed for 5 min to complete self-curing. The assemblies were stored in distilled water at a temperature of 37 °C before sectioning. After, microbar specimens with cross-sectioned areas of 1 mm^2 were achieved after sectioning (Isomet, Buehler, An ITW Company, IL, USA). Half of the microbars were subjected to hydrothermal aging for 10,000 cycles (521-4D, Ethik Technology, São Paulo, Brazil). Bond strength was evaluated through microtensile bond strength test (Instron 4444; Illinois Tool Works Inc., MA, USA) and failure mode analysis was performed. Morphological analysis of the specimens was also performed through optical profilometry (DektakXT, Bruker Corporation, Massachusetts, USA) and XRD analysis (XRD D8 Advance, Bruker Corporation, Massachusetts, USA). Bond strength values were analyzed by the Weibull analysis. In order to evaluate the surface roughness, One-Way ANOVA test was performed.

Results: Weibull analysis revealed the higher Weibull parameters of bond strength for conventional zirconia (ZrC; ZrC-AO; ZrC-T). High-translucent zirconia groups (ZrT; ZrT-AO; ZrT-T) showed lower Weibull parameters of bond strength (Table 1). According to the One-Way ANOVA test, there were significant statistical differences between groups ($p = 0.000$), being ZrC-AO and ZrT-AO the groups with the highest roughness. Rietveld analysis of XDR patterns revealed a higher

Table 1 – Mean and standard deviation (coefficient of variation) of tensile strength σ_0 and Weibull modulus (95% confidence interval) (m).

	Tensile strength (σ_0) (MPa)		Weibull modulus (m)	
	As sintered	Hydrothermal aging	As sintered	Hydrothermal aging
ZrC	11.53 (9.76–13.63)^{g,i}	8.34 (7.08–9.82)^{i,j,k}	2.58 (1.87–3.57)^{d,e,f,g,h,i}	2.47 (1.81–3.37)^{d,e,f,g,h,i,j}
ZrC-AO	22.78 (21.10–24.59)^{a}	22.01 (20.05–24.16)^{a,b}	4.91 (3.68–6.55)^{a,b,c}	4.01 (3.00–5.36)^{a,b,c,d,e,f}
ZrC-T	18.45 (16.78–20.29)^{b,c,e}	20.31 (19.06–21.64)^{a,b,c}	3.92 (2.89–5.31)^{a,b,c,d,e,f,g}	5.90 (4.40–7.91)^{a,b}
ZrT	8.98 (7.62–10.58)^{h,i,j}	4.58 (3.85–5.45)^{l}	2.03 (1.50–2.75)^{h,i,j,k}	1.27 (0.92–1.75)^{k,l}
ZrT-AO	18.24 (17.14–19.41)^{c,d,e}	16.70 (15.29–18.23)^{d,e,f}	6.17 (4.59–8.29)^{a}	4.29 (3.25–5.68)^{a,b,c,d,e}
ZrT-T	11.70 (10.48–13.07)^{f,g,h,i}	12.92 (11.85–14.08)^{g}	3.52 (2.60–4.76)^{a,b,c,d,e,f,g,h}	4.42 (3.26–5.99)^{a,b,c,d}

Same letters mean statistically similar behavior ($\alpha = 0.05$).

phase transformation (t → m) for ZrC-OA, ZrT-OA, ZrC-T and ZrT-T groups.

Conclusions: Bond strength values of high-translucent zirconia are lower than those of conventional zirconia. The use of universal adhesives after mechanical surface treatment of zirconia could result in a durable bonding to conventional and high-translucent zirconia.

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Postoperative sensitivity of composite replacement of amalgam restoration

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Purpose/aim: The aim of this double blind, randomized clinical trial was to compare the postoperative sensitivity of the placement technique (incremental and bulk fill) in posterior resin composite replacement of amalgam restorations.

Materials and methods: Posterior cavities of 47 patients ($n = 235$), with depth of at least 3 mm, were randomly divided into five groups. The restorations were bonded and restored using the following systems: Z350XT/Single Bond Universal (3M ESPE) and Premisa/OptiBond All-in-one (Kerr) placed incrementally, and SonicFill/OptiBond All-in-one (Kerr), Filtek Bulk Fill/Single Bond Universal (3M ESPE) and Opus Bulk Fill/Ambar Universal (FGM) placed using the bulk fill technique. The restorations were evaluated by two calibrated examiners using World Dental Federation criteria after one week. Postoperative sensitivity was assessed using a 0-4 numerical rating scale and a 0-10/0-100 visual analog scale after 24 h, 07 and 30 days.

Results: The postoperative sensitivity was not affected by the filling technique because there was no difference on the overall postoperative sensitivity risk on 24 h ($p = 0.223$), 07 ($p = 0.215$) and 30 days ($p = 0.664$) for all groups, but it was affected by dimensions of the cavities after 24 h ($p = 0.007$), 07 ($p = 0.038$) and 30 days ($p = 0.031$). Within 30 days, the risk of postoperative sensitivity reduced significantly ($p = 0.045$) for Filtek Bulk Fill composite, which was not observed for the other materials. The necessity of replacement showed no significative difference among the groups ($p = 0.731$).

Conclusions: Within the limitations of the study, we can conclude that the immediate postoperative sensitivity was not affected by filling technique.

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Evaluation of chemically synthetic carbonate apatite bone substitute

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Purpose/aim: The inorganic component of human bone is not hydroxyapatite, but carbonate apatite (CO_3Ap), which contains 4–8% of carbonate in its apatite structure. Therefore, we focused on synthetic CO_3Ap as effective bone substitutes for bone regeneration. We have developed novel synthetic CO_3Ap bone graft substitutes (Cytrans Granules) by using dissolution-precipitation reaction. In this study, we aimed to evaluate the physical properties and osteoconductivity of CO_3Ap in dog.

Materials and methods: Bone graft substitutes made from bovine bone mineral (BBM) and β-tricalcium phosphate (β-TCP) were used as comparative control. The microstructure of samples was examined using a scanning electron microscope (SEM). Powder X-ray diffraction technique (XRD) was used to identify the crystal phase of the materials. Compression tests were performed by using a mechanical tester. Also, resorption property of each material was measured by the test method based on JIS T 0330-3. The animal experiments were performed at Hamri Co., Ltd., which has been approved by the AAALAC International. 4 adult beagle dogs were used. 2 standardized 5 × 5 × 4 mm box-shaped defects with a dehiscence of 5 mm were bilaterally created, and Ø 3.8 mm dental implants were placed in distal of the defects. After a healing period of 12 weeks, histological evaluation was performed.

Results: The CO_3Ap showed mineral deposition structures similar to BBM (Figure). The XRD pattern of CO_3Ap and BBM showed a typical apatitic pattern with lower crystallinity. The compressive strength of CO_3Ap, BBM and β-TCP were 2.24 N, 0.66 N and 0.24 N respectively. Histological evaluation revealed a relatively higher augmented area for CO_3Ap groups compared to others. Regarding the bone-to-implant contact, CO_3Ap was superior to all other groups at 12 weeks.

Conclusions: The results indicate that the CO_3Ap showed similar physical properties to bone mineral and the ability to form new bone tissue on dog mandibular bone, which shows the potential of using this material clinically.

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Evaluation of bond strength of 2-step type adhesives

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Purpose/aim: The aim of this study was to evaluate the bond strength of 2-step type adhesives applied in self-etch (SE) and etch-and-rinse (E&R) mode to tooth structure.

Materials and methods: Bovine enamel and dentin surfaces were ground with 320-grit SiC paper and divided into three groups ($n = 5$ each): New 2-step type adhesives (GC) (BZF); Clearfil SE Bond 2 (Kuraray) (SE2); OptiBond XTR (Kerr) (XTR). Adhesives were applied to the surface according to manufactures' instructions. Adhesives were light cured via the ultradent mold (Ø = 2.38 mm), and composite resin was applied via the mold and light cured. The bonded specimens were subjected to shear bond strength (SBS) test at 1 mm/min after stored in water at 37 °C for 24 h. Data were analyzed using ANOVA followed by Tukey's test ($p < 0.05$).

Results: Mean (±SD) SBS values to enamel applied in SE were 33.1 (±11.2), 31.8 (±7.1), and 25.9 (±5.5) and in E&R were 56.1 (±5.9), 47.2 (±5.4), and 36.7 (±5.6) MPa for BZF, SE2, XTR respectively. In SE, there were no significant differences in SBSs to enamel among three adhesives. In E&R, SBS to enamel for BZF was significantly higher than XTR. Mean (±SD) SBS values to dentin applied in SE were 40.1 (±2.1), 30.1 (±4.9), and 29.8 (±6.9) and in E&R were 50.0 (±6.9), 31.1 (±4.1), and 45.4 (±8.9) MPa for BZF, SE2, and XTR respectively. In SE, SBS to dentin for BZF was significantly higher than SE2 and XTR. In E&R, SBSs to dentin for BZF and XTR was significantly higher than SE2. To enamel, all adhesives in E&R showed significantly higher SBSs than SE. To dentin, SBSs of BZF and XTR applied in E&R were significantly higher than SE. However, SBS of SE2 did not show significant differences between SE and E&R.

Conclusions: To tooth structure, bond strength of BZF applied in E&R was higher than SE. Bond strength of BZF was the highest regardless of in SE/E&R or to enamel/dentin.

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Characterizing laser irradiation through an YSZ ceramic for debonding purposes

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Purpose/aim: The use of the Er,Cr:YSGG laser could be a fast and non-destructive alternate method for removal of yttria-stabilized zirconia (YSZ) restorations instead of the traditional method using a coarse diamond bur in a high-speed handpiece. However, before introducing the use of this device for debonding of the YSZ restoration from the resin cement, first, it is important to characterize the effect of the heat produced through the YSZ structure. Thus, the aim of this study was to characterize the effect of low and high power Er,Cr:YSGG laser settings through a YSZ ceramic.

Materials and methods: In a previous study, YSZ samples were irradiated using the Er,Cr:YSGG laser (Waterlase MD) that was operated at a constant combination of 33% water and 66% air during 60 s with two different power settings (W) at 20 PPS, forming the following experimental groups (W/PPS): 2.5/20 and 4.5/20. The temperature through YSZ was recorded in degrees Celsius by using a digital thermometer (OMEGA HH506R) with a type K thermocouple. For the surface roughness (R_a), tortuosity (D^*) and topography analysis, an area of 100 μm × 100 μm of the YSZ slices (1 mm thick) was scanned using the AFM in the ScanAsyst mode. The height data from the scans were imported into a custom MathCAD script, and FRACTALS software was used to determine D^* by the Minkowski cover technique.

Results: Results are shown in Table 1. One-way analysis of variance showed that the high laser power of 4.5 W at 20 PPS affected significantly the surface roughness and topography of the YSZ ceramic. The groups irradiated with laser showed similar tortuosity but higher than that of the YSZ surfaces after slicing. D^* had a lower coefficient of variation than the surface roughness data.

Table 1 – Surface roughness (R_a), tortuosity (D^*) and topography analysis.

Group name	Median (°C) (SD)	R_a in μm (SD)	D^* (SD)	Surface topography
Baseline[a]	–	0.23[c] (0.02)	0.23[b] (0.00)	Smooth surface – shallow depressions
2.5/20	39.27[b] (36.26–42.00)	1.57[b] (0.34)	0.46[a] (0.01)	Rough surface – sharp depressions and peaks
4.5/20	45.86[a] (41.43–51.13)	2.53[a] (0.61)	0.46[a] (0.03)	Rough surface – pattern suggests zirconia grains pull out and structural defects

[a] Baseline: YSZ after slicing.

Conclusions: The heat produced by the laser power of 4.5 W at 20 PPS might not only potentially decrease the dental pulp cell viability, but also have shown to cause noticeable modifications on the YSZ surface, making this parameter not suitable for debonding purposes.

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Sorption and solubility of dental cements after acid etching

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Purpose/aim: The aim was to evaluate the sorption and solubility of dental cements with and without acid etching.

Materials and methods: Twenty samples were prepared for each material: Vidrion R (Vi), Vitremer (VT), Hydro C (HC) and Biocal (Bi) and subdivided: without and with conditioning ($n = 10$). Each material was handled and put into an addition silicone matrix (15 mm × 1 mm). Half of the samples were conditioned for 15 s with phosphoric acid and then washed. All samples were transferred to oven at 37 °C and the mass was weighed daily until reaching its constancy (M1). Afterwards, they were immersed in deionized water for 7 days and weighed (M2). The samples were then returned to the oven and weighed daily to constant mass (M3). For the calculation of the sorption and the solubility, the equations were used, being (M2 − M3)/V and (M1 − M3)/V, respectively. The statistical analysis was performed by the Kruskal–Wallis and Dunn tests ($p = 0.05$).

Results: The sorption data of Vi, HC and Bi without etching (50.43 ± 5.88, 47.10 ± 16.25, 33.74 ± 12.95, respectively) were statistically the same with the situation (51.57 ± 5.23, 36.06 ± 13.58, 27.21 ± 7.71, respectively). VT presented the same behavior, without and with etching (112.90 ± 15.63 and 103.43 ± 18.64), but it differed statistically from the others in both situations. For the solubility test, the conditions without and with acid etching did not differ statistically for all cements evaluated. However, it can be observed that Vi (−2.98 ± 1.17 and −1.67 ± 1.66) and VT (−18.96 ± 2.73 and −24.55 ± 5.17) did not differ but were statistically lower than HC (64.60 ± 15.65 and 68.0 ± 12.60) and Bi (61.40 ± 38.90 and 30.24 ± 10.92) in both conditions.

Conclusions: Thus, it was concluded that for the mixed restoration technique, acid etching did not influence the sorption and solubility of dental cement studied.

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Withdrawn

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Influence of volume on polymerization contraction force of bulk-fill-composites

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Purpose/aim: This in vitro study evaluated the influence of volume on the intensity of the forces generated during the polymerization contraction of conventional and bulk-fill composites, with and without APS technology (Advanced Polymerization System – Bis-GMA free).

Materials and methods: Bulk-fill resins (Bulk Fill Posterior Restorative, 3M ESPE – BFP and Opus Bulk Fill APS, FGM – OBF) and low-viscosity ones (Bulk Fill Flowable, 3M ESPE – BFF and Opus Bulk Fill Flow APS, FGM – OBFF) were compared to conventional resin composites (Z350XT, 3M ESPE and Vittra APS, FGM). The materials tested were inserted between two rectangular steel bases (6 × 2 mm) connected in a Universal Testing Machine (UTM, Instron 3342), varying the height between the bases (2 and 4 mm) and the volume (V1 = 24 mm^3 and V2 = 48 mm^3). The insertion of the materials was performed in a single increment, totaling 12 groups ($n = 5$). The photoactivation of the composites was performed using a LED (Kavo, 1200 mW/cm^2) for 30s. The contraction forces (N) generated during the polymerization were recorded at intervals of 20, 65, 120 and 300 s by the UTM software and the means were calculated. Data analysis was accomplished using three-way paired measures, ANOVA/Tukey's test ($p < 0.05$).

Results: The present results highlight the polymerization contraction force values of the initial and final time. V1: 20 s – OBFF (1.04 ± 0.46), BFF (2.22 ± 0.78), Vittra APS (2.30 ± 0.87), Z350XT (2.48 ± 0.86); and 300 s – Z350XT (3.46 ± 0.71), Vittra APS (3.51 ± 1.74), OBFF (4.81 ± 0.86), BFP (7.02 ± 1.87), OBF (7.03 ± 1.33). For V2, the results showed significant differences for the following groups: 20 s – OBFF (2.96 ± 1.04), OBF (5.79 ± 0.63), BFP (5.99 ± 0.92), Vittra APS (6.55 ± 1.76), Z350XT (7.31 ± 2.01); and 300 s – BFF (7.31 ± 1.73), OBFF (8.07 ± 1.20), OBF (9.55 ± 1.33), BFP (10.65 ± 1.41), Z350XT (12.31 ± 2.56) and Vittra APS (14.52 ± 3.02).

Conclusions: Overall, the volume of the increment influenced the polymerization contraction force of the evaluated composites. The generated forces increased with higher volume of increment. In addition, the contraction force increased over time and the highest values were found in 300 s.

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Microtensile bond strength of a novel resin-modified glass ionomer adhesive

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Purpose/aim: To compare the microtensile bond strength of a resin-modified glass ionomer adhesive, with different etching protocols, to traditional etch-and-rinse and self-etch bonding agents.

Materials and methods: Twenty-six human sound molars, were randomly allocated between six groups ($n = 4$) according to the dentin etching method and to the type of adhesive applied: (1) 37% phosphoric acid + Riva Bond LCTM (PhA + RB); (2) 20–30% polyacrylic acid + Riva Bond LCTM (PAA + RB); (3) Riva Bond LCTM without etching (RB); (4) OptibondTM FL (FL); (5) OptibondTM XTR (XTR) and (6) OptibondTM All-In-One (AIO). All samples were restored with resin composite FiltekTM Z250 (3M ESPE). After 24 h storage in distilled water, the samples were sectioned to obtain beams with $1 \pm 0.2\ mm^2$ area that were submitted to microtensile testing until failure in a universal testing machine with a cross head speed of 0.5 mm/min. After testing, the fractured beams were evaluated under a stereomicroscope and classified according to their mode of failure. Statistical analysis was performed with ANOVA one-way and post-hoc $p \leq 0.05$ tests (SPSS 20.0).

Results: PhA + RB group obtained significantly lower results (21.36 MPa) when compared to XTR group (38.82 MPa) and FL group (29.81 MPa) but when compared with AIO group (23.03 MPa), the differences were not statistically relevant. PhA + RB (21.36 MPa) and PAA + RB (20.44 MPa) groups obtained similar bond strength values and they were significantly higher than RB group alone (14.37 MPa).

Conclusions: The resin-modified glass ionomer adhesive had a lower bond performance compared to traditional etch-and-rinse and self-etch adhesives. However, upon using it, etching with phosphoric acid is recommended.

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Assessment of S-PRG fillers' effect on enamel demineralization using SS-OCT

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Purpose/aim: To observe the bacterial demineralization of the enamel around composite restorations with Surface-Pre Reacted Glass Ionomer (S-PRG) fillers using swept-source optical coherence tomography (SS-OCT).

Materials and methods: Sixty round-shaped cavities (2.0 mm surface diameter, 1.0 mm depth) were prepared on the mid-buccal enamel surface of sound bovine teeth. The cavities were restored with Fluoro Bond Shake One bonding agent (Shofu Inc.) + Beautifil Bulk composite resin (Shofu Inc.) (Group 1) or Scotchbond Universal Adhesive (3 M ESPE) plus Filtek Bulk Fill composite resin (3 M ESPE) (Group 2). *Streptococcus mutans* suspension was applied to form a cariogenic biofilm on the surface using Oral Biofilm Reactor for 24 hours. After 1, 2 or 3 weeks of incubation ($n = 10$) with Heart Infusion Broth plus sucrose, the biofilm was removed to observe the carious demineralization at the enamel-composite interface and 50 μm far away from the margin using SS-OCT. Confirmatory direct observation was accomplished at the same location using Confocal Laser Scanning Microscope (CLSM). The statistical analysis included Pearson's correlation and Student's *T* test at the 95% significance level.

Results: The demineralized enamel around the restorations was observed as a zone of intensified brightness in SS-OCT. There was a significant correlation between SS-OCT and CLSM values of lesion depth ($p < 0.05$). The demineralized area in Group 2 was significantly deeper than for Group 1 ($p < 0.05$). Enamel total-structure loss was detected only in Group 2. Furthermore, Group 1 showed remineralized area in enamel in CLSM observation, confirmed by Energy Dispersive X-Ray Spectrometer (EDS).

Conclusions: Bonding agent and composite resin without S-PRG fillers have no potential to inhibit enamel lesion around restorations, which can be detected nondestructively by SS-OCT. S-PRG fillers containing bonding system and composite resin promote remineralization. SS-OCT appears to be a promising tool for the detection of dental caries adjacent to composite restorations.

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Fractographic analysis in vivo failed molar resin composite restorations

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Purpose/aim: Composite resins, due to a similar rigidity as dentin and improved material properties, are increasingly employed for adhesively cemented large restorations such as overlays and endocrowns on endodontically treated teeth. Despite overall good clinical outcomes, catastrophic failures may occur under function. Currently no thorough failure analysis has been reported, therefore the aim of this study was to use fractography on clinically broken large resin composite restorations in order to understand the mode of failure and compare failure origins.

Materials and methods: Four endodontically treated molars, restored with adhesively cemented resin composite endocrowns (3) or overlay (1), fractured during function,

splitting the teeth in two parts through the mesio-distal central isthmus. After careful extractions, the recovered parts were fractographically analyzed using a systematic approach of stereomicroscopy and SEM in order to identify crack features, direction of crack propagation (dcp), crack origins and occlusal surface degradation. The restorative materials were (1) an in-lab layered bis-GMA-TEGDMA nano filled (84 wt%) with Ba and Si glass particles resin composite (Premise (P) (Kerr), and (2) Lava Ultimate (LU) (3 M), a CAD-CAM highly crossed-linked resin filled with 80 wt% of nano zirconia and silica particles distributed in clusters (0.6–10 μm) and individual particles (20 nm). Tooth location (FDI numbering), type of restoration, material and time to failure are described as follows. Case 1 = #26, Endocrown, LU, 4 months; Case 2 = #46, Overlay, P, 54 months; Case 3 = #17, Endocrown, P, 44 months; Case 4 = #36, Endocrown, P, 34 months.

Results: All four cases showed a wedge opening mode of failure with a fracture path moving from occlusal to apical. Hackle, twist hackle and arrest lines were easily identified. Multiple origins (main and secondary) were located on the occlusal surface along the central isthmus in conjunction with the presence of multiple fatigue micro-cracks. All cases showed surface degradation such as contact wear and micro-pitting as a result of contact loading.

Conclusions: The similarity in failure mode (wedge opening) and origins located along the central isthmus showing micro-cracking from mechanical fatigue indicate the need for reinforcing this area. Mechanical and chemical degradation (wear, micro-cracking, micro-pitting) observed despite differences in the processing, anatomical design, time to failure and tooth location indicate the importance of controlling and monitoring occlusal contacts. Fractography should be systematically used for all clinical failures.

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Bulkfill can decrease conversion at the bottom of deep preparations

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Purpose/aim: To determine the effect of the filling approach (bulkfill vs incremental) and the light curing units on the degree of C=C conversion at the bottom of deep preparations.

Materials and methods: Two resin composites – Opus Bulkfill (regular consistency, FGM) and Natural Z (conventional, DFL) – and two light curing units – Bluephase G2 (1.450 mW/cm^2; Ivoclar Vivadent) and RaciiCal (960 mW/cm^2; SDI) – were considered. The degree of C=C conversion (DC) was determined by Fourier-transformed infrared spectroscopy (ATR) at the top (0.1 mm) and the bottom surfaces of deep preparations (8 mm depth). The incremental technique considered 4 subsequent increments with 2 mm thickness each in an 8 mm depth plastic mould, while the bulkfill approach considered 2 increments of 4 mm thickness each. Each increment was light activated by 20 s. Bottom/top ratios were calculated considering the highest possible DC for each material at the top surface. Data was submitted to analyses of variance and Tukey's test ($\alpha = 0.05$).

Table 1

Approach	Region	DC (in %)		% bottom/top ratio	
		Bluephase G2	RadiiCal	BP	RadiiCal
Incremental	Bottom after 1st exposure	66±3 A	61±4 Bc		
	Bottom after 2nd exposure	68±3 A	67±1 Ab		
	Bottom after 3rd exposure	69±4 A	68±3 Aab		
	Bottom after 4th exposure	70±4 A	69±1 Aa		
	Top	67±2 A	64±2 Aa	100±3 Aa	100±2 Aa
Bulkfill	Bottom after 1st exposure	56±4 Ab	48±1 Bc		
	Bottom after 2nd exposure	69±3 Aa	52±3 Bb		
	Top	73±2 Aa	68±4 Aa	95±4 Aa	72±5 Bb

Results: Mean values (and standard deviations) of DC and bottom/top ratios are presented in Table 1.

Conclusions: Depending on the light-curing unit, the degree of conversion can be reduced at the bottom region of deep preparations when using the bulkfill approach. The effect of light curing unit can be nullified when using the subsequent exposures recommended for the incremental technique.

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Evaporation time: Aging adhesive properties of universal adhesives to dentin

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Purpose/aim: This study evaluated the effect of two evaporation time on microtensile resin–dentin bond strength (μTBS) and nanoleakage (NL) of three universal adhesives applied as self-etch (SE) and etch-and-rinse (ER) strategy (I-Bond Universal [IBU], Prime&Bond Elect [PBE] and Scotchbond Universal [SBU]) after aging.

Materials and methods: Sixty caries-free extracted molars were included in this study. The occlusal enamel of all teeth was removed with wet grinding the occlusal enamel on # 180-grit SiC paper. Adhesives were applied according to the manufacturer's instructions, but solvent time evaporations varied for 5 and 15 s. After restorations were constructed, specimens were stored in water (37 °C/24 h) following to cut to obtaining bonded sticks (0.8 mm^2). All specimens were thermocycling (10,000 cycles, 5 °C and 55 °C, 15 s dwell time) before to be tested. For μTBS, specimens were tested in tension (0.5 mm/min) and for NL, specimens were immersed in silver nitrate solution and examined by scanning electron microscopy. Data from μTBS and NL were analyzed using three-way ANOVA (adhesive vs. strategy vs. evaporation time) for each strategy, and Tukey's test ($\alpha = 0.05$).

Results: For μTBS and NL, no significant different was observed when both evaporation times of all adhesives were

Table 1

Adhesive	Application mode	Microtensile bond strength (μTBS)		Nanoleakage (%)	
		5 s	15 s	15 s	15 s
IBU	ER	32.1 ± 5.2 A	23.5 ± 4.2 A,B	8.6 ± 3.7 a	7.1 ± 2.3 a
	SE	21.4 ± 2.3 A,B	24.2 ± 4.7 A,B	17.5 ± 1.4 c	19.9 ± 5.8 c,d
SBU	ER	24.7 ± 2.8 A,B	28.6 ± 5.9 A,B	8.2 ± 1.6 a	7.6 ± 0.9 a
	SE	24.9 ± 4.9 A,B	27.8 ± 6.3 A,B	8.1 ± 2.7 a	10.0 ± 1.4 a,b
PBE	ER	19.4 ± 3.7 B	32.0 ± 4.3 A	22.9 ± 5.3 c,d	26.1 ± 3.3 d,e
	SE	21.3 ± 6.4 A,B	24.1 ± 4.5 A,B	17.3 ± 4.0 b,c	33.4 ± 4.5 e

(*) Similar capital or lower case letters indicates groups statistically similar for each property evaluated (3-way ANOVA and Tukey's test; $p < 0.05$).

compared (Table 1; $p > 0.05$), with exception of PBE SE when longer evaporation time was applied (15 s; Table 1; $p < 0.05$). For μTBS values, no significant differences were observed when universal adhesives and strategy were compared (Table 1; $p > 0.05$). For NL, the adhesive strategy varied according the universal adhesive evaluated. Significant lower NL values were observed for SBU and IBU, mainly when evaluated in the ER mode in comparison to PBE (Table 1; $p < 0.05$).

Conclusions: When submitted to aging, the extended evaporation time did not increase the adhesive performance of universal adhesive evaluated.

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Wear and marginal gap of direct composites on endodontically-treated teeth

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Purpose/aim: In modern restorative dentistry almost exclusively resin-based materials are used both in the rehabilitation of dental elements compromised by carious pathology and in the preparation of prosthetic abutments. The aim of this in vitro study was to evaluate the effect of different direct restoration techniques on endodontically treated anterior teeth restoration, with or without fiber posts, analyzing interfacial adaptation, wear and fracture resistance.

Materials and methods: 36 extracted single-rooted anterior teeth were selected. Endodontic treatment was carried out in all samples. After 24 h of storage in water at 37 °C, samples were divided in 3 groups according to the cavity design: (1) endodontic access; (2) endodontic access + 1 third class cavity; (3) endodontic access + 2 third class cavities. Samples were then divided in 3 subgroups according to the restoration technique: (SB1) direct composite restoration (DCR); (SB2) DCR supported by a fiber post (Rebilda Post, Voco); (SB3) DCR supported by vertical fibers (Rebilda Post GT, Voco).

All specimens were scanned with X-ray computed microtomography (micro-CT SKYSCAN, BRUKER). Then, specimens of each group were subjected to mechanical fatigue test in a dual-axis masticatory simulator (CS4.4, Mechatronik, Germany). A force of 5 kg was applied using a ceramic steatite ball with a diameter of 6 mm as an antagonist for 100,000 cycles. After fatigue, micro-CT scanning was performed to evaluate the interface behavior and wear resistance. MicroCT images, before and after cycling load, were analyzed with Geomagic Software and Mimics to evaluate composite wear and interfaces gap progression before and after mechanical load. Finally, a static fracture test with universal machine was performed to measure the fracture resistance of the samples after fatigue tests. Statistical analysis was performed with two-way ANOVA test to evaluate the effect of cavity configuration and restoration of wear, interfacial gap and fracture resistance.

Results: Gap progression and volume are significantly related to the build-up technique ($p = 0.001$) as well as to the cavity configuration ($p = 0.032$). The 2-way ANOVA showed that both the variable cavity ($p = 0.0020$) and the variable material ($p = 0.0013$) significantly influence the fracture resistance.

Conclusions: Based on the results obtained, endodontically treated anterior teeth should be restored with composite restorations supported by fiber structures, especially in the case of loss of both marginal ridges. Further studies are needed to better understand the influence of fiber post on interfacial adaptation, wear and fracture resistance over time.

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Shear bond strength of brackets under exposure to cigarette smoke

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Purpose/aim: To evaluate the shear bond strength of metal brackets in dental blocks with or without exposure to cigarette smoke.

Materials and methods: Sixty bovine incisors were randomly divided into 6 groups ($n = 10$), according to the type of orthodontic composite used for cementing brackets [Orthocem (O); Transbonsd XT (T)] and exposure to smoke (no exposure, exposure for 40 cigarettes before or cigarette exposure after bonding). After 24 h, the shear bond strength test was performed in a universal testing machine (EMIC). Data were statistically analyzed using two-way ANOVA and Tukey's test ($p < 0.05$).

Results: There was no difference among cigarette-smoke and control groups, but there was significant difference ($p = 0.034$) between the orthodontic composites, as Transbond attained higher bond strength than Orthocem.

Conclusions: Cigarette smoke does not influence the bonding strength of orthodontic brackets with tested orthodontic composites.

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Surface properties and wear resistance of conventional and bulk-fill composites

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Purpose/aim: This study evaluated the effect of toothbrushing on gloss, roughness profile, surface roughness and wear of conventional and bulk-fill resin-based composites.

Materials and methods: Gloss and surface roughness of resin-based composites disks (RBCs: Admira Fusion X-tra, Aura Bulk Fill, Filtek Bulk Fill Flowable, Filtek Bulk Fill Posterior Restorative, Filtek Supreme Ultra, Herculite Ultra, Mosaic, SDR flow+, Sonic Fill 2, Tetric EvoFlow Bulk Fill and Tetric EvoCeram Bulk Fill) were analyzed before and after brushing, with a glossmeter ($n = 5$) and a confocal microscope ($n = 5$); and roughness profile and wear (surface loss) were determined after brushing the specimens, with a confocal microscope ($n = 5$) and an optical profilometer ($n = 5$). Representative 3D images of the surface loss and microscopy images comparing unbrushed and brushed sides were also obtained. Analysis of variance (ANOVA) and Tukey post-hoc tests were applied to the gloss, surface roughness, roughness profile and surface loss data (α: 0.05). Correlation between gloss and surface roughness, surface loss and percentage of gloss decrease after brushing, and surface loss and surface roughness decrease after brushing were analyzed by Person's correlation test.

Results: Gloss reduced after 25,000 brushing cycles for all tested RBCs ($p < 0.05$). Likewise, surface roughness increased for all RBCs tested after brushing ($p < 0.05$). Roughness profile and surface loss were material dependent. Admira Fusion X-tra, Aura Bulk Fill, Tetric EvoCeram Bulk Fill and Tetric EvoFlow Bulk Fill presented deepest wear areas according to profilometry measurements ($p < 0.05$). A significant inverse correlation was found between gloss and surface roughness and a weak correlation was found between gloss decrease and surface loss, and surface roughness increase and surface loss.

Conclusions: Toothbrushing reduced the gloss, increased the surface roughness and promoted surface loss of all RBCs tested. All tested properties were material dependent. Considering the tested properties, Mosaic presented great gloss retention, low profile roughness and low wear; while Admira Fusion X-tra was the most affected by toothbrushing, presenting the greatest gloss decrease, increased roughness profile and substantial wear.

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Mechanical properties of methyl-methacrylate resins including metronidazole or chlorhexidine

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Purpose/aim: The objective of this study was to evaluate flexural strength (FS), flexural modulus (FM) and Knoop hardness (KH) of methyl methacrylate resins (MMA) loaded with Metronidazole or with Chlorhexidine.

Materials and methods: In this project was used a chemically activated MMA resins (VIP Flash). Three groups were prepared the first being a Control group (C), which did not receive any nanoparticle; the second group MMA/MMT/Metronidazole (MMM) received 5% by weight of MMT loaded with 0.5% metronidazole in its final composition. And finally, the MMA/MMT/Chlorhexidine group (MMC), which received 5% weight of MMT, equivalent to 0.5% chlorhexidine in its final concentration. All the samples were made with $65 \times 10 \times 4$ mm (length × width × height). After 24 h, FS and FM, were analyzed in a universal test machine (DL 500–EMIC) at a speed of 1 mm/min, then the KH was measured in a microdurometer (Shimadzu).

Results: The results obtained were for the MMC group, FS (MPa) 119.2, FM (GPa) 5.0 and KH (KHN) 41.8, and for the MMM group, RF 16.9, MF 0.7 and DK 14.1. The data were analyzed by the one-way ANOVA statistical method.

Conclusions: We can conclude; that the incorporation of chlorhexidine did not alter the physical properties of the resin, whereas the incorporation of Metronidazole decreased the FS, FM and KH.

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Color stability of repairs on bis-acrylic resin after colorants immersion

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Purpose/aim: This study evaluated the color stability of bis-acrylic composite resin samples repaired with flowable composite or bis-acrylic composite resin, after immersion in colorants.

Materials and methods: Forty disks were fabricated in bis-acrylic composite resin (A2, Protemp 4, 3 M ESPE, USA). Ten disks (3 mm) were not repaired (G1–control group); 10 disks (2 mm) were repaired (1 mm) with the same bis-acrylic resin (G2); 10 disks (2 mm) had the surface roughened and repaired (1 mm) with flowable resin (A2, Filtek Flow Z350XT, 3 M ESPE, USA) (G3); and 10 disks (2 mm) received a coat of adhesive (Adper Single Bond 2, 3 M ESPE, USA) previously the repair with flowable resin (G4). The disks and repairs were made in a metal device with thickness control, and stored in dark envelops. The disks were measured by a spectrophotometer (Minolta CM 3600d, Konica Minolta, Japão), on absolute white title ($L^* = 92.717$; $a^* = -1.391$; $b^* = 4.184$). The measurements were made three times in the center of the disks, by the same operator, and the L*a*b* coordinates were recorded (T0). Each group were subdivided ($n = 5$) and the disks were immersed in coffee (Nescafé Tradição Forte, Nestlé Brasil, Brazil) and cola beverage (Coca-Cola, Coca-Cola Company, USA), for 7 days. The L*a*b* coordinates were recorded again, after immersion (T1). Color differences (ΔE00) were calculated among the groups and times by CIEDE2000 system. Statistical analysis was performed by ANOVA (2-way) and Tukey's HSD test ($p < 0.05$).

Results: Means of the L*a*b* coordinates, color differences and standard deviation are shown in Table 1. Repairs made with bis-acrylic composite resin (G2) showed the lowest color differences (1.84) ($p < 0.001$). Color differences around 5 ΔE00 were observed in groups 3 and 4 before immersion, likely from color variation of the suited material. After immersion, the greatest differences have been seen for coffee (G2 = 22.40; G3 = 22.68 and G4 = 26.86); but with no significance ($p = 0.39$).

Conclusions: Repairs made with the same bis-acrylic composite resin showed the lowest color differences; however, regardless the material used for repair, drinking coffee should be avoided while the material is in clinical use.

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Table 1 – Means of the L*a*b* coordinates with SD.

	G1–CG			G2			G3			G4		
	T0	Coffee	Cola	T0	Coffee	Cola	T0	Coffee	Cola	T0	Coffee	Cola
L*	72.57 ± 0.45	62.31 ± 1.08	72.88 ± 0.62	71.48 ± 0.53	62.87 ± 1.75	71.83 ± 0.72	67.89 ± 1.07	59.25 ± 1.24	67.80 ± 1.01	68.15 ± 0.54	55.53 ± 5.60	69.61 ± 1.19
a*	−4.70 ± 0.22	0.24 ± 1.24	−4.89 ± 0.31	−4.43 ± 0.25	−0.26 ± 1.40	−4.82 ± 0.29	−1.63 ± 0.29	1.64 ± 0.79	−0.99 ± 0.26	−1.97 ± 0.28	4.00 ± 3.88	−1.39 ± 0.38
b*	7.63 ± 0.73	31.72 ± 1.81	8.86 ± 1.00	9.65 ± 0.95	27.31 ± 4.27	11.85 ± 0.83	9.63 ± 0.51	24.74 ± 3.60	10.69 ± 0.79	9.12 ± 0.63	26.25 ± 4.01	9.74 ± 0.88
ΔE_{00}	–	16.76 ± 1.32	1.18 ± 0.52	1.84 ± 0.68	14.95 ± 2.60	3.07 ± 0.65	5.64 ± 0.66	16.88 ± 1.90	6.62 ± 0.31	5.05 ± 0.43	20.56 ± 5.98	5.22 ± 0.63

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Flexure strength of a glass ceramic: Effect of cementation protocols

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Purpose/aim: To evaluate the effect of etching time and the application of the adhesive system and silane on the biaxial flexural strength of a new lithium disilicate based ceramic (Rosetta SM, Hass, Gangneung).

Materials and methods: One hundred and thirty five ($N = 135$) ceramic disks (12 mm diameter and 1.2 mm ± 0.2 mm in thickness–ISO 6782) were made and polished with silica carbide papers with #600, 800 and 1200 grit. The samples were sintered and divided into nine groups ($n = 15$), according with the factors "10% hydrofluoric acid etching time" for 20 s and 120 s (HF20 and HF120) and "Surface Bonding System": control–no application (N), silane (S/Prosil, FMG, Joinville, SC, Brazil), adhesive (A/Ambar, FGM) or silane followed by adhesive (AS). After etching (HF) and the resin cement application (AllCem/FGM) in those groups that received this type of treatment, all samples were subjected to biaxial flexural strength test (EMIC, DL-1000–1 mm/min, 1000 kgf) until its fracture. Data were analyzed using three-way ANOVA and Tukey (5%) test.

Results: ANOVA revealed that the factor "Acid etching time" ($p = 0.0003$), "Bonding System" ($p = 0.0070$) and the combination of both factors "Time and Bonding system" ($p = 0.0007$) were statistical significance. There were no statistically significant difference on the flexural strength regarding the bonding system application for the groups HF20: HF20S (228.40 ± 37.83)BCD, HF20 A (208.92 ± 31.16)D, HF20 SA (241.60 ± 21.27)ABCD and HF20N (235.68 ± 45.11)ABCD. The HF120 groups showed this difference: HF120S (272.02 ± 35.29)A, HF120 A (254.42 ± 26.87)ABC, HF120 SA (259.30 ± 36.55)AB and HF120 N (218.45 ± 17.15)CD. The etching time factor presented significant difference between: HF20S (228.40 ± 37.83)BCD and HF120S (272.02 ± 35.29)A; HF20 A (208.92 ± 31.16)D and HF120 A (254.42 ± 26.87)ABC.

Conclusions: The acid etching time influenced significantly the biaxial flexural strength of a lithium disilicate-based ceramic when silane or adhesive is applied into the surface. This influence was more significant for the 20s etching time. The application of silane or silane and adhesive increased the ceramic flexural strength for 120 s etching time.

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Cytotoxicity and physical properties of new composites for pulp capping

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Purpose/aim: The aim was to investigate the physicochemical properties of experimental composite resins with bioactive nanoparticles and to evaluate cytotoxicity and in vivo pulp response to direct pulp capping.

Materials and methods: Experimental resins were prepared with hydroxyapatite nanoparticles adsorbed with simvastatin and glutathione at 0% (Control Resin), 1% (Res 1%) and 10% (Res 10%) by weight. Light-curable calcium hydroxide [Ca(OH)2] (Ultra-blend Plus, Ultradent) was used as the control group. Physicochemical properties studied were flexural strength and elastic modulus from a three-point bending test ($n = 10$), calcium release ($n = 6$) and degree of conversion ($n = 3$) assessed by Raman spectroscopy. Proliferation and cell counting assays were performed to investigate in vitro cytotoxicity evaluated by confocal microscopy with live/dead fluorophores. To evaluate the pulp response, pulp capping was performed directly on the lower molars of Wistar rats ($n = 6$). The animals were euthanized after 7 days, and the hemimandibles removed for histological analysis. Statistical analysis was performed with Kruskal–Wallis, ANOVA and Tukey post-test ($p < 0.05$).

Results: No statistical difference between groups was found for flexural strength ($p > 0.05$). Regarding elastic modulus, Res 10% presented the best outcomes, but with no statistical difference between Res 1%. Res 10% conversion was statistically higher than the Res 0% and Res 1%. $Ca(OH)_2$ showed higher calcium release after 28 and 45 days of storage, with no statistical difference in the second period from the Res 10% group. Regarding the cell proliferation assay, no statistically significant difference was observed between all tested groups ($p > 0.05$). Confocal microscopy revealed that the resins composed of lower concentrations of bioactive nanoparticles depicted higher cell viability. The in vivo experiments showed pulp damage in the group treated with calcium hydroxide, with minor alterations for teeth treated with experimental resins, in which the teeth restored with Res 10% demonstrated moderate deep pulp vascular ectasia. The findings of the group restored with Res 0% demonstrated large vascular ectasia. However, it was possible to observe deep pulp vascular ectasia in the no treatment group.

Conclusions: The experimental resins demonstrated a similar biological behaviour and in vivo performance to standard calcium hydroxide. It can therefore be concluded that the experimental resins may be a feasible alternative to calcium hydroxide. Nevertheless, further studies in larger animal models are necessary to further evaluate the repair of pulp tissue and dentin neoformation prior to its translational use in humans.

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Evaluation of polymerization stress of bulk fill composites

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Purpose/aim: The aim of the study was to analyze the polymerization stress of bulk fill composite resins. The tests were performed in 3 groups: (1) Filtek Bulk Fill–3 M; (2) SonicFill-Kerr; (3) Z350 XT-3 M.

Materials and methods: Poly (methyl methacrylate) rods, 5 mm in diameter and 13 or 28 mm in length, had one of their flat surfaces sandblasted with 250 μm alumina. The rods were attached to the opposing clamps of a universal testing machine (Instron 5565, Canton, MA, USA) with the treated surfaces, facing each other with a 1 mm gap. The resin-composite was light-cured with 1200 mW/cm^2 (Bluephase, Ivoclar Vivadent, Schaan, Liechtenstein) for 40 s. The resin-composite was inserted into the gap and shaped into a cylinder following the perimeter of the rods. An extensometer (0.1 μm resolution), attached to the rods (Instron 2630-101, Bucks, UK) in order to assess the height of the specimen, provided the feedback to the testing machine to keep the height constant. Force development was monitored for 10 min from the beginning of the photoactivation and the nominal stress was calculated by dividing the maximum force value by cross-section of the rod. Five specimens were tested for each tested material. Physicochemical properties data was submitted to analysis of variance with one factor (One way-ANOVA), followed by Tukey test. Significance level was set at 5%. The program used to perform the analyses was IBM SPSS Statistics Version 20.0 (Armonk, NY, USA).

Results: Filtek Bulk Fill and SonicFill resins presented similar results (Table 1) to the conventional resin Z350 XT used as control ($p = 0.104$).

Table 1 – Polymerization Shrinkage ($p = 0.104$) $n = 5$.

Materials	Mean (±SD)
SonicFill	3.64 (±0.54)^A
FiltekBulk	3.14 (±0.57)^A
Z350 XT	3.82 (±0.22)^A

Conclusions: It can be concluded, with the limitations of the present study, that the bulk-fill resins presented similar performance to the control resin.

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MDP-based systems profile when combined with chlorhexidine/hydroxyapatite

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Purpose/aim: MDP (10-methacryloyloxy-decyl-dihydrogen phosphate) is the main functional monomer used in current commercial self-etching and universal dentin bonding systems, which partially demineralize the substrate and promotes the chemical bonding to calcium. Especially when used with etch-and-rinse mode, chlorhexidine (CHX), a cationic bisguanide, is commonly associated as an agent capable to inhibit dentin intrinsic enzymes. Since both MDP and CHX have the ability to bind to calcium present in the Hydroxyapatite (HAP) structure, likely they can interact among them simultaneously in the way that their benefits can be nulled. Therefore, the aim of this study was to investigate the interaction of MDP-based adhesive systems with CHX and HAP.

Materials and methods: Five dentin bonding system (DBS) was used: MP – Adper Scotchbond Multipurpose and SB – Adper Single Bond as a negative control (MDP-free); CSE – Clearfil SE Bond; CPB – Clearfil Protec Bond; SU – Adper Scotchbond Universal. For degree of conversion assessments, a drop of each dentin bonding system (?3.0 μL, $n = 3$), combined or not with 2%CHX, 1%HAP or both (CHX and HAP) was assessed using Fourier Transform Infrared Spectroscopy (FT-IR) with attenuated total reflectance (ATR), before and after light curing with Radii Cal/SDI, LED-curing unit (1000 mW/cm^2). This calculation was used to determine degree of conversion (DC) and analyze their spectroscopy profile. Data of DC was statistically analyzed by two-way ANOVA and Tukey tests ($p < 0.05$). Comparison of profile graphs of the identified main bands for each system was also obtained and qualitatively analyzed.

Results: DC was influenced by DBS and combinations (CHX, HAP and/or CHX + HAP) ($p > 0.001$). Addition of CHX impaired the degree of conversion for the DBS CSE and SU, which are MDP-based systems. When HAP was added solely to the system, only MP increased its degree of conversion. No differences were promoted when CHX + HAP was combined with these systems. In the comparison of the systems, they differed by means of degree of conversion only when combined with CHX, except for SB. Graphs revealed likely reactions promoted with these mixtures, highlighting more expressive bands towards phosphate molecular identification to the

functional monomers-based materials and their reaction with calcium.

Conclusions: Degree of conversion of MDP-based adhesives systems was negatively affected by addition of CHX. However, when CHX and HAP was incorporated the DC values were reestablished.

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Intracanal bonding with therapeutic adhesives and new dentin conditioners

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Purpose/aim: The aim was to study etching solution and adhesive containing beta-calcium phosphate (β-TCP) on adhesive luting of glass-fiber posts to root canal dentine.

Materials and methods: Thirty single-rooted extracted human teeth were used. The groups were divided as with or without the addition of β-TCP, and according to etching solutions: 37% phosphoric acid (Control), 15% EDTA (ethylenediamine tetra-acetic acid) or 15% EDTMP (ethylenediamine tetra-methylene phosphonic acid). The restored roots were cut in 1mm-thick slices and submitted to push out bond strength test after 24 h and 6 months of water storage. Micro-Raman spectroscopy and silver nanoleakage were used to track degradation/remineralization of interfaces. Data were submitted to the two-way ANOVA and Tukey test ($p < 0.05$).

Results: The group etched with EDTMP without β-TCP in adhesive attained the greatest immediate and long-term bond strength; statistically different from all groups ($p < 0.05$). EDTMP with β-TCP presented the lowest adhesion resistance, Micro-Raman spectroscopy revealed the presence of more mineralization with carbonated apatite (peak at 1090 cm^{-1}) in EDTMP group. In nanoleakage, minor silver impregnation was overall observed in all interfaces.

Conclusions: EDTMP may be a suitable agent for conditioning root dentin prior to application of etch-and-rinse adhesive for luting glass-fiber posts, being superior to phosphoric acid and EDTA.

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Mechanical, chemical and bond strength properties of bisphenol-A free composites

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Purpose/aim: The aim of this study was to evaluate mechanical, chemical and bond strength properties of bisphenol-A free (BPA-free) resin-based composite (RBC) containing an elastomeric monomer.

Materials and methods: BPA-free RBCs were blended either containing 60/25/14 wt% of UDMA, PEG400 and TEGDMA (UDMA) or 35/25/25/14 wt% of UDMA, PEG400, Exothane 24 and TEGDMA (UDMA-EXO) monomers. Camphorquinone (0.5 wt%) and DMPOH (0.5 wt%) were added as the photoinitiator system and, 52 wt% of 7.5 μm BaBAlSi glass and 13 wt% 40 nm fumed silica were added as filler loading. A multiwave LED (VALO, Ultradent) was used to photo-activate all samples. Mechanical properties ($n = 10$) were assessed by ultimate tensile strength (UTS), flexural strength (FS), flexural modulus (FM) and Knoop hardness (H) tests. Chemical properties ($n = 10$) were assessed by degree of conversion (DC), chemical softening (CSoft), water sorption (Wsp) and water solubility (Wsl). For Microtensile bond strength test, twenty box shaped Class I (4 mm in depth) preparations were fabricated in the pulp chamber of sound human third molars. The restorations were made (two layers of 2-mm in thickness) using either a UDMA or UDMA-EXO experimental composites ($n = 10$). After 24 h in water storage, the restorations were sectioned in beams (0.81 mm^2 area) and tested for dentin microtensile bond strength (μTBS). Data were submitted to ANOVA and Tukey's test ($\alpha = 0.05$, $\alpha = 0.2$).

Results: Table 1 shows all means for all performed tests. The results showed that BPA-free RBCs containing UDMA-EXO showed lower FS and FM than UDMA, but no differences were found for CS and Wsol. However, UDMA-EXO showed lower CSoft and Wsp and higher H, DC and microtensile bond strength than UDMA.

Conclusions: Thus, it was possible to conclude that despite the reduction in mechanical properties, the use of an elas-

Table 1 – Means of each group for all performed tests.

	UTS (MPa)	FS (MPa)	FM (GPa)	H (KHN)	DC (%)	CSoft (%)	Wsp ($g/mm^3 \times 10^{-4}$)	Wsl ($g/mm^3 \times 10^{-4}$)	μTBS (MPa)
UDMA	72.5a	120.4a	2.04a	36.1b	61.4b	40.0a	3.62a	0.138a	12.5b
UDMA-EXO	68.4b	108.2b	1.82a	44.0a	85.9a	31.3b	3.50b	0.090a	18.4a

Means followed by different small letter in the column represent statistical difference (Tukey's test, $p < 0.05$).

tomeric monomer could improve chemical properties and increase bond strength of BPA-free RBCs.

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Mouthguard biomechanics for protecting dental implants from impact

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Purpose/aim: To evaluate mouthguard shock absorption ability, strain, and stress generation during impact on dental implants placed in the anterior maxilla. The mouthguard material was also characterized.

Materials and methods: Sixty experimental models were created and divided into six groups ($n = 10$): implant type, external hexagon (EH) and Morse taper (MT); without and with two mouthguards (MTG), EVA custom-fitted (Ct-MTG) and standard self-adapted (St-MTG). The Shore A hardness, EVA sheet and mouthguard thickness, and elastic modulus were measured to characterize the mouthguard material. A strain gauge was attached to the palatal surface of the implant abutment, which was subjected to an impact test. Distortion of the abutment and implant was determined after impact from centroid displacements in standardized radiographic images. Two-dimensional finite element models were created to represent the six groups and were submitted to nonlinear dynamic impact analysis. The data were statistically analyzed using analysis of variance (ANOVA) and Tukey test ($\alpha = .05$).

Results: Ct-MTG resulted in higher Shore A hardness ($P < .001$). After the heat-forming process, the St-MTG maintained the original thickness, but the Ct-MTG thickness had decreased. The elastic modulus of EVA was 18.1 ± 0.5 MPa. The mouthguard presence reduced strain values significantly ($P < .001$), particularly for Ct-MTG. There was no significant difference between implant connection types EH and MT ($P = .547$).

Conclusions: The external hexagon abutment resulted in higher stress and micro-displacement values. The mouthguard was able to absorb 40–46% of the energy caused by the impact on the dental implant.

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Withdrawn

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Flexural-strength and translucency of feldspar-ceramic: Specimen's number-position in furnace effect

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Purpose/aim: To evaluate the effect of the number and position of feldspathic ceramic discs during firing inside the furnace on flexural strength and translucency.

Materials and methods: Ninety (90) VM9 feldspathic ceramic discs (ISO 6872:2008) were made using metallic templates and assigned into two groups: G1–15 specimens sintered separately in a firing (15 firings containing 1 specimen each; $n = 15$), placed at the center of the furnace; and G5–75 specimens, with 5 of them sintered together (15 firings containing 5 specimens each; $n = 15$), where 1 disc was positioned at the center of the furnace and 4 discs at the periphery. Next, all discs were ground and polished for surface regularization and standardization of the final dimensions (1.2 mm thick; 13.5 mm diameter). Then, translucency using a spectrophotometer and biaxial flexural strength test (ISO 6872:2008) were performed. One-way ANOVA were carried out for biaxial strength and for translucency data.

Results: The position of the specimens (comparing center × periphery) in the furnace did not affect the flexural strength ($p = 0.08$), while it did affect the translucency (periphery > center; $p = 0.009$). Also, the number of specimens in the furnace affected the flexural strength ($p = 0.025$) and translucency ($p < 0.05$) (Table 1).

Conclusions: A higher amount of specimens in the furnace during sintering seems to decrease the flexural strength and translucency (opacification effect) of feldspar ceramic specimens. Specimens positioned at the periphery of the furnace

Table 1 – Means (standard deviation) of biaxial strength and contrast ratio data for different conditions.

	Specimen position		Specimens amount	
	Center	Periphery	One	Five
Biaxial strength	52.52 (5.16)^{A}	55.58 (3.69)^{A}	57.57 (6.07)^{A}	52.52 (5.16)^{B}
Contrast Ratio	0.91 (0.03)^{A}	0.84 (0.03)^{B*}	0.88 (0.03)^{A}	0.91 (0.03)^{B}

Distinct letters show significant statistical differences ($p < 0.05$).
* Clinically significant differences.

seemed to become more translucent than those positioned at the center.

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Composite restoration of endodontically-treated molars: Bite-force and specific FE-analysis

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Purpose/aim: This study evaluated the effect of different levels of tooth structure loss on stress distribution and bite force in endodontically-treated permanent molars restored with direct bulk-fill resin composite.

Materials and methods: First mandibular molars with severe caries were selected in three adolescent patients. The bite force in habitual occlusion was measured before and after restoration using a mini load cell. The measured bite forces were used in patient-specific finite element models, created from cone-beam computed tomographic images of the molars before and after restoration. Forces were applied at the contact points with the antagonist teeth, identified by the computed tomographic images and clinical examination.

Results: Initial and post-restorative bite forces (N) in the three patients were 30.1/136.6, 34.3/133.4, and 47.9/124.1. Mean bite load increased 260% (36.7 ± 11.6 to 131.9 ± 17.8) after endodontic and restorative procedures. Before rehabilitation the stresses concentrated in coronal tooth structure and after rehabilitation stresses were more evenly transferred to root dentin, irrespective of the severity of the tooth structure loss. The postoperative bite force applied on non-treated teeth resulted in high stress concentrations in weakened tooth areas and at the furcation.

Conclusions: Extensive caries negatively affected the bite force and caused higher stress concentrations in the weakened tooth structure. Endodontic treatment followed by direct composite restoration was an effective method to reestablish oral biomechanical performance in adolescents.

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Clinical evaluation of lithium disilicate veneers manufactured by CAD/CAM

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Purpose/aim: The purpose of this research is to evaluate the clinical performance of lithium disilicate manufactured by CAD/CAM technology, comparing with those veneers produced by the heat-pressed method (IPS e.max Press), in a period of 6 m evaluation.

Materials and methods: Patients were selected with veneers needed for anterior teeth, with a minimum of two and a maximum of six veneers per patient. The sample were dived into two different mouth groups: (1) E.MAX CAD–Images obtained with inEos Blue scanner, followed by milling IPS e.max CAD blocks (Ivoclar, Liechtenstein) for CEREC inLab (Sirona) and (2) E.MAX Press–Manufacturing of lithium disilicate ceramic veneers (IPS e.max Press–Ivoclar, Liechtenstein) with the use of heat-pressed, following the standards and the manufacturer's instructions. The veneers were scored according to the criteria of USPHS (United States Public Health Service): marginal adaptation, color change, marginal discoloration, restoration fracture, tooth fracture, wear restoration, antagonist wear, presence of caries and postoperative sensitivity.

Results: Data were analyzed by analysis of variance at two repeated measures criteria, with significance level of 5%, using statistical softwares STATISTICA 10.0 and SIGMAPLOT 12.0. It was observed that for marginal adaptation criterion, there was a statistical difference to time ($p = 0.045$) independent of the processing method, being the baseline for CAD 1.056 and for PRESS 1.067. After 6 m, for CAD 1.089 and for PRESS 1.078. There were no differences intra-groups and between the groups at the baseline and 6 months as well as no interaction between time and groups for the other evaluated criteria.

Conclusions: Lithium disilicate veneers showed similar stability regardless the processing method.

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Gap evaluation of class II resin-filling techniques – MCT and SEM analysis

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Purpose/aim: This study aimed to evaluate gap formation of different resin composite filling techniques in class

II restorations, seen by micro-computed tomography (mCT) scans and scanning electronic microscopy (SEM).

Materials and methods: Standardized class II cavities (2.5 mm occlusal depth × 4 mm wide × 4 mm mesial box depth and 1 mm beyond the cementoenamel junction distal box depth) were prepared in 30 human third molars ($n = 6$) and analyzed in distal and mesial views. Prime & Bond Universal adhesive (Dentsply Sirona) was applied in all teeth according to manufacturers' instructions, which were randomly divided in 5 groups: G1: SS + HIT (Spectra Smart, Dentsply Sirona + Horizontal Incremental Technique); G2: SS + OBL (Spectra Smart + Oblique Incremental Technique); G3: SDR + BFT (Surefil SDR Flow, Dentsply Sirona + Bulk Fill Technique); G4: SDR + SS (Surefil SDR Flow placed on the pulpal floors from the mesial and distal boxes from the class II cavity (not yet light-cured), followed by application of conventional composite Spectra Smart and light curing incrementally together with the horizontal technique); and G5: BEZ + BFT (Bulk EZ, Danville Materials + Bulk Fill Technique). All light-curing procedures were performed for 20s (High mode, Bluephase Style 20i, Ivoclar Vivadent ~1200 mW/cm^2). Teeth were scanned before and after resin composite application (1st scan – empty tooth; 2nd scan – filled tooth) by micro-computed tomography (mCT40, Scanco Medical). Acquired mCT data were imported into a workstation and evaluated with Amira software (version 5.5.2) looking for gaps and misadjusted mesial and distal margins. Gaps were considered when misadjusts were bigger than 0.06 nm according to previous findings. Data were submitted to statistical analysis (1-way ANOVA and LSD post-hoc test). Validation of the mCT analysis was performed by scanning electronic microscopy (SEM).

Results: G5 showed the lowest % of gap formation, which was statistically similar than G4 ($p = .20$). G4 also showed statistical similarities to G1 ($p = .41$) and G3 ($p = .13$). G2 showed the highest percentages of gap formation, statistically similar to G1 ($p = .10$), but different than the rest of the groups ($p < 0.05$). SEM images validated the mCT technique.

Conclusions: Different techniques promote different percentages of gap formations on class II cavities. The dual resin composite BEZ and the use of SDR non-polymerized plus the use of a horizontal filling technique showed the best marginal adaptations (less % of gap formation). The mCT technique was validated for visualization of gap formation after being analyzed by SEM; although mCT presents the advantage of being a non-destructive technique.

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Bioactive glasses may interfere on dentin adhesion of experimental composites

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Purpose/aim: The aim was to investigate dentin bonding and in situ degree of conversion of experimental composites containing bioactive glasses 45S5 or strontium substituted 45S5 (Sr-45S5).

Materials and methods: Experimental light-curable composites were prepared with BisGMA/TEGDMA co-monomer blend and 15 wt% 45S5, 15 wt% Sr-45S5 or with only inert barium glass fillers (Control). Extracted third molars were cut to expose a flat dentin surface. The two-step etch-and-rinse adhesive Optibond S (Kerr) was employed for all groups and the restorations were built with the composites. Bonded teeth were cut into resin-dentin sticks and microtensile bond strength test ($n = 5$) was undertaken after 24 h water storage. Further sticks ($n = 3$) were surveyed by Micro-Raman spectroscopy to assess in situ degree of conversion by the ratios of 1608/1638 cm^{-1} peaks and by scanning electron microscopy to observe silver nanoleakage. The results were analyzed with ANOVA and Tukey's test ($p < 0.05$).

Results: The bond strength of control composite (43.9 ± 7.2 MPa) was significantly higher than 45S5 (19.5 ± 6.7 MPa) and Sr-45S5 (18.2 ± 4.8 MPa) ($p < 0.001$). The degree of conversion depicted no statistical difference among composites ($p = 0.541$), which attained mean conversions between 50% and 58%. Nanoleakage was slightly higher with interfaces created with composites containing bioactive glasses.

Conclusions: The experimental composites demonstrated acceptable polymerization behaviour, but with diminished initial bond strength. Nevertheless, further studies with in long-term experiments are necessary to further evaluate potential therapeutic effects of such innovative composites.

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Sorption and solubility of different resin cements

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Purpose/aim: It is important to understand the diffusion mechanisms of dental composites, by analyzing properties

such as water sorption and solubility, in order to predict the clinical behavior of these materials, especially their stability in the oral environment. Thus, the objective of this in vitro study was to evaluate the sorption and solubility of different cementation composite materials photoactivated throughout a ceramic laminate. The hypothesis tested is that the cementing materials show similar values of sorption and solubility.

Materials and methods: Four composite materials used for cementation of indirect restorations were evaluated (Ivoclar Vivadent): dual-cure universal resin cement (CD, Variolink N), dual-cure self-adhesive resin cement (CA, Multilink Speed), light-cured resin cement (CF, Variolink Esthetic LC) and low viscosity resin composite (flow) (RC, Tetric N-Flow). Disc-shaped specimens (1 mm thick × 15 mm diameter) were produced according to manufacturer's instructions and photoactivated throughout a lithium disilicate-based glass-ceramic (e-max CAD, A1 HT, Ivoclar Vivadent) laminate of 0.5 mm thickness, simulating the cementation of a ceramic veneer ($n = 5$). The sorption and solubility test was performed according to ISO 4049. One-way ANOVA and Kruskal–Wallis statistics were used to analyze solubility and sorption data, respectively ($\alpha = 0.05$). Differences between groups were evaluated with Tukey's test ($\alpha = 0.05$).

Results: There was a significant difference between the experimental groups for sorption ($p = 0.023$) and solubility ($p < 0.001$). CA showed the highest sorption median (32.3 $\mu g/mm^3$). RC, CF and CD showed lower and similar sorption values. For solubility, the following statistical ranking was observed: CA (8.6 $\mu g/mm^3$) < CF (6.6 $\mu g/mm^3$) < RC (2.2 $\mu g/mm^3$) = CD (1.8 $\mu g/mm^3$). Yet, all materials presented water sorption values lower or equal to 40 $\mu g/mm^3$, which is the limit recommended by ISO 4049 for clinical use. Except for CA, all groups presented solubility values lower than 7.5 $\mu g/mm^3$, also in agreement with ISO recommendations. Higher solubility found for CA may be explained by the hydrophilic behavior of self-adhesive cements.

Conclusions: The hypothesis of the study was rejected since there were differences in the values of sorption and solubility among the cementation materials. However, all materials complied with the ISO 4049 requirements, except for the dual-cure self-adhesive resin cement, which showed solubility values higher than the recommended limit.

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Use of violet light on tooth color change in-office bleaching

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Purpose/aim: This randomized clinical trial evaluated the effectiveness of in-office tooth bleaching with the use of a violet light.

Materials and methods: Twenty-six caries-free patients, both gender, were divided into two treatment groups: Group 1 – violet light (VL) and group 2 bleaching without activation. For the VL group, violet light (Bright Max Whitening, MMO, São Carlos SP, Brazil) was used alone without bleaching gel, according to manufacturer's directions. Four sessions of bleaching were performed at one-week intervals with 20 cycles of 1′ light and 30″ light paused. For group 2, a 35% hydrogen peroxide gel (Whiteness HP, FGM Dental Products, Joinville SC, Brazil) was used in three 15 min applications for 3 sessions at one-week intervals. Color was registered at baseline, after the last session and after 7 days using a digital colorimeter (Vita Easy Shade, Vita).

Results: Tooth color changes were evaluated by repeated measures analysis of variance (ANOVA) at 5% significance. The two groups presented statically significant difference after treatment. At immediate after bleaching evaluation, group II presented a greater tooth color change (5.61 ± 2.28) compared to group I (2.11 ± 2.71), statistically significant at $p < 0.05$. For the 7 days after bleaching analyses group II showed either a better result (5.21 ± 1.82) compared to group I (2.41 ± 3.54) at $p = 0.024$.

Conclusions: The use of hydrogen peroxide gel without light showed better aesthetic results compared with the use of violet light without bleaching gel at in-office bleaching technique.

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Efficacy of plant-derived crosslinkers on fiber-post bonding to radicular dentin

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Purpose/aim: To evaluate the effects of collagen crosslinking agents as a pre-treatment for adhesive luting of glass fiber post to root dentin on bonding durability, adhesive polymerization and dentin biomodification.

Materials and methods: Biomodification solutions were prepared and groups were divided according to the following crosslinking agents: proanthocyanidin (PAC) from grape seed extract, cardol and cardanol from cashew nut shell liquid, and negative control (without pre-treatment). The solutions were applied before the adhesive application on 20 roots of uniradicular extracted teeth ($n = 5$) and the glass fiber posts were luted with RelyX ARC (3 M) dual-cure resin cement. Bonded roots were cut in slices for the push-out bond strength test after 24 h or 6 months water storage. The underlying dentin was analyzed by micro-Raman spectroscopy to evaluate the formation of collagen crosslinking, and at adhesive layer to

assess in situ degree of conversion (DC) by the ratios of 1608/1638 cm^{-1} peaks. The results were analyzed with two-way ANOVA and Tukey test ($p < 0.05$).

Results: No significant alterations on bond strength were found for all groups, except with cardol, which presented increase of bond strength (from 8.44 ± 3.95 MPa to 15.0 ± 2.9 MPa, $p < 0.001$). The formation of 1117 cm^{-1} and 1235 cm^{-1} peaks showed the presence of actual collagen crosslinks for all three agents. The DC depicted no statistical difference between groups ($p = 0.514$).

Conclusions: Biomodification agents did not impair adhesive polymerization and cardol demonstrated the most promising influence on radicular dentin bonding for glass fiber post luting.

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Effect of hydrofluoric acid on resin-bond strength to glass ceramics

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Purpose/aim: To evaluate the effect of the concentration of hydrofluoridric acid (HF) and time of acid conditioning on bond strength of three glass ceramics to a resin cement.

Materials and methods: Fifty blocks (10 mm × 5 mm × 2 mm) of each ceramic (IPS e.max CAD – LDCAD, IPS Empress CAD – LCAD, and IPS e.max Press – LDHP) were made and embedded in acrylic resin. The surfaces were polished with sandpaper (600, 800, 1000, and 1200 grits) and samples were randomly divided into 15 groups ($n = 10$) according to the following factors: Concentration of HF (10 and 5%), conditioning time (20 and 60 s) and ceramic (LDCAD, LDHP, and L). After conditioning, silane (Prosil/FGM) was applied and after 2 min, cylinders (Ø = 2 mm; $h = 2$ mm) of dual resin cement (AllCem/FGM) were made in the center of each block with a Teflon matrix and light cured for 40 s (1200 mW/cm^2). Then, the samples were aged in a thermocycler (10,000 cycles, 5/55 °C, 30 s) and submitted to the shear bond test (50 kgF, 0.5 mm/min). The data (MPa) were analyzed with 3-way ANOVA and Tukey's test (5%). Failure analysis was performed in a stereomicroscope (20×) and scanning electron microscopy (SEM).

Results: The "concentration" factor ($p = 0.017$) had a significant effect; however, the "ceramic" ($p = 0.897$) and "conditioning time" ($p = 0.260$) factors did not influence the results. The LDHP10% 60 s (10.98 MPa) group presented significantly higher bond strength than the LDHP5% 20 s (5.21 MPa), LDHP5% 60 s (5.66 MPa), and LDHP10% 20 s (5.57 MPa) groups (Table 1). Failure analysis revealed that 100% of specimens had mixed failure.

Conclusions: The pressed lithium disilicate-based ceramic conditioned with 10% HF for 60 s had higher bond strength to the resin cement. For the other ceramics (LDCAD and LCAD) the concentration and time of acid exposure did not affect bond strength.

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Push-out bond strength of semi-direct composite to dentin

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Purpose/aim: To evaluate the influence of acid etching and three universal adhesive systems on the interfacial physical/mechanical properties of a semi-direct composite resin restoration adhesively cemented to dentin.

Materials and methods: 78 bovine lower incisors were selected and a slice of dentin (thickness: 2 mm) between the

Table 1 – Shear bond strength (MPa) means (standard deviations) of ceramics submitted to different hydrofluoric acid (HF) concentrations and exposure times.

Group name	Glass-ceramic	HF concentration	Exposure time	Bond strength (MPa)
$LDCAD5\%_{20s}$	CAD/CAM lithium disilicate-based ceramic	5%	20 s	5.30 ± 2.9A
$LDCAD5\%_{60s}$			60 s	7.79 ± 2.9A
$LDCAD10\%_{20s}$		10%	20 s	8.78 ± 3.6A
$LDCAD10\%_{60s}$			60 s	7.92 ± 4.3A
$LDHP5\%_{20s}$	Heat pressed lithium disilicate-based ceramic	5%	20 s	5.21 ± 1.6β
$LDHP5\%_{60s}$			60 s	5.66 ± 2.9β
$LDHP10\%_{20s}$		10%	20 s	6.57 ± 1.6β
$LDHP10\%_{60s}$			60 s	10.98 ± 4.1α
$LCAD5\%_{20s}$	CAD/CAM leucite-based ceramic	5%	20 s	8.66 ± 5.1a
$LCAD5\%_{60s}$			60 s	6.66 ± 3.5a
$LCAD10\%_{20s}$		10%	20 s	7.17 ± 2.9a
$LCAD10\%_{60s}$			60 s	6.90 ± 3.5a

Table 1 – Means (SD) of the push out strength values in the studied groups.

Adhesive system	Acid conditioning	
	Without	With
Tetric N bond	12.67(6.3)^{aA}	5.54(3.5)^{bB}
Futura bond	10.70 (4.2)^{aA}	6.34(2.9)^{bB}
Scotch bond universal	10.22(3.9)^{aA}	5.09(1.9)^{bB}

Upper case letters: comparisons between columns in the same lines. Lower case letters: comparisons between lines in the same columns.

buccal surface and pulp chamber was obtained for each tooth. Conical cavities were made on this surface. The internal walls of the cavities were then coated with a hydrophilic gel, filled with composite resin and photopolymerized. The dentin/cone sets were divided into 6 groups ($n = 10$) according to type of universal adhesive (TETRI: Tetric N Bond, FUT: Futura Bond U, SBU: Single Bond Universal) and acid etching on dentin (A: with acid etching; WA: without acid etching). The acid etching and the adhesive systems were applied to the surface of the dentin. All composite resin cones were sandblasted (Al2O3, 20s) and silanized. After surface treatment, the cones were cemented (RelyX Ultimate/3 M ESPE) into the dentin cavity and photopolymerized. After thermocycling (10,000 cycles) samples were submitted to marginal adaptation analysis (using caries detector dye), push-out test (0.5 mm/min), and failure mode analysis (stereomicroscope – 20×). Additional samples were prepared for nanoleakage analysis (SEM). Data (MPa) were analyzed by two-way ANOVA and Tukey's post-test (5%).

Results: The "adhesive system" factor ($p = 0.532$) did not present a significant effect on results. On the other hand, the "acid conditioning" factor ($p = 0.0001$) was statistically significant. Acid-etching the dentine prior to cementation significantly decreased bond strength of the three adhesive systems compared to no conditioning. There was no significant difference among adhesive systems (Table 1). In the FUT groups, the acid etching group showed significantly more infiltration than the acid-free groups. Different patterns of silver nitrate nanoleakage were found along the adhesive layer for the three universal adhesive systems.

Conclusions: Dentin acid etching significantly reduced the bond strength between universal adhesive systems and dentin in semi-direct restorative procedures.

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Effect of bleaching interval on color change of discolored teeth

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Purpose/aim: Considering that sodium perborate can be continually active for at least 28 days, this bleaching agent would not need to be changed frequently. This study assessed the influence of bleaching interval using sodium perborate on the color change after intracoronal bleaching.

Materials and methods: Endodontic cavity accesses were performed in bovine crowns and the cervical barrier was made with glass ionomer cement. Samples were artificially stained using whole blood and those with a discoloring index of ΔE (mean) ≥ 5.5 were included in this study. Color measurements were performed in triplicate with a spectrophotometer before staining, after staining and after the bleaching procedure. Sodium perborate and water mixture (2:1 g/mL) was placed in the chamber and sealed for 3, 7, 14 and 28 continuous days, and 28 days with agent replacement every 7 days.

Results: The data of color change (ΔE^*) were based on the CIELAB (L*a*b*) system and analyzed by ANOVA e Tukey's test ($\alpha = 0.05$). The time interval of 28 days with change of bleaching agent every 7 days presented higher ΔE^* than the other time intervals ($p < 0.05$), which did not differ from each other ($p > 0.05$).

Conclusions: In conclusion, replacing the sodium perborate seems to be more effective for color change of discolored teeth than no renewal of the bleaching agent.

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Computational analysis of amine activators in amine-peroxide redox polymerization

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Purpose/aim: Amine-peroxide redox polymerization is a versatile, robust method to produce bulk polymer and composites. Since its introduction in the 1950s, this type of redox polymerization has been utilized to prepare industrial polymers as well as biomaterials used in multiple dental materials applications and in orthopedic surgery as bone cements. Despite the long history, there is a lack of chemical insights on the mechanism responsible for radical generation. As a result, the search for more efficient amine activators has been largely empirical without strong guiding justification. With increased interest in bulk-filling restoratives, we investigated amines in the redox polymerization process in the search of more efficient amine reductants.

Materials and methods: We computationally investigated the amine peroxide redox chemistry, using quantum chemical calculations in GAUSSIAN 16. Density functional theory was used to predict the energies of chemical species in the mechanism to elucidate the rates of reactions. Our baseline model chemistry is N,N-dimethylaniline (DMA) and benzoyl peroxide (BPO) along with various derivatives such as N-methylaniline, N,N-dimethyl-p-toluidine, etc. We corroborated the computational studies with experimental results, using a Fourier-transform infrared spectroscopy to monitor

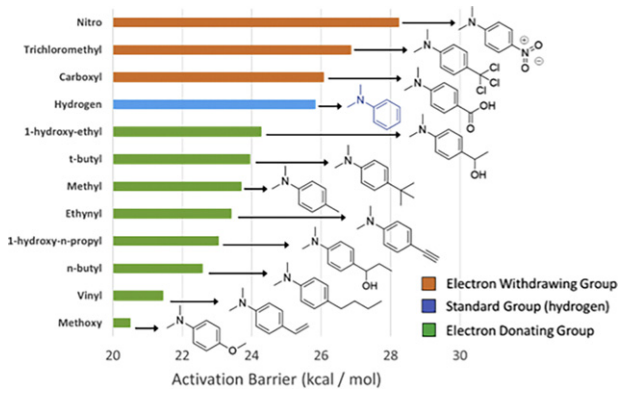

Fig. 1

the disappearance of vinyl groups in di(ethylene glycol) ethyl ether acrylate (Fig. 1).

Results: Through our computational and experimental investigations, we found the homolysis of alkoxyamine intermediate to be a rate-determining step (RDS), contrary to the prevailing hypothesis that nucleophilic attack of amine on peroxide is the RDS. Primary and secondary amines were confirmed not to generate radicals due to available alternative mechanisms. Nucleophilic, basic, and reducing amines were examined; most highly nucleophilic and basic amines failed to initiate due to high homolysis barriers while reducing amines facilely generated radicals as the intermediates are resonance stabilized. The computational results were confirmed by kinetic experiments, leading to a correlation ($R^2 = 0.97$) between calculated activation barriers and experimental redox polymerization rates. Lastly, using newly gained insights, we computationally screened over 100 amines and found novel amines that can generate radicals many times faster than currently utilized amines, as confirmed by subsequent experiments.

Conclusions: The amine-peroxide redox mechanism was computationally investigated to expedite the search for more efficient amines with new structures identified that exhibit higher radical initiation rates in ambient temperature polymerizations of a monoacrylate. This result can be generalized to common dimethacrylate dental resins, implying that dual-cure bulk-filling dental resins can be formulated with much lower concentration of amines. The resultant resins likely have lower toxicity and higher color stability while retaining or accelerating the initiation rates.

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Marginal chipping of lithium disilicate crowns produced by CAD-CAM systems

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Purpose/aim: Margin quality has been described as an essential aspect for longevity of CAD/CAM ceramic restorations. Due to the wide application of CAD/CAM systems, evaluation of production accuracy is of great clinical interest. The purpose of this in vitro study was to investigate the degree of marginal chipping of monolithic lithium disilicate crowns manufactured by four different CAD/CAM systems.

Materials and methods: Four CAD-CAM systems were selected: Ceramill (Ceramill Motion 2), Cerec (Cerec inLab MC XL), EDG (CAM5-S1 SmartDent) and Zirkonzahn (M5 Heavy). An artificial lower first molar was prepared for a full crown, duplicated in plaster, scanned and a crown was designed following standardized parameters. Ten lithium disilicate crowns (IPS e.max CAD; Ivoclar-Vivadent) per group were milled. As standard, a wax-up model was used to determine the occlusal anatomy. The marginal perimeter and integrity were examined using a scanning stereomicroscope Stemi 2000-C (Zeiss) and images were reproduced by assistance of AxionVision 4.9.1. The images were imported to Adobe Photoshop CS6 software, which allowed the recognition of the chipping areas. An ideal selected image, without marginal chipping was considered the baseline for overlapping the other images of the same group (Fig. 1). This overlapping ensures the observation of the chipping area and, consequently, the perimeter for analysis. Measurements of the marginal perimeter and chipping area were performed (ImageJ software). To evaluate the degree of marginal chipping, the Chipping Factor (CF) and chipping area of each crown was calculated and the data were subjected to Kruskal–Wallis One-way test followed by Dunn's method ($p < 0.05$).

Results: Based on SD and absolute mean values, the CF of Ceramill (14.5% ± 8.3%) and Cerec (13.4% ± 9.4%) groups was statistically higher than EDG (3.4% ± 1.2%) and Zirkonzahn

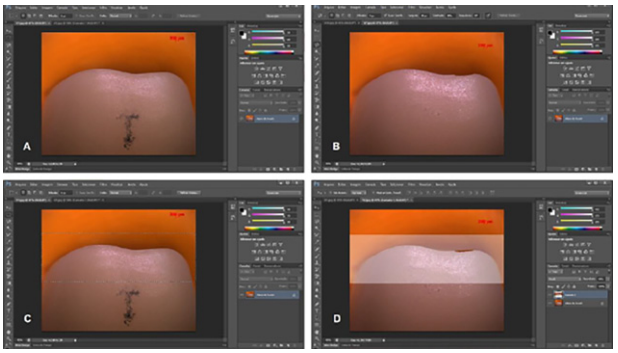

Fig. 1

(2.8% ± 1.3%), demonstrating a heterogeneous distribution. Pairwise multiple comparison procedures (Dunn's Method) were used to compare discrepancies among groups with regard to perimeter and chipping area (μm^2). Ceramill and Cerec presented higher chipping perimeter than EDG and Zirkonzahn (Fig. 1). When the chipping area was calculated, only EDG and Cerec groups presented significant differences.

Conclusions: The chipping factor of monolithic lithium disilicate crowns exhibited statistical differences among the test groups ($p < 0.001$). The data demonstrated the influence of selected parameters during the design, parameters settings and manufacturing tools of CAD/CAM systems on the marginal integrity of monolithic crowns.

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Biological characterization of dental pulp stromal cells onto PMMA scaffolds

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Purpose/aim: Regenerative medicine is a novel approach that tries to mimic tissues that were damage for trauma or illness. To regenerate the tissue is vital to develop new technologies that could be cheaper, safer and easier to generate a new bio-inspired material that could be implanted in the human body. The objective of this work was to synthetize by air jet spun (AJS) technique a scaffold that mimic extracellular matrix (ECM) of connective tissues, and then, an in vitro characterization of the response of adhesion and proliferation of human dental pulp stromal cells (hDPSC).

Materials and methods: The synthesis of the scaffold was made by AJS briefly, poly-methyl methacrylate (PMMA), was dissolve in 8% and 10% (w/v) in ethanol solution and then spinned on wax paper collector with a commercial available air brush (ADIK™/model 699) with 12 cm of distance from collector to the tip of the brush with 30 psi of pressure. PMMA scaffolds were analyzed by SEM and FTIR. hDPSC cells were culture using α-MEM supplemented with 10% FBS and antibiotic solution. Cells were culture onto the PMMA surface scaffolds at 5×10^4 cells/cm^2 for the biological assays.

Results: Cell adhesion was evaluated at 4 and 24 h by colorimetric assay and cell viability were evaluated after 3, 5, and 7 days of culture by MTT assay. Our results showed that cell adhesion assay was enhanced on PMMA scaffolds and no showing any cytotoxic effect on the viability of hDPSC after 7 days of culture.

Conclusions: AJS technique is a good alternative to synthetize scaffolds that mimic the ECM of connective tissue and this scaffold are biocompatible and might be a good candidate for bone tissue regeneration on dentistry therapy.

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Temporary denture liners modified by medicinal plants on candidal biofilm

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Purpose/aim: Searching for crude extracts based on medicinal plants with low toxicity and minimum side effects, which can be used together (synergic effect) or as substitutes for synthetic drugs to treat denture stomatitis, this study evaluated the effectiveness of the surface modification of temporary resilient denture liners by Equisetum giganteum (EG) and Punica granatum (PG) on the biofilm of *Candida albicans* throughout the lifespan of these products.

Materials and methods: Disc specimens (10 × 1 mm) of tissue conditioner Coe-Comfort (CC) and temporary resilient liner Coe-Soft (CS) were superficially modified by application of a primer to improve the bonding between denture base acrylic resin/reline material (Rite-Line) mixed or not (control) to minimum inhibitory concentrations (MICs) of the tested antimicrobials: 0.100 g/mL for EG and PG, and 0.016 g/mL for the pure drug nystatin (g of drug/mL of primer). Then, the biofilm of one of *C. albicans* strains (SC 5314 and ATCC 90028) was formed on the samples in the 24 h, 7 or 14 days period. Fungal viability was determined by counting colony forming units (CFU/mL). Three independent experiments were performed, with each condition tested at least in triplicate. The effectiveness of the superficial treatment of the materials by the herbal plants was expressed in percentage of fungal inhibition in relation to the control (only primer without drug), and data were statistically analyzed by 4-way ANOVA and Tukey's test ($\alpha = 0.05$).

Results: At 14 days of evaluation, regardless of the resilient material or *C. albicans* strain, there was no significant difference between the inhibition percentages presented by both plants (PG and EG) compared to those of nystatin, which were close to 100% ($p > 0.05$). In the other periods, the three antimicrobials also showed the same effectiveness in relation to the control, with the exception of the inhibition percentages of *C. albicans* SC in the CS material modified by EG in 24 h, and by PG in 24 h and 7 days of evaluation, which were lower than those obtained with nystatin ($p < 0.05$).

Conclusions: The effectiveness of the medicinal plants against the biofilm of *C. albicans* was similar to that of nystatin during 14 days of incubation, which corresponds to the duration of conventional denture stomatitis' treatment with topical antifungal drugs and to the life cycle of temporary

resilient liners, suggesting that this protocol may be a promising alternative to allopathic drugs for this therapy.

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Microshear bond strengths of nine CAD/CAM restoratives materials

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Purpose/aim: To evaluate the microshear bond strength (μSBS) of a universal adhesive and an MDP-containing silane applied on indirect restorative materials, after 24 h and after thermo-cycling.

Materials and methods: Nine CAD/CAM materials were selected: (1) LAVA Ultimate (LAV, 3 M Oral Care); (2) Brava (BRV, FGM); (3) VIPIBlock (VIP; VIPI); and (4) BRILLIANT Crios (CRI, Coltene) as indirect resin composite materials; (5) VITA Enamic (ENA, Vita) as a polymer-infiltrated ceramic network (PICN) material; (6) IPS e.max CAD (EMX, Ivoclar Vivadent), as a lithium disilicate ceramic material; (7) Ceramill ZI (CZI, Amann Girrbach), as a 3Y-TZP material; and (8) VITA Suprinity (SUP, Vita) and (9) Celtra Duo (CEL, Dentsply Sirona), as zirconia-reinforced lithium silicate ceramic materials. For each material, 6 blocks were used and processed as recommended by the respective manufacturer. For each indirect material, an MDP-containing silane (Monobond N, Ivoclar Vivadent) followed by an MDP-free universal adhesive system (Peak Universal Bond, Ultradent) were applied as per the manufacturers' instructions specific for each material. After the application of the silane and universal adhesive system, cylinder-shaped transparent matrices were filled with universal light-cure resin cement (NX3) and light cured. Specimens were stored in water (37 °C for 24 h) and tested immediately (24 h) and after 10,000 thermo-cycling (TC), in shear mode at 1.0 mm/min. Mean μSBS were statistically analyzed using 2-way ANOVA ($\alpha = 0.05$) and Tukey's post-hoc test.

Results: 24 h: ENA (25.5 ± 2.8) resulted in statistically higher mean μSBS compared with LAV (18.9 ± 3.0), BRV (16.3 ± 1.1), and VIP (11.9 ± 2.6) ($p < 0.001$). ENA showed similar mean μSBS compared with CRI (22.3 ± 2.2), EMX (23.2 ± 3.1), CZI (24.9 ± 4.3), SUP (23.5 ± 4.1), and CEL (21.0 ± 3.7) ($p > 0.05$). TC: ENA (19.3 ± 0.9) resulted in statistically higher mean μSBS compared with BRV (12.9 ± 2.5) and VIP (7.7 ± 1.5) ($p < 0.05$). ENA showed similar mean μSBS compared with LAV (14.3 ± 1.4), CRI (15.8 ± 2.0), EMX (19.0 ± 2.9), CZI (15.3 ± 2.4), SUP (15.8 ± 1.9), and CEL (18.6 ± 2.0) ($p > 0.05$).

Conclusions: ENA resulted in the highest mean μSBS, in the immediate time and after thermo-cycling. VIP resulted in the lowest mean μSBS, in the immediate time and after thermo-cycling. The zirconia/lithium silicate hybrid materials (SUP and CEL) showed similar mean bond strength compared with CZI and EMX, in the immediate time and after thermo-cycling.

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Influence of silver nanoparticle on mechanical properties of adhesive interface

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Purpose/aim: This study evaluated the influence of silver nanoparticle on mechanical properties of the components of underlying dentin and resin cement in different regions of intraradicular dentin.

Materials and methods: Ninety extracted single-rooted human teeth were used in this study. After endodontic preparation, the teeth were divided into five groups, according to the irrigating agents: distilled water, 5.25% sodium hypochlorite, 25% polyacrylic acid, 2% chlorhexidine and 23 ppm silver nanoparticles dispersion. Then, the groups were divided in 3 subgroups ($n = 6$) according to the technique adopted for adhesive cementation: SUA group: Scotchbond Universal Adhesive + RelyX ARC; U200 group: RelyX U200; and MCE group: MaxCem Elite. The mechanical properties of hardness and elastic modulus were measured in resin cement and underlying dentin in ultra-micro hardness tester in different thirds of radicular dentin surface. Data were subjected to ANOVA and Fisher's test ($p = 0.05$).

Results: In the underlying dentin, in general, there was no statistically significant difference in different thirds of intraradicular dentin according to the different solutions used. In the resin cements, higher hardness values were found, in general, for the cervical third. When silver nanoparticle solution was used, higher mechanical properties were generally obtained for resin cement for the SBU and U200 groups, with little or no changes in mechanical properties for the dentin.

Conclusions: Silver nanoparticle application is a viable option for irrigation the intraradicular dentin previously through the cementation process of glass fiber posts. The mechanical properties are influenced by irrigant solutions used and the depth intraradical analyzed area.

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Tricalcium silicate repair materials doped with fluorine and radiopacifiers

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Purpose/aim: Materials based on tricalcium silicate (C3S) are developed as repair materials. Fluorine ions were incorporated as chemical stabilizers to C3S, promoting the development of a new biomaterial, the C3S doped with fluorine ions (C3S-F). Zirconium oxide (ZrO_2) or calcium tungstate ($CaWO_4$) are added to C3S to provide radiopacity to the material. The present study evaluated setting time, radiopacity, pH and solubility of pure C3S or doped with fluorine ions (C3S-F) and association with 30% of ZrO_2 or $CaWO_4$ radiopacifiers.

Materials and methods: The setting time and the radiopacity were evaluated according to ISO 6876: 2012. Solubility was evaluated by mass loss (%) after 7 days of immersion in distilled water. The pH was evaluated after 1, 7, 14, 21 and 28 days of immersion in distilled water. The data were submitted to ANOVA and Tukey tests ($\alpha < 0.05$).

Results: All cements evaluated provided higher pH than control at all periods ($p < 0.05$). C3S-F + ZrO_2 and C3S-F presented the shortest settling time, with no statistical difference between them ($p > 0.05$), followed by C3S-F + $CaWO_4$, C3S + ZrO_2 and C3S ($p < 0.05$). C3S-F + Zr, C3S + Zr and C3S-F + $CaWO_4$ presented higher radiopacity ($p > 0.05$), above 3 mm Al recommended by ISO 6876. C3S-F and C3S presented values of radiopacity less than 3 mm Al ($p < 0.05$). All materials presented solubility lower than 3% recommended by ISO 6876, with no statistical difference between them ($p > 0.05$).

Conclusions: It is concluded that the cements based on tricalcium silicate doped with fluorine ions associated with the radiopacifiers zirconium oxide or calcium tungstate present proper setting time, radiopacity, pH and solubility. Therefore, these materials present potential to be used as reparative biomaterials.

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Novel lignan and stilbenoid mixtures inhibit cathepsin-K activity in dentin

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Purpose/aim: Inactivation of host-derived enzymatic activity by natural crosslinkers has been suggested to prevent collagen degradation in demineralized dentin. Plant-derived phenolic compounds have been shown to have anti-MMP activity in preclinical cancer models. The aim of this study was to evaluate the effect of nine experimental plant-derived phenolic compounds on dentin cathepsin-K activity.

Materials and methods: Nine experimental lignan and stilbenoid-rich extracts were obtained from Scots pine (*Pinus sylvestris*) knots and diluted in water/DMSO to prepare 100 μM solutions. Demineralized dentin beams (1 × 2 × 6 mm, $n = 10$/group) were randomly divided into 11 groups and pretreated with the experimental extracts or CHX for 5 min, rinsed and incubated in 0.5 mL of simulated body fluid (37 °C) for 7 days. Demineralized dentin beams with no pretreatment served as control. Dry mass before and after incubation was assessed via precision weighing and used as a measure of total dissolution of collagen peptides. Aliquots of the incubation media was analyzed for C-terminal crosslinked telopeptide of type I collagen (CTX) CTX using specific ELISA kit. Data were analyzed by ANOVA and Tukey's tests ($p < 0.05$).

Results: Results: ANOVA showed significant differences among experimental extracts ($p < 0.05$). The inhibitory effect on cathepsin-K mediated degradation ranged between 20 and 99%. After 7 days incubation, dry mass loss ranged between 5% (control) and 2% (phenol extract). All extracts except for two, showed lower dry mass loss than control. However, the difference was significant for only three of the tested experimental lignin and stillbenoid mixtures ($p < 0.05$).

Conclusions: Experimental lignan and stillbenoid mixtures showed a signifiers effect on endogenous cathepsin-K activity. However, effective cathepsin-K inhibition may not be enough to slow down the progressive degradation in demineralized dentin matrices.

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Multidisciplinary approach for the treatment of external cervical root resorption

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Purpose/aim: The aim of this study was to report a multidisciplinary treatment in a 32-year-old patient who presented with sinus tract opening at labial attached gingiva of upper right central incisor after having a root canal treatment 3 years prior. The patient's history included 20 years of dental trauma and 14 years orthodontic treatment.

Materials and methods: The patient was referred to the Special Dental Clinic of Faculty of Dentistry, Khon Kaen University. A resin composite filling with secondary caries was found at the cervical area of labial of the upper right central incisor. Its margin was deep inside the gingiva and a sinus tract opening had been found. The radiographic image showed overfilled root canal treatment and external cervical root resorption. The multidisciplinary treatment was included a periodontal flap procedure, 90% trichloroacetic acid application at resorption area and restoration at cervical area with dual-cure resin ionomer (Geristore®, Den-Mat, Santa Maria, CA, USA) as a temporary wall before a non-surgical endodon-

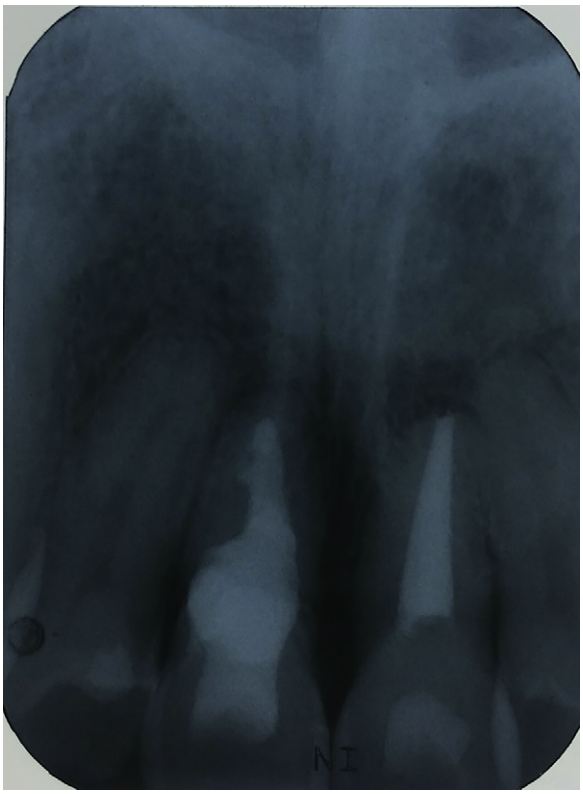

Fig. 1

tic retreatment. Old gutta percha was removed, followed by mechanical instrumentation, 5.25% hypochlorite irrigation, 17% EDTA irrigation as a final flush and obturation with mineral trioxide aggregate (ProRoot MTA®, Dentsply Tulsa Dental, Tulsa, USA). Three prefabricated posts (D.T. light post®, Bisco, Schaumburg, USA) and core build-up material (MulticCore Flow®, Ivoclar Vivadent, Schaan, Liechtenstein) were used to reinforce the cervical area due to extensive loss of tooth structure (Fig. 1).

Results: After the non-surgical endodontic retreatment, the sinus tract opening was healed. Periodontal status and tooth color were in good condition. The patient had more confident with his smile. The posts and core build-up were reinforced the tooth reducing the chance of tooth fracture, helping the patient to keep the upper right central incisor in position instead of making an artificial tooth.

Conclusions: In this case report the etiologic factors of extensive external cervical resorption were dental trauma and orthodontic treatment. The resorption was delayed after the first root canal treatment. The main purpose of the multidisciplinary approach was to eliminate inflammation and establish function and esthetic of the front teeth to the patient. Although the prognosis of this tooth is questionable, long term regularly follow up was needed to confirm the survival rate of the treatment.

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Evaluation of initial bacterial adhesion on zirconia using artificial-intelligence (AI)

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Purpose/aim: Initial bacterial adhesion appears in the early stage of biofilm formation. It is an important factor to evaluate the biological properties of various materials. Various bacterial methods have been used for analyzing bacteria, such as microbial colony counts, Gram staining, and nucleic acid quantitation. However, they are all indirect measurements with estimated results and cannot truly reflect the bacterial adhesion. Direct measurement provides a perceived result, such that more information can be acquired from the results such as bacteria–material surface interactions and the distribution of bacteria. This study provides a new approach to directly measure the initial bacterial adhesion on Scanning Electron Microscope (SEM) images using an artificial intelligence (AI) approach.

Materials and methods: Twenty-four cylindrical zirconia discs (IPS e.max® ZirCAD, 20.0 ± 0.5 mm in diameter, 1.0 mm in thickness) were polished to homogeneous surface roughness ($Ra \sim 0.55 \pm 0.05$ μm) after sintering and randomly divided into 6 groups. *Porphyromonas gingivalis* (P.g.) and *Fusobacterium nucleatum* (F.n.) were cultured individually on zirconia specimens. Initial bacterial adhesion was evaluated at time points of 1 h, 7 h and 24 h by taking 3 random areas of SEM images of bacteria adhered surfaces at 2000× magnification on each specimen, using Fiji (ImageJ) software and Trainable Weka Segmentation plugin, respectively, that have pre-learned with the P.g. and F.n. patterns.

Results: P.g. and F.n. attached on the zirconia discs successfully such that the areas were similar at 1 hour. Strong positive linear correlations were found between the time points and square-root of bacteria adhered area for both P.g. ($R^2 = 0.985$) and F.n. ($R^2 = 0.999$).

Conclusions: Direct SEM images analysis by an AI method can be utilized directly for both morphological and quantitative analysis of initial bacterial adhesion on zirconia.

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Interface created by self-adhesive resin and sound or caries-affected dentin

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Purpose/aim: The aim of this study was to analyze the microhardness and morphological characteristics of the bonding interface between a self-adhesive flowable composite (Vertise Flow) and sound or caries-affected dentin, comparing to interfaces formed by other materials: a resin-modified glass

ionomer cement (Fuji II LC) and a universal adhesive system (Scotchbond Universal Adhesive).

Materials and methods: Class I cavities were made in the occlusal dentin of human molars and dentin affected by caries was produced in their pulp wall, using the microbiological method. The specimens were restored according to the experimental groups and cut in the vestibular-lingual direction to expose the adhesive interface. The specimens were submitted to transversal Knoop microhardness tests ($n = 5$) and analyzed by scanning electron microscopy ($n = 3$) and confocal laser scanning microscopy ($n = 10$).

Results: Two-way repeated measures analysis of variance and Tukey's post-hoc tests were performed for the hardness results (α: 0.05). Morphological characteristics were qualitative analyzed. The hardness of the material layer varied according to the composition of each material. The hardness of the hybrid layer was influenced according to the material and the highest values of hardness were obtained when the universal system was used ($p < 0.05$). The hybrid layer formed by dentin caries-affected presented low hardness values independently of the material used. Morphologically, the tested materials promoted the formation of interfaces with different characteristics, although all the materials were able to form tags in dentin. However, when the interfaces involved caries-affected dentin, a greater number of defects were observed and the layers were irregular.

Conclusions: Hardness of the hybrid layer is influenced by the restorative material, and enhanced by materials that promoted higher amount of tags. Self-adhesive resin was able to promote homogeneous hybrid layer in sound dentin. Restorative procedures over caries-affected dentin are still a challenge, since none of the tested materials promoted hybrid layers free of defects over this substrate.

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Implantology patents deposited in Brazil: A technological prospection

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Purpose/aim: To evaluate patents deposited and granted with a purpose in Implantology by the National Institute of Industrial Property in Brazil (INPI), as well as the main materials and the industrial production in Implantology with patent deposits and to evaluate the evolution of deposits over the years.

Materials and methods: This is a prospective study in which searches of patents on Implantology deposited and granted on INPI were realized. Searches in the titles and summaries of reports on patent applications related to Implantology were made, from the first deposit to the present day using the term "dental implants" and a second search with the term "Implantology". 134 patent reports were selected, which were organized into graphics and tables in the Microsoft Excel program.

Results: From 1988 to 2017, 134 patent deposits were carried out, where 17.9% (24) were registered and 82.1% (110) were published, of which 68.2% (75) were classified as utility model patents and 31.8% (35) as patents of invention. The largest number of deposits is related to implant accessories, while equipment-related deposits represent a much smaller portion.

Conclusions: It was verified that most of the patent deposits of use in Implantology at INPI are related to implant accessories and prosthetic components indicating that the industry in Brazil is investing more in this sector. However, in 30 years only 134 patents were deposited, thus suggesting that the importation of products in the area is still large, which consequently makes the specialty products more expensive.

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Self-adhesive cement bond strength to differently surface treated relined posts

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Purpose/aim: This study investigated the influence of surface treatment in relined fiber posts on the bond strength to self-adhesive resin cement.

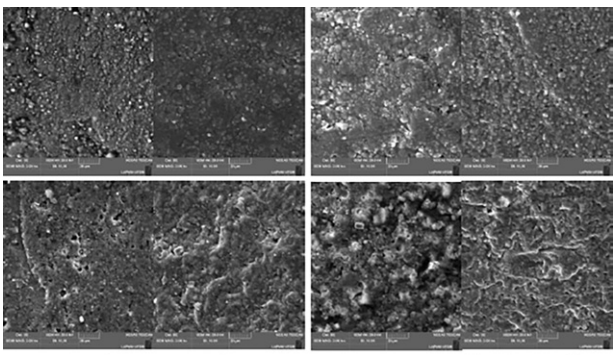
Materials and methods: 160 composite resin blocks (Filtek Z250, 3M ESPE, Seefeld, Germany) were made for the microtensile bond strength test (MTBS). Every two, the same surface treatments were applied: absence of treatment (GC), absence of treatment plus silane application (GCS), blasting with aluminum oxide (GJ) and plus silane (GJS), treatment with 35% hydrogen peroxide (GP) and plus silane (GPS) and treatment with 10% hydrofluoric acid (GF) and plus silane (GFS). The pair was cemented to each other with self-adhesive resin cement (RelyX U200, 3M ESPE, Seefeld, Germany). The blocks were sectioned into microbars (interface area: 1 mm^2), producing a total of 16 microbars each. Half of the specimens were immediately tested, and another half was subjected to 12,000 cycles of thermocycling and storage for 120. In another hand, the push-out test compared the adhesion of untreated relined posts to the root canal of bovine teeth with those treated with the same surface treatment of MTBS blocks. Surface scanning by SEM was performed to analyze the surface topography of relined posts.

Results: In MTBS, specimens with silane presented different results on baseline. In this case, blasting presented the highest mean (81 MPa ± 11.4), followed by hydrofluoric and control acid groups (68.5 MPa ± 11.7, 66.7 MPa ± 11.8), which were not different from each other (Table 1). The hydrogen peroxide group showed a marked decrease (48.7 MPa ± 11.3). When comparing the means of the specimens immediately tested within the same treatment followed or not by silane coupling agent, only the absence of surface treatment showed no statistically significant difference. For the other treatments, the silanization increased the mean of the bond strength. After

Table 1 – Descriptive table of the means of the values per specimen in the microtreatment test in MPa.

Treatment	Baseline		Thermocycling	
	No silanization	Silanization	No silanization	Silanization
No surface treatment	63.6 ± 18.9 A,a*	66.7 ± 11.8 B,a*	42.4 ± 13.9 B,a°	52.3 ± 11.1 B,b°
Hydrofluoric acid 10%	55.5 ± 11 B,a*	68.5 ± 11.7 B,b*	45.9 ± 10.8 B,a°	51.8 ± 10.9 B,b°
Hydrogen peroxide 35%	65.2 ± 12.4 A,a*	48.7 ± 11.3 C,b*	34.7 ± 9.1 C,a°	35.3 ± 8.3 C,a°
Sandblasting	71.8 ± 16.3 A,a*	81 ± 11.4 A,b*	60.6 ± 12.7 A,a°	57.7 ± 12.7 A,a°

Different lowercase letters indicate statistical difference between silane applications within the same treatment. Different upper-case letters indicate statistical difference between treatments. Different symbols (*/°) indicate statistical difference between the means of the specimens tested immediately and those submitted to thermocycling.



Representative SEM images at 2000X magnification of, respectively, groups GC, GCS, GP, GPS, GF, GFS, GJ and GJS.

Fig. 1

thermocycling and storage, the blasting was also the best surface treatment silanized (57.7 MPa ± 12.7) and non-silanized specimens (60.6 MPa ± 12.7), although was no difference in silane application. However, despite the important results in the MTBS and the change in surface topography (observed in the SEM), in the push-out test, there was no statistical difference between the groups (Fig. 1).

Conclusions: Treatment of the composite resin surface with blasting increased the bond strength of this material with the self-adhesive resin cement. However, this benefit is still not significant in adhesion to the root canal due to adhesive failures occur mainly between cement and root dentin.

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Performance of self-adhesive resin-cement by cotton-wool-like nanofibers-embedded with niobium

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Purpose/aim: Niobium pentoxide (Nb_2O_5) is a promising compound for biomedical applications. In association with a silica network, it presents bioactivity and can form a nano-crystalline carbonate apatite layer. Reinforcement with nanofibers has been shown to result in substantial improvements on mechanical properties of dental materials. Therefore, based on interaction with tooth substrates and in the prospect to provide optimal mechanical properties over time, this study aimed to evaluate the reinforcement of a novel hybrid organic-inorganic nanofibers embedded with Nb_2O_5 (niobium pentoxide in orthorhombic crystallographic phase) and network on silica-niobium pentoxide (Nb_2O_5-SiO_4) on a self-adhesive resin cement.

Materials and methods: Poly(lactide acid) (PLA) nanofibers cotton-wool-like were formulated by a spinning sol-gel (SBS) method. Functionalized content of nanofibers (1% mass fraction) were mixed into self-adhesive resin cement (Rely X U200, 3 M ESPE) varying nanofiber composition. Controls for comparison were self-adhesive resin cement without nanofibers and self-adhesive resin cement containing additional PLA nanofiber. The four groups formed were: (1) U200; (2) U200-PLA; (3) U200-PLA-Nb_2O_5 and (4) U200-PLA-Nb_2O_5-SiO_4. The nanofibers were characterized by Field Emission Gun Scanning Electron Microscopy (FEGSEM) and by Differential Scanning Calorimetry (DSC), measured on the DSC 60 (Shimadzu, Japan) at 10 °C min^{-1} heating rate, ranging from 25 to 200 °C, in nitrogen atmosphere. In order to evaluate the nanofibers dispersion into resin cement, FEGSEM images were also conducted in specimens in the four tested groups ($n = 3$/per group). The 3-point flexural strength (σ, $n = 5$), Knoop hardness (H, $n = 6$) and degree of conversion (DC, $n = 3$) were conducted as quantitative variables to characterize the specimens. The σ was determined in specimens (2 × 2 × 6 mm) by a Universal Mechanical

Table 1 – Mean and standard deviation values of self-adhesive resin cement controls and reinforcement with nanofibers.

Groups	Flexural strength (MPa) (σ, $n=5$)	Hardness (kgf) (H, $n=6$)	Degree of conversion (%) (DC, $n=3$)
Group 1 – U200	84.6 ± 13.2^{a}	39.1 ± 0.8^{a}	67.6 ± 0.7^{b}
Group 2 – U200-PLA	115.0 ± 18.3^{ab}	45.8 ± 0.8^{ab}	61.5 ± 4.8^{ab}
Group 3 – U200-PLA-Nb_2O_5	142.0 ± 32.0^{b}	55.8 ± 1.9^{b}	63.2 ± 3.5^{ab}
Group 4 – U200-PLA-Nb_2O_5-SiO_2	131.8 ± 6.3^{b}	60.7 ± 0.4^{b}	54.6 ± 4.9^{a}

Values in the same column with different superscript lower-case letters significantly differ from each other ($p<0.05$).

Testing Machine (INSTRON, 3344). For DC test, infrared (IR) spectra were obtained and monomer conversion (%) was calculated by comparing the aliphatic-to-aromatic IR absorption peak ratio before and after polymerization by Infrared Fourier Transfer with Attenuated Total Reflection coupled (FTIR-ATR). Quantitative data were analysed with one-way ANOVA and Tukey's test ($\alpha=0.05$).

Results: The nanofibers presented adequate morphological aspects (FEGSEM). DSC analysis showed greater thermal stability of polymer chains with additional NbO on nanofibers. The highest σ and H were found in Groups 3 and 4 ($p<0.05$). DC test showed similar data for all tested groups, except for Group 4 (Table 1).

Conclusions: The reinforcement of self-adhesive resin cement with PLA-Nb2O5 and PLA-Nb_2O_5-SiO_4 improved mechanical properties of self-adhesive resin cement.

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Effect of cranberry on dentin subjected to dental erosion

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Purpose/aim: The aim of this in situ study was to evaluate the protective effect of a Cranberry gel applied on dentin submitted to erosion. This double-blinded study was performed in 1 phase of 5 days.

Materials and methods: For that purpose, 10 volunteers wore a palatal device with 4 bovine dentin specimens (4 × 4 mm) divided into 2 groups: G1 – Erosive challenge with acid drink (Coca-cola®) on dentin without any previous treatment and G2 – Erosive challenge with acid drink on dentin treated with Cranberry based gel, which was applied only once before the erosive challenge. The device was immersed into the acid beverage, 3 times daily for 5 min during 5 days. The percentage of surface microhardness loss (%PDS) and profilometry were the variables used to quantify dentin changes. The data presented normal distribution (Shapiro–Wilk) and were submitted to paired t test.

Results: There was no statistical difference between groups in relation to microhardness (G1: 28.12 μm ± 5.71/G2: 24.92 μm ± 5.38, $p=0.169$). To profilometry, G2 presented lower wear value when compared to G1 (G1: 4.97 μm ± 1.35/G2: 3.29 μm ± 1.16, $p<0.05$).

Conclusions: The results obtained in this study suggest a significant efficacy of the Cranberry based gel in the prevention of dentine wear subjected to dental erosion.

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Polymer-based material containing biogenic silver nanoparticles: Conversion and antibacterial assay

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Purpose/aim: The aim of this study was to evaluate the effect of two different synthesized silver nanoparticles (AgNPs), the degree of conversion (DC) and antimicrobial activity against *Streptococcus mutans* of a resin-based material.

Materials and methods: The biogenic synthesis of the AgNPs was mediated by green tea extract (*Camellia sinensis*), in which its polyphenols acted as reducing and stabilizing agents for the nanoparticles (Ag@GT). In one group, AgNP had its surface covered with silicon dioxide (Ag@SiO_2) in order to improve the shade of the material. The two tested nanoparticles (Ag@GT and Ag@SiO_2) were incorporated into an organic matrix BisGMA:TEGDMA (1:1 in mols), in the concentrations of 1 and 3 wt%, resulting in four test groups and one control group (without particles). DC after 24 h ($n=3$) was determined by FTIR spectroscopy. Antimicrobial activity was tested by agar diffusion method ($n=5$), with the inoculation of *S. mutans* in nutrient agar plates. This method was conducted according to Clinical Standard Laboratory Institute M2-A8 protocol, with some modifications (CLSI, 2003). Data were analyzed by one-way ANOVA/Tukey test (alpha: 5%).

Results: DC values ranged from 86 to 95% and no statistical difference were observed among groups ($p=0.150$). Inhibition halos (in mm) were observed in Ag@GT 1 wt% (3.97 ± 2.01), Ag@GT 3wt% (3.46 ± 1.72) and Ag@SiO_2 3 wt% (3 ± 1.03). Halo diameter size did not differ among groups ($p=0.696$).

Conclusions: The incorporation of two different AgNPs (Ag@GT and Ag@SiO2) did not affect the percentage of DC. Antimicrobial activity against *S. mutans* was found in both

Ag@GT groups, at relatively small silver contents (1 and 3 wt%). For the Ag@SiO_2 group, however, inhibition halo was detected only with the incorporation of 3 wt% of particles in organic matrix. (Supported by FAPESP 2017/22999-0.)

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Flexural strength of monolithic zirconia: Effect of finishing/polishing procedures

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Purpose/aim: To investigate the effect of different finishing and polishing regimes and low temperature degradation on flexural strength and surface topography of monolithic zirconias.

Materials and methods: 300 zirconia bars (Z: Ice zirkon transluzent/Conventional and UT: Prettau Anterior/Ultra-transluzent/zirkonzahn) were made (2.1–1.3 × 2.5 × 10 mm), sanded and sintered at final dimensions of 1.7–1.0 × 2 × 8 mm. The bars were divided into 20 groups ($n = 15$) according to three factors "type of ceramic – 2 levels", "Degradation" (D – with: autoclave at 127 °C, 1.7 bar/24 h) and "Finishing and Polishing" (C – Control, B – Polishing, P – Diamond burs, PB – Diamond burs and Polishing, PG – Diamond burs and glaze). The bars were submitted to the 3-point-miniflexure test. Two samples from each group were prepared for the topographic analyzes in SEM/EDS, X-ray diffraction and atomic force microscopy. The mean roughness of each group was also measured. Data were analyzed statistically by means of ANOVA (3 factors) and Tukey (5%).

Results: ANOVA revealed that the factors "Degradation" ($p = 0.01$; with (D):1007.4 MPa A > without: 919.1 MPa B), "Finishing and Polishing" ($p = 0.0000$; B:1183.4 MPa A > PB: 1066.4 MPa B > C: 1012.4 MPa BC > P: 933.2 MPa C > PG: 620.9 MPa D) and "Zirconia" ($p = 0{,}0000$; Z: 1398.4 MPa A > UT: 528.1 MPa B) were statistically significant. The ZPB-D (1670.2 ± 252.73)A, ZB-D (1663.5 ± 216.80)A and ZB (1654.7 ± 367.79 A) groups had the highest values of flexural strength (Table 1). Ultra-transluzent zirconia groups had lower mean values, especially the UTPG (372.1 ± 56.295) G, which obtained the lowest among the others (Tukey).

Conclusions: The appropriate protocol for finishing and polishing the zirconia is the polishing with diamond polishers or grinding with Diamond burs followed by diamond polishers. Moreover, the glaze reduced the resistance of the zirconia, and did not provide a surface as polished as the diamond polishers.

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Bulk-fill composites: Effect of technique and heat-treatment strength

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Purpose/aim: Bulk-fill composites were developed so that they can be polymerized in 4 mm increments. These composites have often been studied in laboratory tests, to understand its properties at different depths or different parts of the restoration, often with conflicting results. This study aimed to evaluate the effect of the processing technique and heat-treatment on the flexural strength of bulk fill composites.

Materials and methods: Discs (1 mm-thick × 10 mm in diameter) were produced with two bulk-fill composites Aura Bulk Fill (SDI) and Filtek Bulk Fill (3 M ESPE) ($n = 20$). Two different techniques were used: (a) a single block (5 mm in height) of each material was sectioned to obtain discs and (b) a block (5 mm in height) containing mylar strips already defining 1 mm thickness of each disc. The blocks were photopolymerized (VALO Ultradent) at the top surface for 20 s (1000 mW/cm^2). The produced discs were divided two groups: (a) those obtained from the top surface and (b) those obtained from the bottom surface, i.e., farther from the polymerization source. Half of the discs were subjected to the heat treatment (170 °C for 10 min). After biaxial flexural strength, piston on three balls (0.5 mm/min) test results were analyzed by two-way ANOVA and Tukey ($p < 0.05$).

Results: For the two resins tested, both the heat treatment (Aura, 170.3 MPa and 215.4 MPa for the Filtek resin) and the production technique were highly significant ($p < 0.001$).

Table 1 – Mean of flexural strength (MPa) and standard deviation of experimental groups.

Zirconia	Degradation	Finishing and Polishing				
		C	P	B	PB	PG
Conventional	Without	1456.1 ± 220.5^{AB}	1343.1 ± 169.7^{B}	1654.7 ± 367.7^{A}	1497.1 ± 196.0^{AB}	837.3 ± 189.8^{CD}
	With	1463.9 ± 258.2^{AB}	1499.3 ± 133.9^{AB}	1663.5 ± 216.8^{A}	1670.2 ± 252.7^{A}	898.2 ± 212.4^{C}
Ultra-transluzent	Without	450.8 ± 79.5^{EFG}	460.3 ± 72.8^{EFG}	623.5 ± 185.9^{DEF}	496.0 ± 103.6^{EFG}	372.1 ± 56.2^{G}
	With	678.7 ± 225.4^{CDE}	429.9 ± 182.3^{FG}	791.8 ± 169.4^{CD}	602.3 ± 163.9^{DEFG}	376.0 ± 75.6^{FG}

* Tukey's test ($p < 0.05$); D – Degradation; C – Control; P – Diamond burs; B – Polishing; PB – Diamond burs + Polishing; PG – Diamond burs + Glaze. Letters will come out between the groups.

For specimens obtained using mylar strip separation, the top discs (106.5 MPa-Aura/215.4 MPa-Filtek) showed significantly higher strength values than those obtained from bottom discs (49.8 MPa-Aura/153.8 MPa-Filtek). Discs obtained by slicing the block showed similar strength regardless of the discs position in the block (top or bottom). As for the interaction between heat treatment versus production technique, Aura obtained the lowest strength value for specimens obtained from the bottom of the block, using mylar strip for separation and without heat treatment (41.8 MPa). The same behavior was noted for Filtek resin in the same conditions (130.1 MPa).

Conclusions: The use of a mylar strip was to separate specimens during their production decreased the flexural strength of the bulk fill composite specimens that were obtained from areas placed far from the activation source. Heat treatment increased strength for both composites studies regardless of the production technique.

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Translucency, contrast ratio and fluorescence of esthetic materials

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Purpose/aim: This study evaluated the translucency, contrast ratio and fluorescence of resin nanoceramic and zirconia materials employed for manufacturing of the indirect restorations.

Materials and methods: 15 disks (5/group) from a resin nanoceramic (Lava Ultimate – LU) a 3Y-TZP zirconia (Lava Plus – LP) and a 5Y-TZP zirconia (Lava Esthetic: Cervical – LEC, Body – LEB and Incisal – LEI) (3 M ESPE, Germany) were sliced with 1.0 mm thickness from blocks with 10 mm diameter (A2 color). The samples were measured in a spectrophotometer (CM 2600d; Konica Minolta, Japan) in reflectance mode. A white background ($L^* = 92.825$; $a^* = -1.402$; $b^* = 4.33$) and a black background ($L^* = 8.465$; $a^* = -0.01$; $b^* = 1.217$) were used for measurements of the translucency parameters (TP) and contrast ratios (CR) associated with the samples. The results for TP and CR were evaluated by one-way ANOVA and Tukey's test ($\alpha = 0.05$). For fluorescence parameter (FP), one sample of each condition was measured in a spectrofluorimeter (Fluorolog-Spex, Horiba Jobin Yvon, Japan). Front-face geometry and a multidimensional fluorescence technique were employed. The 3D maps were obtained from luminescence measurements generated by excitation wavelengths of 280–500 nm, with a step of 10 nm.

Results: The highest translucency was observed in LU (22.12), followed by LP (12.28). LEC, LEB and LEI presented similar behavior (10.80, 10.06 and 10.52) ($p < 0.01$). The contrast ratio was lower in the more translucent material (LU = 0.52), and all other samples showed opacities values close to 0.75 ($p < 0.01$). Three-dimensional fluorescence maps revealed different emissions, both in intensity and spectral distribution. LP presented only residual fluorescence, whereas LEI showed the highest fluorescence, followed by LEB, LEC and LU, respectively (Fig. 1). The fluorescence of LU was distributed in two very distinct bands, with maximum emissions at 482 nm (excitation at 320 nm) and at 435 nm (excitation at 380 nm). The other samples have only one fluorescence band with their maximum at 435 nm (excitation at 310 nm). All conditions, except for LU, had an emission behavior distributed up to 550 nm, showing no significant fluorescence at excitation wavelengths greater than 350 nm.

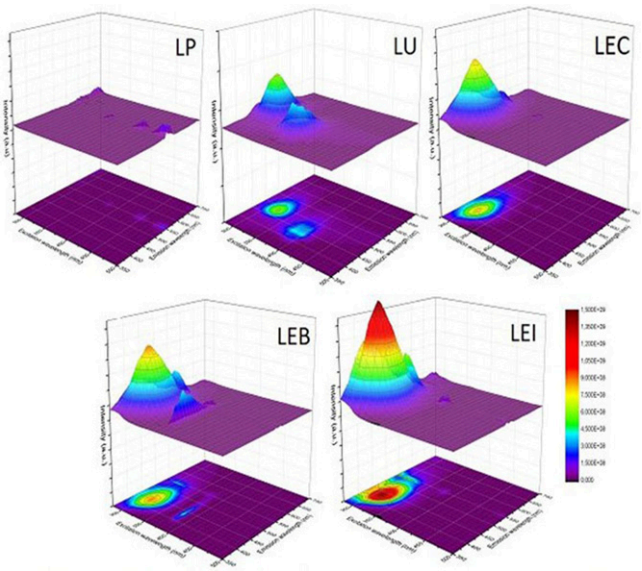

Fig. 1

Conclusions: The LU nanoceramic resin showed to be more translucent than the LP, LEC, LEB and LEI zirconia. LEI was the most fluorescent sample, with a maximum band of 435 nm (excitation at 310 nm).

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Fatigue resistance of fiber reinforced polymer

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Purpose/aim: This study evaluated the fatigue resistance of a double tapper (DT) fiber-reinforced polymer through staircase method.

Materials and methods: Sixty glass fiber post ($n = 60$) were allocated into three groups: DT0.5, DT1, DT3, with coronal diameters 1.4 mm, 1.6 mm and 2 mm, respectively. The polymers were submitted to staircase method (18,000 cycles, 45° of inclination, initial load of 60% to static load, 5 Hz, step size of 5% to initial load and temperature of 37 °C). The failures were analyzed on stereomicroscope (10×).

Results: The smallest values of fatigue resistance were found to DT0.5 (57.4 ± 3.7). There was no difference between DT1 (62.2 ± 6.2) and DT3 (74.2 ± 15.7). Most specimens failed by shear stress.

Conclusions: Thus, depending on the clinical situation and aiming to preserve the dental remaining, a 1.6 mm fiber post of coronal diameter can be more recommendable than a 2 mm fiber post of coronal diameter.

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Erosive, abrasive and erosive-abrasive challenges: Effect on ceramic materials

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Purpose/aim: To evaluate the effect of different challenges on surface roughness (SR) and surface loss (SL) of CAD/CAM ceramic blocks after glaze application.

Materials and methods: Two ceramic materials (Translucent Monolithic Zirconia – LuxaCam Zircon HT Plus, DMG – LZ; and Vitro-Ceramic – IPS e.max CAD, Ivoclar Vivadent – IPS) were submitted to different surface challenges (erosive – EC, abrasive – AC and erosive-abrasive – EAC) and their SR and SL were evaluated by optical profilometry ($n = 10$). Specimens were cut (6 × 7 × 1.3 mm), sintered and glazed (Glaze Plus, Zirkonzahn, for LZ; and IPS Ivocolor Glaze Paste, Ivoclar Vivadent, for IPS). The erosive challenge consisted in immersion of the specimens in 5 ml of 0.06 M hydrochloric acid solution (HCl), pH 1.2, for 30 h at 37 °C. The abrasive challenge was made using a toothbrushing machine, with soft bristle brushes and toothpaste/water slurry (1:2 ratio). The challenge consisted in 400.000 brush strokes with a 200 g load. The erosive/abrasive challenge was a combination of the two previously described challenges in the same specimens. SR and SL evaluations were performed after application of glaze (baseline) and after the surface challenges. Data were submitted to analysis of variance (ANOVA) and Tukey tests ($p < 0.05$).

Results: For SR, there was a statistically significant difference when the ceramic material ($p = 0.00$), the surface challenge ($p = 0.00$) and the interaction between factors ($p = 0.017$) were considered. When comparing ceramic materials, LZ (0.847087) presented higher SR than IPS (0.562890). Regarding surface challenge, EC produced lower SR (0.526800) than AC (0.815745) and EAC (0.772420), which were not different when compared. For both ceramic materials, a higher roughness was detected in AC and EAC, without significant difference between them, in comparison with specimens submitted to EC. For SL, a significant difference was detected for the ceramic material ($p = 0.006$) and surface challenge ($p = 0.00$). No significance was detected for the interaction between them ($p = 0.184$). LZ (0.168100) presented higher SL in comparison with IPS (0.114603). AC and EAC produced a higher SL than EC, with no significant difference between them.

Conclusions: The abrasive and erosive-abrasive challenges were more aggressive to the surface roughness and loss of both ceramic materials. LZ was more susceptible to the tested challenges than IPS.

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Dimethyl sulfoxide improves degree of conversion of hydrophobic bonding agents

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Purpose/aim: Uncured monomers play relevant role on the acceleration of collagen fibrils degradation and the release of toxic by-products. Therefore, the aim of this study was to evaluate the feasibility of the incorporation of an aprotic solvent, dimethyl sulfoxide (DMSO), as a strategy to improve the degree of conversion (DC) of resin adhesive agents, minimizing the abovementioned issues.

Materials and methods: Different DMSO concentrations (0, 0.5, 1, 2, 5, 10 wt%) were incorporated into four commercially available dentin bonding systems (DBS): non-solvated/non-simplified – Adper Scotchbond Multipurpose – MP and Clearfil SE Bond – CSE versus solvated/simplified systems: Adper Single Bond 2 and Adper Scotchbond Universal – SU. DC was evaluated by Fourier transform infrared spectroscopy (FTIR). For this, 3 μL of the bond agent ($n = 3$) was dropped in the center of the ATR crystal, allowing direct contact with the crystal. Uncured and cured absorption spectra were obtained, and DC was determined by measuring the ratio of C=C aliphatic absorption (≈1038 cm^{-1}) and C=C aromatic absorption peaks (≈1608 cm^{-1}) both before and after polymerization, respectively. The polymerization was standardized with Radii Cal/SDI, LED-curing unit (irradiance of 1000 mW/cm^2) for 20 s. Data were submitted to two-way ANOVA and Tukey tests ($p < 0.05$).

Results: DBS and DMSO concentration were statistically significant factors as well as their interaction ($p < 0.0001$). For the non-solvated systems (MP and CSE), DMSO provided improvement of DC using 10% and 5%/10% DMSO concentrations, respectively. On the other hand, its combination with solvated systems resulted in no difference for SB and jeopardized SU system using 10% DMSO.

Conclusions: DMSO notably was able to improve DC of non-simplified DBS even in lower concentrations. For simplified

systems, as the content of solvent and HEMA are more consistent, no evidence of changes could be detected.

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Polycaprolactone porous scaffolds containing calcium-silicate and dicalcium-phosphate for jaw defect

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Purpose/aim: Polycaprolactone (PCL), calcium silicates (CaSi) and dicalcium phosphate dihydrate (DCPD) have been used to prepare highly porous scaffolds for regeneration, post-extractive sockets and surgical defects.

Materials and methods: The scaffolds have been produced by using a thermally induced phase separation technique (TIPS). Three experimental mineral-doped formulations were prepared (PCL-10CaSi, PCL-5CaSi-5DCPD, PCL-10CaSi-10DCPD); pure PCL scaffolds constituted the control group. The Scaffolds were tested for their chemical-physical and biological properties, namely calcium release, alkalinizing activity, surface microchemistry and micromorphology by Environmental Scanning Electronic Microscope (ESEM), apatite-forming ability in HBSS by energy dispersive X-ray spectroscopy (EDX) and micro-Raman, thermal properties by differential scanning calorimetry, mechanical properties by quasi-static parallel-plates compression testing, porosity by a standard water-absorption method. Biological properties have been tested with direct contact cytotoxicity on mouse embryo fibroblasts and differentiation of aortic endothelial stem cells and vascular wall endothelial stem cells. Statistical analysis was performed by using 2-way repeated measures analysis of variance followed by Student–Newman–Keuls test ($p < 0.05$).

Results: All mineral-doped scaffolds released biologically relevant ions (biointeractive). ESEM surface micromorphology analyses after soaking in HBSS revealed: pure PCL, PCL-10CaSi and PCL-10CaSi-10DCPD kept similar surface porosity percentages but different pore shape modifications. PCL-5CaSi-5DCPD revealed a significant surface porosity increase despite CaPs nucleation ($p < 0.05$). Micro-Raman spectroscopy detected the formation of a B-type carbonated apatite layer on the surface of PCL-10CaSi-10DCPD aged for 28 days in HBSS; a similar phase (but of lower thickness) formed also on PCL-5CaSi-5DCPD and PCL; the deposit formed on PCL-10CaSi was mainly composed of calcite (Fig. 1). All PCL showed bulk open porosity higher than 94%; however no relevant brittleness was observed in the materials, which retained the possibility to be handled without collapsing. The thermo-mechanical properties showed that the reinforcing and nucleating action of the inorganic fillers CaSi and DCPD improved viscoelastic properties of the scaffolds, as confirmed by the increased value of storage modulus and the slight increase in the crystallization temperature for all the biomaterials. A detrimental effect on the mechanical properties was observed in samples with the highest amount of inorganic particles (PCL-10CaSi-10DCPD). All the scaffolds showed absence of toxicity, in particular PCL-10CaSi-10DCPD.

Conclusions: The designed scaffolds are biointeractive (release biologically relevant ions), nucleate apatite, possess high surface and internal open porosity and can be colonized by cells, appearing interesting materials for regeneration of oral bone defects.

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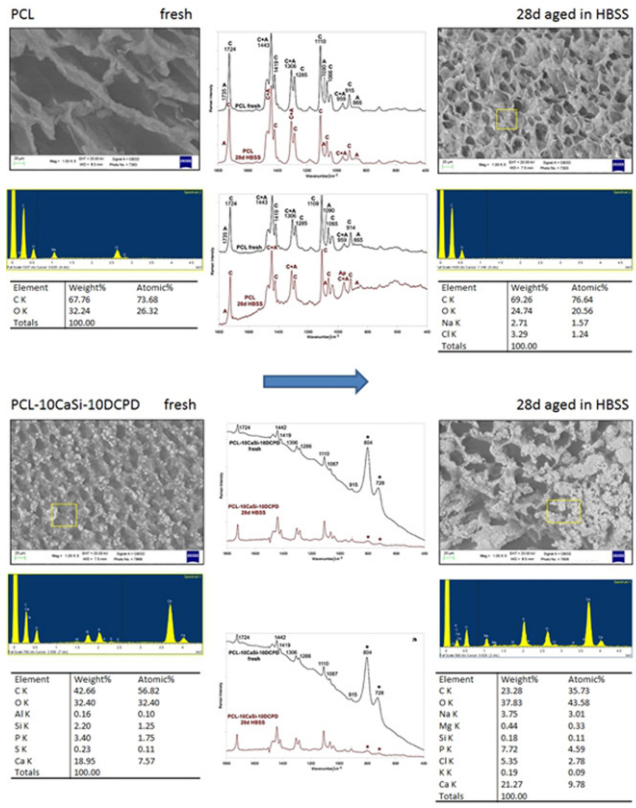

Fig. 1

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Fatigue characterization of yttrium-stabilized zirconia materials for monolithic restorations

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Purpose/aim: To evaluate the fatigue failure load of yttrium-stabilized zirconia (YSZ) of second- and third-generations adhesively cemented to a dentin analogue material using a simplified model to mimic posterior luted restorations.

Materials and methods: Disc-shaped specimens ($n = 10$; Ø = 10 mm; thickness = 1.0 mm) were produced from 4 partially stabilized zirconia of 2nd generation (Lava Plus, 3 M ESPE; Vita In-Ceram YZ-HT, VITA Zahnfabrik; Zirlux FC, Ivoclar-Vivadent; Katana ML/HT, Kuraray) and 2 fully stabilized zirconia of 3rd generation (Katana UTML and STML, Kuraray). Sixty disc-shaped epoxy resin (dentin analogue) specimens were also produced (Ø = 10 mm; thickness = 2.5 mm). All top surfaces of YSZs specimens were polished (SiC papers 400–2000 grit) prior to sintering, and after sintering all the bonding surfaces were air-abraded with 45 μm aluminum oxide particles (10 s, 15 mm distance, 2 bar pressure). All the epoxy resin discs were etched with 10% hydrofluoric acid for 60 s and received a primer coating. Pairs of ceramic and epoxy discs were adhesively cemented (dual-cure resin cement) under 750 g load application and then light cured for 20 s in each direction (top, 0°, 90°, 180° and 270°). After 7 days under water storage at 37 °C, the specimens were subjected to stepwise fatigue test (load ranging from 400 to 2600 N; step-size of 200 N, 20,000 cycles per step, 20 Hz), to obtain the fatigue failure load and number of cycles until fracture. Fracture/survival data were analyzed by Kaplan Meier and Mantel-Cox tests. Topographic characteristics and fractography of failed specimens were assessed by Scanning Electron Microscopy. X-ray diffractometry analysis was executed for assessing superficial crystalline phase content (m-, t- and c-phase) (Table 1).

Results: Second-generation zirconia ceramics (Lava Plus = Vita In-Ceram YZ-HT = Zirlux FC = Katana ML/HT) presented higher fatigue failure load, number of cycles until fracture, and survival probabilities than third-generation zirconia ceramics (Katana UTML = Katana STML). Similar topographical characteristics were noticed among all YSZs considered. Second-generation zirconia showed (t-m) phase transformation after air-abrasion, while third-generation zirconia structure was not affected. All observed failures started on surface/sub-surface defects from the cementation zone.

Conclusions: Second-generation zirconia suffered t-m phase transformation when submitted to stimuli (e.g. air-abrasion for enhanced adhesion), and presented higher fatigue performance than third-generation materials.

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Precision of different fatigue methods for predicting dental ceramic failure

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Purpose/aim: To evaluate the precision of two fatigue methods, boundary and staircase, for predicting the probability of failure (Pf) of a glass-ceramic, testing the hypothesis that the methods show similar precision.

Materials and methods: Bar-shaped specimens of zirconia-reinforced lithium silicate glass-ceramic were produced (VITA-Suprinity) (1.2 × 4.0 × 18.0 mm). Thirty specimens were subjected to a three-point flexural strength test, in 37 °C distilled water (0.5 mm/min). Flexural strength data were analyzed with Weibull statistics. The remaining bars were subjected to cyclic fatigue using boundary ($n = 30$) and staircase techniques ($n = 40$); with the same configuration of the fast fracture test. Fatigue tests were performed using a pneumatic cycling machine (2 Hz, 37 °C distilled water) for 10^3 and 10^4 cycles. Fatigue data were analyzed with statistical software (ALTA Pro 7, Reliasoft) using an inverse power law relationship (IPL) and log normal-lifetime distribution. Three types of datasets were analyzed: (1) boundary; (2) staircase; (3) com-

Table 1 – Fatigue results depicting mean fatigue failure load (N) and number of cycles until failure with the respective 95% confidence intervals.

YSZs materials		Fatigue failure load (N)		Cycles for failure	
		Mean	CI (95%)	Mean	CI (95%)
Second-generation YSZ	Lava Plus	2.540[a]	2.422–2.658	239,000[a]	227,240–250,760
	YZ-HT	2.200[a]	1.959–2.441	205,000[a]	180,906–229,094
	Zirlux	2.580[a]	2.540–2.619	243,000[a]	239,080–246,920
	Katana ML	2.380[a]	2.200–2.560	223,000[a]	205,037–240,965
Third-generation YSZ	Katana UTML	920[b]	700–1.140	77,000[b]	54,980–99,020.33
	Katana STML	860[b]	800–920	71,000[b]	65,012–76,988.89

*Different letters in each column indicates statistical differences for each outcome.

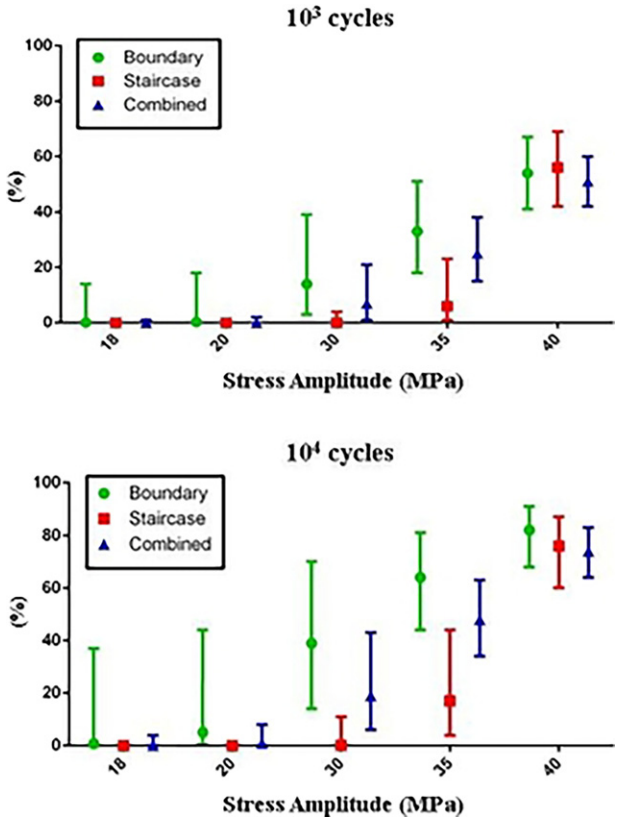

Fig. 1

bined (data from the two techniques). The Pf was estimated for five different stress levels and two lifetimes with a 90% confidence interval (CI).

Results: The Pf and 90% CI for different stress levels and lifetimes estimated using IPL and log normal-lifetime distribution are presented in Fig. 1. The combined dataset resulted in the highest precision of the Pf predictions as the CI were smaller. The precision was higher due to the larger number of specimens and wider range of stress levels included in the analysis. The boundary dataset by itself resulted in similar precision to that obtained using the combined dataset. On the contrary, when the staircase dataset was used, Pf predictions were not very efficient for low stress levels (18–20 MPa) since most specimens were tested in fatigue using stress values around the median (50% Pf). A stress of 40 MPa corresponded to the highest precision for all datasets. Additionally, both methods resulted in similar Pf and precision at 40 MPa, which can be explained by the fact that 40 MPa is within the range of stress used to test specimens in both boundary (34–46 MPa) and staircase fatigue tests (37–40 MPa).

Conclusions: Both fatigue methods show similar precision for predicting ceramic failure when simulations were made in the range of stress levels and lifetimes used in the fatigue tests. Yet, when predicting the probability of failure at low stress levels, which are more clinically relevant, the boundary technique gives better accuracy and precision.

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How sensitive are glass-ceramics to acid etching time?

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Purpose/aim: To evaluate the fracture load of lithium silicate reinforced with zirconia (ZLS) and lithium disilicate (LD) glass-ceramics submitted to different acid etching times. Hypotheses tested: H1 – the fracture load and structural reliability of the materials are similar, H2 – the etching time has no influence on the ceramics fracture load and H3 – water storage reduces the fracture load of both ceramics.

Materials and methods: 120 specimens of each glass-ceramic (LD and ZLS) were produced (12 mm × 14 mm × 1.2 mm) and divided into 3 groups ($n = 20$), according to the etching time (20 s, 40 s and 60 s) using 10% hydrofluoric acid. Cylindrical bases (4 mm-thick) of a dentin analogue (G10) were made with 3 channels, allowing the water to contact the adhesive interface. Before cementation, the channels were obliterated using gutta-percha and removed afterwards. After acid etching, silane and adhesive were applied on the ceramic and G10. The ceramic was cemented on G10 using resin cement. Half of the specimens were tested 24 h after cementation and the other half was stored in distilled water at 37 °C for 12 months. A compressive load (0.1 mm/min) was applied to the ceramic surface using a G10 flat piston (3 mm diameter contact area) in a universal test machine. A microphone was used to detect the first sign of fracture (acoustic emission). The failure mode was analyzed using transillumination. The fracture load results were evaluated using Three Way Anova (material, etching time and time of evaluation), and Tukey test with significance of 5%. The characteristic fracture load and Weibull modules were obtained and compared by Chi-square test and Bonferroni.

Results: Fig. 1 shows the ceramic surfaces after acid etching. Interactions were not significant. ZLS showed higher fracture load than LD ($p = 0.032$). However, LD showed greater structural reliability, rejecting H1. For ZLS, a higher fracture load was obtained with 20 s of conditioning time ($p = 0.009$). Nevertheless, the conditioning time had no influence on the fracture load of the LD, partially accepting H2. Aging decreased

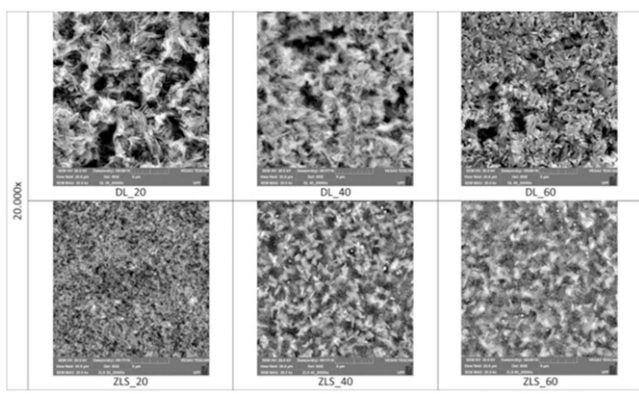

Fig. 1

the specimens fracture load ($p < 0.001$), confirming H3. The most frequent failure mode was radial crack originating from the adhesive interface, similar to the clinical fractures.

Conclusions: ZLS showed a higher fracture load than LD. However, LD structural reliability was higher, which may result in improved predictability of its mechanical performance. The etching time of 20 s is adequate for ZLS and LD. The aging protocol was efficient to degrade the adhesive interface, simulating the clinical condition.

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Effect of staining and ageing on strength of Y-TZP

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Purpose/aim: The objective of this study was to evaluate the effect of staining and aging on the flexural strength of two types of yttria-stabilized tetragonal zirconia (Y-TZP).

Materials and methods: Granulated Y-TZP powders (Zpex and TZ-3YB-E, Tosoh) were compacted by uniaxial pressing followed by cold isostatic pressing in order to obtain 1.0mm-thick discs ($n = 40$). The discs were pre-sintered at 900 °C/2 h (5 °C/min) and subsequently immersed in staining solutions (Lava Frame Shade, 3M ESPE) to reproduce seven distinct shades (Table 1). Final sintering was performed at 15 °C/1 h. The biaxial flexural strength was determined using the piston-on-three-balls design in distilled water (37 °C/0.5 mm/min). Flexural strength was calculated according to ASTM F 394-78. Specimens ($n = 10$) of each shade had their strength measured before and after ageing in an autoclave (AHCM-10, Sercon) for 5 h at 134 °C/2 bar. Data were analyzed by means of three-way analysis of variances and Tukey's test with global significance level of 5%.

Results: The results of flexural strength (in MPa) are shown in Table 1. Ageing did not significantly affect the flexural strength of the materials tested regardless of the shade. Staining only affected the flexural strength of Zpex, as for this material the flexural strength of shade D2 was significantly lower than that obtained for shade B2 without ageing. When both materials tested are compared, the only statistical difference between their strength values was noted obtained for shade D2 without ageing, with TZ-3YB-E showing higher strength than ZPex.

Table 1 – Mean flexural strength (MPa) with SD.

Materials	Ageing	Shades									
		Control	A2	A3	B2	B3	C2	C3	D2	D3	
Zpex	No	637.6 (55.1)A,B,C,D,E	548.4 (130.3)A,B,C,D,E,F	504.2 (120.4)A,B,C,D,E,F	685.3 (57.3)A,B,C	605.8 (70.7)A,B,C,D,E	612.3 (119.2)A,B,C,D,E	505.4 (115.3)A,B,C,D,E,F	414.0 (242.0)E,F	620.0 (27.2)A,B,C,D,E	
	Yes	440.3 (69.3)C,D,E,F	572.0 (168.6)A,B,C,D,E,F	460.9 (109.4)B,C,D,E,F	579.8 (97.3) A,B,C,D,E,F	490.4 (114.1) A,B,C,D,E,F	582.7 (74.9) A,B,C,D,E,F	338.4 (149.2) F	559.9 (51.6) A,B,C,D,E,F	416.3 (74.8)D,E,F	
TZ-3YB-E	No	548.9 (72.7) A,B,C,D,E,F	669.8 (617) A,B,C,D	585.9 (105.5) A,B,C,D,E,F	671.5 (84.4) A,B,C	664.3 (84.8) A,B,C,D,E	701.2 (39.4) A,B	654.8 (103.3) A,B,C,D,E	721.5 (133.4) A	602.9 (21.5)A,B,C,D,E	
	Yes	537.0 (106.1) A,B,C,D,E,F	656.7 (58.0) A,B,C,D,E	510.5 (90.3) A,B,C,D,E,F	540.9 (115.7) A,B,C,D,E,F	467.9 (48.2) A,B,C,D,E,F	671.1 (63.9) A,B,C	553.1 (106.8) A,B,C,D,E,F	589.3 (89.5) A,B,C,D,E,F	558.4 (114.6)A,B,C,D,E,F	

Table 1 – Vickers hardness (HV), Cellular viability (UFC/mL) and Shear bond strength (MPa) means (standard deviations) of restorative materials CAD/CAM submitted to different repair protocol.

Restorative materials CAD/CAM	Vickers hardness (HV)	Shear bond strength (MPa)						Cellular viability (UFC/mL)	
		Repair protocol						Fungal strains	log UFC/mL
		Aging	Al_2O_3 SiAc	COJET SiAc	HF SiAc	Bd SiAc	Bd SBU		
Lava Ultimate	137.4α	Non-aged	9.05 (2.7) aABC	6.30 (2.4) aC	7.60 (2.0) aBC	11.65 (3.8) aAB	14.38 (4.5) aA	*C. glabrata*	5.92 (0.2) Y
		In situ	9.54 (5.7) aB	4.21 (2.7) aC	1.31 (3.9) bD	5.67 (2.3) bBC	14.67 (2.6) aA	*C.albicans*	6.60 (0.2) Z
Vita Enamic	364.7β	Non-aged	12.60 (4.8) eEF	16.58 (5.9) eE	13.46 (3.0) eEF	10.75 (4.6) eEF	9.11 (3.7) eF	*C. glabrata*	5.91 (0.1) Y
		In situ	12.74 (5.2) eEF	13.94 (6.3) eEF	17.10 (4.0) eE	9.94 (3.1) eF	10.07 (3.1) eF	*C.albicans*	6.55 (0.3) Z
Vita Suprinity	734.1γ	Non-aged	9.51 (4.4) iJ	4.71 (2.0) iL	14.27 (5.9) iI	4.81 (1.5) iL	0.0 (0) iM	*C. glabrata*	6.01 (0.6) Y
		In situ	0.17 (0.3) uJ	1.41 (2.4) iJ	9.73 (4.8) uI	7.49 (2.9) iI	0.0 (0) iJ	*C.albicans*	6.41 (0.2) Z

Vickers hardness: Different symbols indicate statistically significant differences between materials. SBS: Different upper case letters indicate statistically significant differences between repair protocols for the same restorative material and aging. Different lowercase letters indicate statistically significant differences between the same repair protocol submitted to different aging for the same material. Cell viability: Distinct upper case letters indicate statistically significant differences between different materials for viability values of *C. glabrata* and *C. albicans*.

Conclusions: Ageing did not reduce the flexural strength of any of the Y-TZPs tested and the addition of staining pigments only resulted in significant differences in strength between two specific shades of one of the materials tested (B2 and D2 of material ZPex).

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Repair protocols and cell viability in CAD/CAM materials: In situ

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Purpose/aim: To evaluate the influence of different repair protocols and in situ aging, the shear bond strength (SBS) of new CAD/CAM blocks to the composite resin and cell viability.

Materials and methods: One hundred blocks (6 × 5 × 2.5 mm) of each restorative material (LU: Lava Ultimate/3 M, VE: Vita Enamic/VITA and VS: VITA Suprinity/VITA) were made, half were fixed in gutters (Width: 8 mm × Length: 19 mm × Depth: 3 mm) prepared in total dentures in use, for 60 days (aging in situ). After, these were removed, cleaned and together with non-aged were randomly divided into 30 groups ($n = 10$) according to factors "Restorative material": LU, VE and VS; "Surface treatment": diamond bur + universal single bond (BdSBU); diamond bur + silane + conventional adhesive (BdSiAc); hydrofluoric acid (HF) 10% + silane + conventional adhesive (HFSiAc); sandblasting with Al_2O_3 + silane + conventional adhesive (Al_2O_3 SiAc); sandblasting with COJET + silane + conventional adhesive (COJETSiAc); and "Aging": in situ and non-aged. Then, composite resin cylinders (Z350/3 M) (Ø: 2.37 mm, *h*: 2 mm) were made on blocks's surface, samples were thermocycled (10,000 cycles, 5°/55 °C, 30 s), submitted to shear bond test (50 kgf, 0.5 mm/min) and optical stereomicroscope failure analysis (20 ×). Additional samples of materials ($n = 50$) were made for analyzes of Vickers hardness ($n = 10$), roughness ($n = 10$), cell viability ($n = 10$), scanning electron microscopy (SEM) ($n = 10$) and EDS ($n = 10$). Data of SBS (MPa), cellular viability (UFC/mL) and microhardness (HV) were analyzed with 2-way ANOVA and Tukey's test (5%). Other were qualitative descriptive analyzes.

Results: ANOVA revealed that for SBS, aging factor in LU and VS, surface treatment factor in LU, VE and VS, and interaction these factors in LU and VS were significant ($p < 0.01$). For LU, aged BrSBU group (14.67 MPa) showed significantly higher SBS value, aged HFSiAc group (1.31 MPa) had lowest (Table 1). For VE, aged HFSiAc group (17.10 MPa) had higher SBS value, and non-aged BdSBU group (9.11 MPa) presented lowest. For VS, non-aged HFSiAc group (14.27 MPa) presented higher SBS values, and BdSBU group (0.0 MPa) lower. Adhesive failure was predominant in all materials (LU: 78%, VE: 61%, VS: 98%). VS (734.31HV) exhibited highest hardness, LU (137.34HV) presented lowest ($p < 0.01$). There was difference in adhesion between fungal strains ($p < 0.01$), however there was no difference between materials ($p = 0.9064$).

Conclusions: In situ aging alters bond strength of LU and VS materials. Most effective surface treatment for LU was diamond bur + SBU, for VE and VS conditioning with HF. VS presented greater hardness. Surface treatments promoted surface changes of topography and roughness of all materials, greatest roughness LU-COJET, VE-Al_2O_3 and VS-Diamond bur, besides altering superficial chemical composition in materials.

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Development of fatigue methodology for ultra-thin ceramic laminates

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Purpose/aim: To develop a fatigue methodology capable of determining the lifetime of ultra-thin ceramic laminates processed via CAD-CAM.

Materials and methods: Sixteen human maxillary central incisors were used to produce the specimens. Ceramic laminates made of lithium disilicate and feldspathic porcelain with thicknesses between 0.3 mm and 0.5 mm were produced via CAD-CAM and cemented with resin cement. Four specimens of each group were taken to a universal testing machine to determine the fracture load of the laminates. For the development of a fatigue methodology, a series of tests was performed using different parameters such as: type of antagonist (natural teeth or metallic roller), applied load (20, 30 or 40 N), and type of masticatory cycle (incision or sliding). Failure modes were analyzed using a stereomicroscope. Fracture load data were analyzed by ANOVA and Tukey's test.

Results: The mean fracture load obtained for the glass-ceramic was 431.8 ± 217.9 N, while that obtained for the porcelain was 454.4 ± 72.1 N. There was no statistical difference between the mean fracture load values. There was also a difference in the failure modes for the two materials tested. The porcelain showed a higher number of factures due to chipping and the lithium disilicate showed a higher number of tooth structure failure. The fatigue experiment showed different results depending on the condition analyzed. In the incision cycle, the antagonists (natural tooth) fractured when loads of 30 N and 40 N were applied. In the sliding type of cycle, the antagonist (natural tooth) suffered wear on the incisal edge after applying load of 30 N. For the metallic roller antagonist, when a 30 N load was applied, the ceramic laminate fractured, and when a 20 N load was applied, an excessive wear of the metal roller occurred. It was not possible to determine the combination of the mechanical cycling parameters that would allow the determination of fatigue parameters for ultra-thin ceramic laminates, since the maximum number of cycles reached was 536,818 cycles.

Conclusions: The material used did not affect the fracture load of ultra-thin ceramic laminates when the static test was used. However, the failure mode was significantly different, as porcelain suffered more chipping than the lithium disilicate; which, in turn, showed most failures related to the tooth structure. Future studies need to be carried out so that a clinically relevant methodology can be developed to determine the fatigue parameters of ultra-thin ceramic laminates in the anterior teeth.

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Conventional GIC containing bioactive glass: Physical, mechanical and microbiological properties

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Purpose/aim: The aim of this study was to evaluate the physical, mechanical and microbiological properties of a conventional GIC (Ketac Molar Easy Mix) after addition of two bioactive glass (45S5 and F18) in two concentrations (5 and 10%).

Materials and methods: For surface roughness, three readings were performed in each specimen ($n = 10$) with the aid of a rugosimeter. The roughness value was obtained by their mean. The samples for porisity ($n = 10$) were fractured, and obtained fragment was analyzed using SEM images and Image J. Two analyses of the same images were made with a week interval. The samples for compressive strength ($n = 10$) were submitted to the mechanical testing machine at a speed of 0.5 mm/min and were measured at the time of their rupture. Biofilm analysis was performed after growth for 1, 7 and 14 days, by viable cell count ($n = 10$). The number of colony forming units (CFU) was obtained. The count was performed and the results were expressed in CFU/mL. To evaluate contact angle the angle formed between the droplet and the surface of the material was measured. One specimen of each group was sputter-coated and the surface composition was analyzed in SEM-EDS.

Results: The roughness test, statistical difference was observed when 10% of bioactive glass (either 45S5 or F18) was added, indicating a roughness surface. For the porosity test, no statistical difference was found, but 45S5 10% and F18 10% showed a higher pores area, which enhance the probability of cracks. For the compressive strength lower values were also found when 10% of the bioactive glass (45S5 or F18) were added. Analyzing the contact angle, no statistical significant difference was observed among the groups. The microbiological test, no statistical difference was observed in the 1 and 7 days analyses. After 2 weeks (14 days analyses), F18 5% and F18 10% showed higher values, indicating more colonies formation, with no statistical difference from the 45S5 5% and 45S5 10%. The EDS analysis showed higher amounts of ions calcium for all groups with bioactive glass addition compared to control. Higher composition variations were found when F18 10% was added to the GIC.

Conclusions: The addition of bioactive glass to GIC may lead to the development of a material with remineralize potential without significant loss in physical and mechanical properties when 5% of the bioactive glass is added.

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Withdrawn

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Effect of different surface treatments on post bonding

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Purpose/aim: The purpose of this study was to evaluate the effect of the pre-treatment of fiber post on bond strength of a new calcium-releasing self-adhesive resin cement, TheraCem (Bisco).

Materials and methods: Fiber posts (#3 D.T. LIGHT-POST, 1.2–2.2 mm diameter) were randomly divided into 3 groups. Group 1 received treatment. Group 2 was treated with 1 coat of Porcelain Primer (Bisco), and group 3 was sandblasted with alumina sand. Immediately after a metal mold (internal mold size: 6 mm diameter, 8 mm height) was filled with TheraCem, a fiber post was placed in the middle of cement. The cement was self-cured in dark in oven at 37 °C for 15 min. The cured specimens were then stored in water for 24 h at 37 °C and tested (pushed) by universal testing machine (Instron, crosshead-speed 1 mm/min) until failure. The data were analyzed statistically by one-way ANOVA and Student t test.

Results: Mean bond strengths in Kg (standard deviation) are shown in Table 1. Means with different letters are statistically different ($p < 0.05$).

Table 1 – Bond strength of post with TheraCem ($n = 5$).

Treatment	Mean bond strength (Kg)	Mean bond strength increase (%)
No treatment	21.1 (3.5) a	–
Porcelain primer	26.1 (10.9) a	24%
Sandblasting	75.6 (8.9) b	258%

Conclusions: Sandblasting post with alumina sand significantly improved the bond strength of fiber posts.

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Paffenbarger Award Finalists

P1

Experimental self-adhesive composites for bulk-fill applications

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Purpose/aim: The study aimed to determine the curing potential, the consequent stress development and the bond strength to dentine of experimental self-adhesive bulk-fill resin-based composites.

Materials and methods: An organic matrix was formulated with bisphenol A-glycidyl methacrylate (10 wt%), triethylene glycol dimethacrylate (10 wt%), urethane dimethacrylate (40 wt%), and bisphenol A ethoxylate dimethacrylate (40 wt%). Camphorquinone (0.5 wt%) and ethyl 4-dimethylaminobenzoate (0.8 wt%) were used as photoinitiator/co-initiator system. To this blend, the acidic monomer 1,3-dimethacryloyl, 3-phosphonoxy glycerol (GDMAP) was added at different ratios (15 and 30 wt%). The following experimental groups were formulated: G0 (no acidic monomer), G15, and G30. Silanated glass fillers (2 μm, 0.7 μm, and 40 nm average sizes at 80:15:5 ratio) were added to each group at 50 wt%, achieving flowable-composites' handling characteristics. Photoactivation procedures were carried out by a polywave LED source (Valo Cordless) with 1500 mW/cm^2 for 40 s. The degree of C=C conversion (DC, $n = 5$) was determined by Fourier-transformed infrared spectroscopy (NIR, FTIR) at 1 and 4 mm thickness samples after 24 h. Depth of cure ($n = 5$) was determined by the scraping method. The polymerization shrinkage stress ($n = 5$) was obtained by universal

Table 1 – Mean values and SD for DC (%), DoC (mm), PS (%) and bond strength (MPa).

	% Degree of C=C conversion*		Depth of cure (mm)	Polymerization stress (MPa)	Microshear bond strength (MPa)
	at 1 mm	at 4 mm			
G_0	84.5 ± 1.0 ^{Ab}	62.1 ± 1.7 ^{Bb}	4.5 ± 0.1^{b}	5.3 ± 0.3 ^{b}	17.5 ± 3.3 ^{c}
G_{15}	96.5 ± 0.9 ^{Aa}	75.2 ± 0.9 ^{Ba}	4.4 ± 0.1^{b}	5.6 ± 0.5 ^{b}	30.1 ± 4.8 ^{b}
G_{30}	96.9 ± 0.8 ^{Aa}	63.2 ± 1.4 ^{Bb}	4.7 ± 0.1^{a}	6.4 ± 0.1 ^{a}	42.2 ± 3.4 ^{a}
G_0 + adhesive					32.8 ± 2.8 ^{b}

For each analysis, distinct lowercase letters indicate statistical difference among groups.
* Distinct capital letters indicate statistical difference between the two thicknesses (1 and 4 mm).

testing machine using acrylic rods as the bonding substrates. The micro-shear bond strength test ($n = 12$) to human dentine (Ethics committee approval #33167714.0.0000.0075) was performed after 24 h, where G0 was tested without (negative control) and with (positive control, PC) the prior application of a commercially available adhesive in the self-etching mode (Single-Bond Universal, 3M). The fracture patterns were characterized by stereomicroscope. Data was submitted to one or two-way analyses of variance and Tukey's test ($\alpha = 0.05$).

Results: The results are described in Table 1. Materials and bonding strategy influenced the fracture patterns.

Conclusions: The addition of the acidic-monomer GDMAP at 15% ratio to the bulk-fill composite improved the bond strength ability to dentine without compromising the curing potential and the stress development.

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P2

Effect of photoinitiator system on polymerization of methacrylamides

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Purpose/aim: The aim of this study was to investigate the influence of the photoinitiator system on the polymerization kinetics of methacrylamide-based monomers as hydrolytically stable alternatives to methacrylates in dental resin-composites and adhesives.

Materials and methods: In total, 16 groups were tested. Monofunctional monomers: 2-hydroxyethyl methacrylate (HEMA); 2-hydroxyethyl methacrylamide (HEMAM); 2EMATE or n-(1-hydroxybutan-2-yl)methacrylamide (2EM) were combined with bifunctional monomers containing the same polymerizing moieties as the monofunctional counterparts (HEMA-BDI; HEMAM-BDI; 2EMATEBDI or 2EMBDI) at 50/50 molar ratios. 0.1 wt% of 2,6-di-tert-butyl-4-methylphenol (BHT) was used as inhibitor and the photoinitiators used were: 0.2 wt% of dl-camphoroquinone (CQ) + 0.8 wt% of ethyl 4-dimethylaminobenzoate (EDMAB); 0.2 wt% of bysacylphosphine oxide (BAPO); 0.2 wt% of IVOCERIN; 0.2 wt% of 2,2-Dimethoxy-2-phenylacetophenone (DMPA1). The polymerization kinetics and final degree of conversion (Final DC – %) were monitored using Near-IR spectroscopy (~6165 cm^{-1}, $n = 3$) in real-time while the specimens were photoactivated with a mercury arc lamp (Acticure 2; 320–500 nm, 300 mW/cm^2) for 5 min. Initial viscosity ($n = 3$) was measured with an oscillating rheometer. Data were analyzed with two-way ANOVA and Tukey's test (95%).

Results: For polymerization kinetics and viscosity, there was statistically significant interaction between monomer and photoinitiator ($p \leq 0.001$). For the methacrylate groups, the highest Rpmax (maximum rate of polymerization – $\%/s^{-1}$) was observed for HEMA/HEMABDI + DMPA1 and 2EMATE/2EMATE + BAPO. For methacrylamide groups, the highest Rpmax were observed for HEMAM/HEMAMBDI and

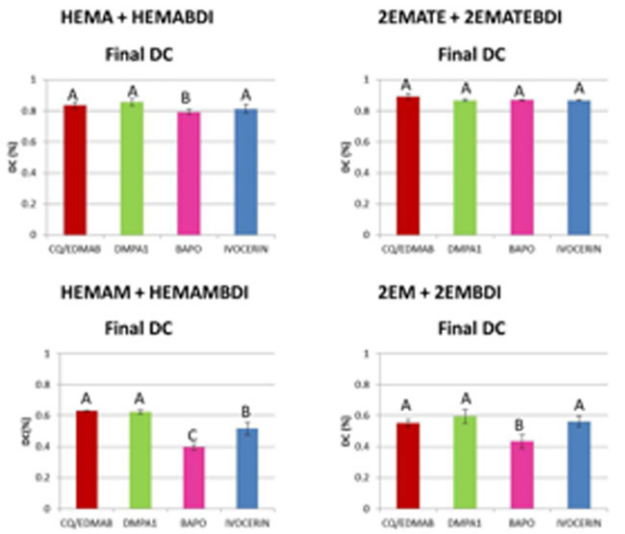

Fig. 1

2EM/2EMBDI monomers, both with DMPA1. Final DC (Fig. 1) was higher for the methacrylate groups, in comparison with methacrylamide groups, independent of the photoinitiators. However, for the methacrylamide groups, the association with BAPO led to the lowest values of DC. For the viscosity (Pa s), only 2EM/2EMBDI had higher values (1.585 ± 0.154) in comparison with all monomers.

Conclusions: In conclusion, polymerization kinetics was affected by the photoinitiators for both monomers. Viscosity was significantly increased with the use of tertiary methacrylamide.

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P3

Thio-urethane addition effect on sol–gel composition of Bis-GMA/TEGDMA networks

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Purpose/aim: The aim of this study was to determine the influence of the addition of thio-urethane additives (TU) on the sol-gel composition of methacrylate networks.

Materials and methods: Different extraction solvents were used and the leachates were analyzed by Nuclear Magnetic Resonance Spectroscopy (^{1}H NMR). ^{1}H NMR (400 MHz) concentration vs. absorbance calibration curves were built for systematic mixtures of Bis-GMA/TEGDMA. For the actual test, 10 groups were included: Bis-GMA/TEGDMA at 20/80; 40/60; 50/50; 60/40; 80/20 mass ratios, with or without the addition of 20 wt% of thio-urethane. 0.1 wt% of 2,2-Dimethoxy-2-phenylacetophenone (DMPA1) was added as the photoinitiator

and 0.3 wt% of 2,6-Di-tert-butyl-4-methylphenol (BHT) was added as a free-radical inhibitor. Disk specimens ($n = 3$, 0.8 mm thickness) were photoactivated with a mercury arc lamp (320-500 nm at 88.90 mW/cm^2) for 1 min. The degree of conversion (DC – %) was measured in near-IR (~6165 cm^{-1}). Water sorption (WS) and solubility (SL) were obtained according to ISO 4049 ($n = 3$). Leachates were collected after immersion in water or Methylene dichloride (CH2Cl2). Lyophilized leachates were dissolved in CDCl3 and analyzed for the signals for the different methylic protons in the 1H-NMR spectra. Data were analyzed with two-way ANOVA and Tukey's test (95%).

Results: For the groups with TU, the DC data were 20/80 = 40/60 > 60/40 > 50/50 > 80/20 Bis-GMA/TEGDMA ratios. For the groups without TU, the DC obtained was 20/80 = 40/60 > 50/50 > 60/40 > 80/20 Bis-GMA/TEGDMA ratios. WS increased as the Bis-GMA concentration increased, independent of TU presence, which was expected based on its greater hydrophilicity. For the groups without TU, SL increased as the Bis-GMA concentration increased. For the groups with TU, lowest value of SL was found to 20/80, followed by 50/50 and similar for the others groups Bis-GMA/TEGDMA ratios. The leachates extracted by immersion in the CH2Cl2 solvent had a molar ratio trend: 20/80 > 40/60 > 50/50 > 60/40 > 80/20 Bis-GMA/TEGDMA ratios, independent of the TU presence. However, the TEGDMA leachates presence had lower molar ratio values. In water immersion, there were no significant extraction products from Bis-GMA mainly for groups without TU.

Conclusions: In conclusion, TU presence affected the leachates in both solvents and this study including oligomers was capable of determining their influence on the compositional drift observed in partial cure dental materials.

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P4

Novel super-speed sintered zirconia by microwave technology

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Purpose/aim: Traditional sintering of dental zirconia is time consuming. Thus, several methods have been investigated in an attempt to speed-up the densification process, without compromising the material's strength. The aim of this study was to evaluate the structural durability of super-speed sintered zirconia by means of microwave (MWZ). A conventionally (CZ) sintered zirconia was used as reference.

Materials and methods: As-machined dental 3Y-TZP discs (Ø12 × 1.2 mm) were super-speed sintered using an industrial microwave at 1450 °C for 15 min (total 1 h); while the reference sintering process was carried out in a standard dental furnace at 1530 °C for 2 h (total 6 h), both followed by natural cooling. Groups were compared regarding density, grain size, zirconia phase assembly, and fracture resistance. Two fatigue protocols, namely step-stress and dynamic fatigue, were used to investigate the zirconia structural durability.

Results: Slightly higher density was observed for CZ group (6.03 g/cm^3) compared to MWZ (5.98 g/cm^3). Associated sparse and small porosity was observed in SEM images, which also showed significant difference in grain size: MWZ = 0.53 ± 0.09 μm, CZ = 0.89 ± 0.10 μm. No difference in strength was observed between groups: MWZ = 978 ± 112 MPa, CZ = 1044 ± 161 MPa. Step-stress test failed to capture the fatigue effect, resulting in fractures at ~700 MPa for both groups, regardless of number of cycles. Dynamic fatigue showed structural degradation due to slow crack growth, yielding strength reduction down to ~800 MPa for both groups.

Conclusions: Super-speed sintered zirconia can be prepared six-times faster by microwave sintering, resulting in similar structural durability to that of conventionally sintered zirconia.

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P5

Non-agglomerated ionic liquid-stabilized titania quantum dots in adhesive resin

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Purpose/aim: Ionic liquids (IL) are organic salts with antimicrobial activity proposed for synthesis and functionalization of nanoparticles. The aim of this study was to synthesize titania (TiO_2) quantum dots (QDs) with an imidazolium ionic liquid (TiO_2QDs/BMI.BF_4) and evaluate its addition in an adhesive resin.

Materials and methods: The adhesives were formulated by methacrylate monomers and photoinitiators. TiO_2QDs/BMI.BF4 were added at 2.5 wt.% (G2.5%), 5 wt.% (G5%) and one group remained without filler as control (GCntrl). TiO_2QDs/BMI.BF_4 were analyzed by μ-Raman, TGA, TEM and fluorescence microscopy. The adhesives were evaluated for polymerization kinetics, softening in solvent, immediate and longitudinal μTBS, fracture pattern, antibacterial activity against *Streptococcus mutans* and cytotoxicity by Sulforhodamine B (SRB) colorimetric assay for cell density determination using human pulp fibroblasts.

Results: TiO_2QDs/BMI.BF_4 (3.54 ± 1.08 nm) with anatase and rutile phases presented 26 wt.% of IL and were non-agglomerated in isopropanol or in the polymerized adhesive. GCntrl reached higher maximum polymerization rate and all groups presented degree of conversion higher than 50%. There was no difference for initial Knoop hardness ($p = 0.909$) and

G5% had higher softening in solvent ($p = 0.021$). There was no difference for immediate μTBS ($p = 0.239$) and G5% presented lower longitudinal μTBS ($p < 0.001$), prevailing mixed fracture for all groups. The addition of TiO_2QDs/BMI.BF_4 at 2.5 and 5 wt.% induced immediate and long-term antibacterial activity compared to GCntrl ($p < 0.001$) with no cytotoxicity ($p = 0.293$).

Conclusions: The use of IL is a new strategy for functionalization to overcome agglomeration concern and improve adhesive resins with nanoparticles.

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P6

Effect of zinc/copper nanoparticles on bonding to artificially caries-affected dentin

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Purpose/aim: To evaluate the effect of addition of zinc oxide and copper nanoparticles (ZnO/Cu Np) at different concentrations into two universal adhesive systems, on antimicrobial activity (AMA), as well as, immediate microtensile bond strength (μTBS), nanoleakage (NL), microleakage evaluation by confocal laser scanning microscopy (ML) and in situ degree of conversion (DC) on caries-affected dentin interface. In addition, it was identified the presence of zinc/copper in the hybrid layer.

Materials and methods: Six universal adhesives were formulated according to the addition of ZnO/Cu Np (0% [control]; 5/0.1 and 5/0.2 wt%). in Ambar Universal adhesive (AMU; FGM) and Prime&Bond Active (PBA; DentsplySirona). The AMA was evaluated against *Streptococcus mutans* using agar diffusion assay. The occlusal enamel of seventy-two caries-free third molars was removed. After enamel removal, a microbiological caries induction model was applied. After 14 days, the specimens were sterilized and washed in deionized water, and dentin was polished with 600-grit silicon-carbide paper for 30 s to standardize the smear layer and simulated caries-affected dentin. Then, the experimental adhesives were applied to dentin in etch-and-rinse (ER) or self-etch (SE) mode. After composite resin build-ups, specimens were longitudinally sectioned to obtain resin–dentine bonded sticks (0.8 mm^2). For microtensile bond strength, specimens were tested in tension at 0.5 mm/min after 24 h of water storage. For nanoleakage, 2 bonded sticks from each tooth were prepared and analyzed under SEM after 24 h of water storage. For microleakage, degree of conversion in the interface and identification of ZnO/Cu in the hybrid layer, 2 bonded slices were prepared and analyzed. All data were submitted to statistical analysis and significance was defined in $\alpha = 0.05$.

Results: For AMA, only 5/0.2 groups showed AMA higher than control ($p < 0.05$). After 24 h, zinc oxide and copper nanoparticles did not influenced negatively the μTBS and DC ($p > 0.05$) and decrease the NL and ML ($p < 0.05$), in both adhesives and strategies. In addition, it was possible to identify the presence of ZnO and Cu in the hybrid layer in all experimental groups.

Conclusions: The addition of ZnO/Cu Np in the tested concentrations in universal adhesive systems may be an alternative to provide antimicrobial activity and improves the integrity of the hybrid layer.

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P7

Chemical and structural characterizations of an experimental silica/Y-TZP glass-ceramic

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Purpose/aim: Ceramics are widely used in Dentistry mainly due to their physicochemical and mechanical properties. However, glass and polycrystalline ceramics have different properties and, consequently, different indications. Considering the need to elaborate dental ceramics that balances good physical and mechanical properties, this present work aims to chemically and structurally characterize an experimental glass-ceramic composed of silica and enriched by yttria-stabilized tetragonal zirconia polycrystals (Y-TZP).

Materials and methods: Silica was obtained using the modified Stöber method, in which 10 ml of milli-q water, 4.0 ml of tetraethylorthosilicate (TEOS), 50 ml of alcohol and 15 ml of ammonium hydroxide were added into a beaker (400 rpm, 40 °C) in order to promote the hydrolysis and condensation of TEOS, resulting in amorphous silica (SiO_2). The Y-TZP powder was acquired in a 40 nm scale. These initial powders were submitted to X-ray diffraction (XRD) and Fourier transform infrared spectroscopy (FTIR). After that, 97 wt.% of silica and 3 wt.% of Y-TZP were submitted to uniaxial and isostatic pressing and sintered at 1000 °C for 4 h into two 3 mm-thick discs. The pure samples and discs were also submitted to FTIR and XRD analysis.

Results: The silica grains size (1.8 nm) was measured through the Scherrer formula. XRD also confirmed the amorphous characteristic of the obtained silica, the presence of tetragonal zirconia in the initial Y-TZP powder, and pointed out that 1000 °C was sufficient to crystallize the amorphous silica without inducing the tetragonal-monoclinic transformation in zirconia. The FTIR analysis carried out in silica indicated a broad band at 1000–1200 cm^{-1} attributed to

the stretching vibration of Si–O–Si bonds, and the 961 and 800 cm^{-1} bands attributed to Si–OH groups. The FTIR analysis conducted in Y-TZP showed bands at 550–650 cm^{-1} due to the Zr–O vibration. It was not verified in another band associated with the chemical bond between the silica and Y-TZP, however, the presence of Y-TZP alters the stability of some vibrational modes of the pure silica. For the experimental glass-ceramic, the bands 1065 and 960 cm^{-1} joined and an intensity increase in the band *circa* 800 cm^{-1} was noticed. These changes must be associated with the formation of ceramics.

Conclusions: Hence, it is possible to conclude that the modified Stöber method is efficient at producing nanoscaled amorphous silica, the processing method to create a new glass-ceramic was able to crystallize the silica without altering the allotropic phase of Y-TZP, and no bond between silica and Y-TZP was seen in the experimental glass-ceramic.

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P8

Dry-bonding with dimethyl sulfoxide pretreatments to reduce collagen degradation

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Purpose/aim: To evaluate the effect of dry-bonding and wet-bonding protocols with dimethyl sulfoxide (DMSO) dentin pretreatments on the host-derived enzymatic activity and immediate bond strength of dentin.

Materials and methods: Etched dentin surfaces from sound molars were randomly bonded in dry- or wet-conditions with no dentin pretreatment (control), DMSO/ethanol or DMSO/H2O pretreatments using a three-step (Adper Scotchbond Multi-Purpose, 3 M ESPE: SBMP) etch-and-rinse adhesive. Bonded teeth ($n = 8$) were stored in distilled water (37 °C/24 h) and sectioned into resin-dentin sticks (0.8 mm^2) for microtensile bond strength test. Extra teeth ($n = 2$) followed the same bonding protocols except that FITC-conjugated collagen was actively applied for 60 s on etched-dentin after DMSO-treatments and the SBMP primer was doped with Rhodamine B for qualitative confocal in situ analyses after 7 days at 37 °C days in calcium- and zinc-containing artificial saliva. Demineralized dry and wet powdered dentin, from human teeth were incubated in the tested DMSO media for 7 days at 37 °C and a hydroxyproline assay was used to evaluate the dissolution of collagen peptides ($n = 5$). Microtensile data was analyzed by two-way ANOVA and Tukey Test and hydroxyproline data by Kruskal–Wallis one-way ANOVA on ranks and Dunn's multiple comparison tests ($\alpha = 0.05$).

Results: DMSO solutions were effective to reduce both hydroxyproline release from demineralized dentin ($p < 0.05$) and collagenolytic activity in the hybrid layer. Additionally, DMSO pretreatments improved immediate dentin bonding effectiveness of dry dentin producing higher bond strengths than conventionally wet-bonded control groups ($p < 0.05$).

Conclusions: The proposed DMSO bonding protocols significantly reduced the collagen degradation and improved the bonding performance of the tested multi-step etch-and-rinse adhesive to air-dried dentin beyond the conventional wet-bonding technique. This new approach could improve the technique sensitivity of etch-and-rinse adhesives and reduce the collagen degradation at the hybrid layers.

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Marshalls Award Finalists

M1

DCPD-containing composites prevent secondary caries: An in-vitro biofilm model

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Purpose/aim: The aim of this study was to evaluate the ability of dicalcium phosphate dihydrate (DCPD) filler-containing resin-based composites (RBC) to prevent secondary caries formation using two in vitro models of cariogenic biofilm challenge.

Materials and methods: Eight sound human molars had their root removed 3 mm apical to cement-enamel junction, and the pulp chamber filled (Majesty ES-2, Kuraray, Japan). Four Class II cavities were made in each tooth having cervical margin in dentin. Cavities were filled with: a conventional resin-modified glass ionomer cement (RMGIC, Ionolux, VOCO GmbH, Germany) or experimental RBCs having a BisGMA-TEGDMA resin blend and: 60 vol% Ba glass (RBC-0); 40 vol% Ba glass, 20 vol% DCPD (RBC-20); 20 vol% Ba glass, 40 vol% DCPD (RBC-40). Restorations were finished (diamond burs, silicon carbide papers), then specimens were sterilized, stored in artificial saliva for one week and randomly divided into 2 groups ($n = 4$/group) according to the biofilm model. Group 1: specimens were inserted in 6-well plates, and *Streptococcus mutans* biofilm formation on the specimens' surfaces was obtained in an orbital shaker (37 °C, 100 rpm) incubating in 1:25 diluted BHI + 5 wt% sucrose for two weeks. Culture broth was changed daily. Group 2: specimens were inserted into the flow-cell of a continuous flow bioreactor (37 °C, 20 ml/h), and *S. mutans* biofilm formation on the specimens' surfaces was obtained incubating in 1:25 diluted BHI + 5 wt% sucrose for two weeks. pH values of the culture broth and absence of contamination were checked daily in both groups. Before and after microbiological procedures, specimens were scanned using microCT

Table 1 – Mean demineralization depth (μm ± 1 SD) of the tested specimens according to the microbiological models. Different superscript letters indicate significant differences between materials (Tukey test, $p < 0.05$).

Material	Group 1		Group 2	
	Margin	Margin + 1.0 mm	Margin	Margin + 1.0 mm
RBC-0	146.8(28.7)^{a,b}	132.8(12.5)^{a,b}	217.4(32.5)^{a}	156.4(21.0)^{a}
RBC-20	156.5(42.8)^{a}	108.8(11.6)^{b}	214.5(44.9)^{a}	163.4(29.8)^{a}
RBC-40	80.8(33.6)^{b}	144.8(4.6)^{a}	84.4(47.6)^{b}	157.9(58.1)^{a}
RMGIC	87.8(20.8)^{b}	125.5(25.4)^{a,b}	100.0(51.0)^{b}	176.8(60.9)^{a}

(Skyscan 1176, 9 μm resolution, 80 kV, 300 mA). Image reconstruction was performed, and demineralization depths (μm) were evaluated at the margins and at 1.0 mm from the margins.

Results: pH values stayed constant throughout the incubation time (Group 1: 4.2 ± 0.1; Group 2: 4.3 ± 0.1), and no contamination was observed. Dentin demineralization (no enamel demineralization) could be observed in all specimens. Significantly higher overall demineralization depth was found in specimens from Group 2 compared to Group 1. RBC-0 and RBC-20 showed secondary caries development, while RBC-40 and RMGIC showed a secondary caries prevention effect (Table 1).

Conclusions: Experimental RBC-40 is a promising bioactive material, able to prevent secondary caries in vitro, similarly to the control RMGIC material. The bioreactor model displayed secondary caries formation in a similar way as in vivo.

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M2

Novel strong graded high-translucency zirconias for broader clinical applications

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Purpose/aim: A glass/zirconia graded surface layer is known to effectively reduce and transfer the maximum tensile stress from the surface into the interior of 3Y-TZP structure, resulting in increased load-bearing capacity. We hypothesize that this effect can be replicated on high cubic content zirconias (4Y- and 5Y-PSZ). Should surface glass-infiltration increase the load-bearing capacity of the weak cubic containing zirconias, a wider range of clinical indications can be realized.

Materials and methods: Three dental zirconias were used: 3Y-TZP (3Y), 4Y-PSZ (4Y), and 5Y-PSZ (5Y). For each material, 40 discs were fabricated and assigned to Graded (G) and Homogeneous (non-graded) groups. For Graded samples, glass-infiltration was carried out using a standard enameling technique: samples were first pre-sintered (1350 °C for 1 h). Then, an in-house developed glass was applied to the surface, and glass-infiltration was carried out along with sintering. The sintering conditions for both Graded and Homogeneous groups were: 3Y at 1530 °C for 2 h, and 4Y and 5Y at 1450 °C for 2 h. Discs (□12 × 1 mm) were then subjected to a free-standing piston-on-3-balls test ($n = 10$), representing the bending stresses the material experiences in a multi-unit bridge. Or, they were subjected to a Hertzian test ($n = 10$) with discs bonded to a dentin-like substrate (G10), replicating an adhesively bonded restoration. Composite-beam theory and plate-on-foundation theory, respectively, corroborated the two test scenarios. Optical, compositional, and microstructural characterization were also performed (Fig. 1).

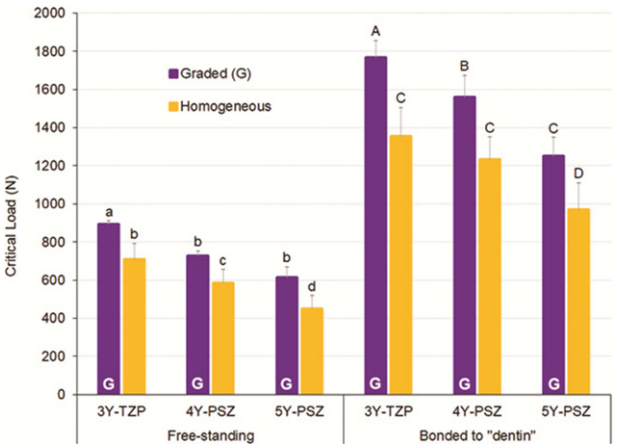

Fig. 1 – Comparative critical load to fracture for 1 mm thick graded and homogeneous (non-graded) zirconias in free-standing mode (bridge scenario) and bonded to a dentin-like substrate (minimally invasive scenario). Different lower-case and upper-case letters indicate statistical differences observed by the one-way ANOVA and Tukey test ($\sigma = 0.05$) and $\beta = 1$) for both free-standing and "dentin"-bonded results, respectively.

Results: The load-bearing results in the free-standing test are (N): G3Y = 892 (19); 3Y = 708 (83); G4Y = 726 (27); 4Y = 585 (72); G5Y = 613 (55); 5Y = 448 (70), showing a significant increase in load-bearing capacity (24–37%) for graded zirconias compared to their homogeneous counterparts. In accordance with the composite-beam theory, maximum tensile stress is reduced and transferred to a transitional region between graded layer and dense zirconia core. Graded zirconias bonded to a dentin-like substrate also show an increase in load-bearing capacity (27–30%), as follows (N): G3Y = 1768 (89); 3Y = 1355 (149); G4Y = 1559 (113); 4Y = 1232 (120); G5Y = 1249 (98); 5Y = 970 (140). Both graded high-translucency zirconias (G4Y and G5Y) achieved similar load bearing capacity to that of traditional dental 3Y-TZP, regardless of whether it was fractured in free-standing or bonded modes.

Conclusions: Graded zirconias can withstand ~30% more bending load than their homogeneous counterparts. This significant improvement makes both high-translucency zir-

Table 1 – Mechanical properties of the materials compared in this study. Mean values followed by same letters denote non-significant differences according to Tukey's test ($p < 0.05$).

CAD/CAM materials	Flexural strength (MPa)	Fracture toughness (MPa$\sqrt{m}$)	Crack-tip stress intensity (K_{tip})	Bridging stress intensity $K_{br} = K_{IC} - K_{tip}$
e.max CAD	383^{A}	2.1^{A}	0.41	1.69
Suprinity	251^{B}	1.5^{B}	0.35	1.15
Lava Ultimate	173^{C}	1.2^{C}	–	–
Enamic	121^{D}	1.1^{C}	0.24	0.86
Vitablocs Mark II	103^{D}	1.1^{C}	0.55	0.55

conias (4Y and 5Y) as durable as homogeneous 3Y-TZP. Thus graded high-translucency zirconia can fulfill the same clinical applications as those of traditional dental 3Y-TZP.

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M3

Damage tolerance in CAD/CAM restorative materials

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Purpose/aim: CAD CAM materials are brittle in nature and thus are prone to failure from flaws that may have been formed during milling or developed during their service lifetime. Accordingly, in order to design new and improved restorative materials, a good understanding is needed of their damage tolerance properties. The aim of this study was to investigate the damage tolerance properties of the newly developed CAD/CAM ceramics with emphasis on the mechanisms of crack propagation and the role of microstructure in toughening.

Materials and methods: Five commercially available CAD CAM materials with different microstructures, reinforced glass (Vitablocs Mark II), glass-ceramics (e.max CAD, Ivoclar-Vivadent; Suprinity, VITA) and hybrid materials (Enamic, VITA; Lava Ultimate, 3M ESPE), were investigated in this study. The latest materials are the hybrid material Enamic and, the glass-ceramic Suprinity. Rectangular bar shaped specimens ($16 \times 2 \times 2$ mm) were prepared for flexural strength (FS). Single edge V-notch beam (SEVNB) samples ($16 \times 4 \times 3$ mm) were prepared for fracture toughness (FT). Three-point bend testing was performed using a universal testing machine at a speed of 0.5 mm/min until fracture. FS was calculated using simple beam theory. FT (KIC) was calculated according to the standard stress intensity factor equation for the SEVNB geometry. The results were compared by two-way ANOVA and Tukey's multiple comparison test ($p < 0.05$). The crack-tip stress intensity (Ktip) was determining from crack-tip opening displacement (COD) measurements of scanning electron microscopy (SEM) images of cracks emanating from Vickers hardness indentations. The results were plotted the measured CODs versus the displacements computed using an analytical solution. The slope of the linear relationship was defined as the Ktip. SEM of crack paths and fracture surfaces was performed to determine the micromechanisms of fracture and toughening.

Results: The results presented in Table 1, showed that e.max CAD is the strongest CAD/CAM ceramic available today. The lowest strength correlates with considerable glassy phase for Enamic and Vitablocs Mark II. Glass ceramics have significant higher toughness ($p < 0.05$). The hybrid materials, Enamic and Lava Ultimate reached fracture toughness values comparable ($p < 0.05$) to those of the feldspathic ceramic Mark II. Crack tip toughness, Ktip, is only 0.24–0.55 MPa$\sqrt{m}$ compared to KIC = 1.1–2.1 MPa$\sqrt{m}$.

Conclusions: Crack bridging and crack deflection are the key toughening mechanisms for good properties in these CAD/CAM ceramics. Newer hybrid and zirconia containing microstructures need more development to compare with traditional e.max CAD glass ceramic.

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