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THURSDAY POSTERS 05TH OCTOBER 2017

1. Laser-Activated Bleaching Effect on Intracoronar Dentin Chemical Stability and Morphology. **F.C. Lopes**^{*1}, R. Roperto², A. Akkus², O. Akkus³, R.G. Palma-Dibb¹, M.D. Sousa-Neto¹ (¹Department of Restorative Dentistry, School of Dentistry of Ribeirão Preto, University of São Paulo, Brazil; ²Department of Comprehensive Care, School of Dental Medicine, Case Western Reserve University, USA; ³Department of Mechanical and Aerospace Engineering, Case Western Reserve University, USA).
2. Superior Hardness of UDMA Dentures over PMMA Dentures. **I. Alabdulla**^{*}, M.J. German, J.M. Thomason (Newcastle University, UK).
3. Analysis of Monomer Elution from CAD/CAM Hybrid Ceramics Using HPLC. **R. Alamoush**^{*}, J.S. Satterthwaite, N. Silikas (School of Dentistry, University of Manchester, Manchester, UK).
4. Degree of Conversion and Microhardness Mapping Within a Resin-Matrix Composite. **A.O. Al-Zain**^{*1,2}, G.J. Eckert³, H. Lukic⁴, S. Megremis⁴, J.A. Platt¹ (¹Indiana University School of Dentistry, USA, ²King Abdulaziz University, Faculty of Dentistry, Kingdom of Saudi Arabia, ³Indiana University, School of Medicine, USA, ⁴Research and Laboratories, American Dental Association Division of Science, USA).
5. Effect of Grinding and LTD on SCG of Zirconia. **M. Amaral**^{*1}, I.S.S.L. Weitzel¹, T. Silvestri², L.F. Guilardi², G.K.R. Pereira², L.F. Valandro² (¹University of Taubaté, Brazil, ²Federal University of Santa Maria, Brazil).
6. Ultrafine Ceramic Restoration Behavior Under Fatigue Bonded in Posterior Teeth. **F.O. Abu-Izze**^{*}, G.F. Ramos, L.C. Anami, M.A. Bottino (São Paulo State University - UNESP, Brazil).
7. Incorporating Compounds in Restorative Materials that Modify Streptococcus Mutans Virulence. **C.B. André**^{*1}, J.L. Ferracane², P.L. Rosalen¹, C. Pfeifer², B.M. Fronza, L.C. Galvão, M¹. Giannini¹ (¹Piracicaba Dental School, State University of Campinas, Piracicaba, Brazil; ²Oregon Health & Science University, Department of Biomaterials and Biomechanics, Portland, USA).
8. New Method for Depth Analysis of Y-TZP T-M Phase Transformation. **A. Arata**^{*1}, L.R. De Pretto¹, V. Ussui¹, N.B. Lima¹, A.Z. Freitas¹, J.P.B. Machado², R.N. Tango³, G.M. De Souza³, D.R.R. Lazar¹ (¹São Paulo University / Nuclear and Energy Research Institute, Br, ²National Institute for Space Research, Br, ³Science and Technology Institute of Universidade Estadual Paulista, Br, ⁴University of Toronto, Faculty of Dentistry, Ca).
9. Bulk-Fill Composite Modulates Specific Virulence Factors of S. Mutans Biofilm. **I.J.S. Araújo**^{*}, R.N. Stipp, R.M. Puppim-Rontani (Piracicaba Dental School, UNICAMP, Piracicaba, Br).
10. An Automated Method to Analyze Root Filling Voids and Gaps. **R.S. Assis**^{*1}, M. Brito-Júnior², R.D. Pereira¹, Y.T.C. Silva-Sousa¹, R.G. Silva¹, C.C.C. Araújo², M.D. Sousa-Neto¹ (¹School of Dentistry of Ribeirão Preto, University of São Paulo, Ribeirão Preto, Brazil; ²Montes Claros State University, Department of Dentistry, Montes Claros, Brazil).
11. Evaluation of Machinable Lithium Disilicate Glass Ceramic Block for CAD/CAM. **T.Azuma**^{*}, T.Kumagai, T.Sato, G.Mashio, T. Fujimoto, S. Akiyama, H. Yokohara, T. Hoshino, T. Miyake (GC Corporation, Research & Development, Tokyo, Japan).
12. Fracture Resistance of Translucent Zirconium-Dioxide Crowns with Different Semi-Monolithic Designs. **F. Bakitian**^{*1}, P. Seweryniak², E. Papias¹, C. Larsson¹, P. Vult Von Steyern¹ (¹Department of Materials Science and Technology, Faculty of Odontology, Malmö University, Malmö, Sweden, ²Commercial Dental Laboratory, Malmö, Sweden).
13. Wear and Fatigue Behavior of Monolithic Zirconia Crown Restorations. **S. Bano**^{*1}, M.R. Kaizer¹, M.B.F. Dos Santos², Y. Zhang¹ (¹Department of Biomaterials & Biomimetics, New York University, New York, USA; ²Federal University of Pelotas, Pelotas, Brazil).
14. Novel Glass-Ceramics Materials Characterization for Dental Applications. **G.H.B. Andrade**^{*1}, A. L. Valle¹, V.M. Sglavo², E.D. Zanotto³, M.O.C. Villas Boas³, V.O. Soares⁴, D. Cabiddu² (¹University of São Paulo, Bauru School of Dentistry, Bauru, Brazil, ²University of Trento, Department of Industrial Engineering, Trento, Italy, ³Federal University of São Carlos, Department of Materials Engineering, São Carlos, Brazil, ⁴State University of Maringá, Department of Science, Maringá, Brazil).
15. Biomimetic Agents can Slow Down Degradation of Caries-Affected Dentin-Resin Interfaces. **L.F. Barbosa-Martins**^{*1}, J.P. Sousa¹, A.K.B. Bedran-Russo², F.D. Nascimento³, R.M. Puppim-Rontani¹ (¹Piracicaba Dental School, University of Campinas, Brasil, ²University of Illinois at Chicago, Restorative Dentistry, USA, ³University of Mogi Das Cruzes, Center for Biomedical Sciences, Brasil).
16. Evaluation of Bond-Strength of Universal Adhesives after Thermal Cycling. **V. Barçal**^{*1}, V.B.C. Silva¹, P.H. Freitas^{1,2}, R. França², M. Giannini¹, S. Consani¹ (¹Piracicaba Dental School of State University of Campinas, Br, ²University of Manitoba, Ca).
17. Arrabidaea Chica Incorporated Into a Total-Etch Adhesive: Influence on Bonding. B.N. Mendes¹, E.C. Bridi¹, C.P. Turssi¹, F.M.G. França¹, F.L.B. Amaral¹, M.A. Foglio², **R.T. Basting**^{*1} (¹São Leopoldo Mandic Dental School and Research Center, Brazil, ²University of Campinas, Brazil).
18. Shear Bond Strength of Lithium Disilicate Using various Adhesive Cement. M. Wen¹, M. Bebsch¹, **M.E.M. Kaaber**^{*2}, C. Salomon¹, R. França¹, (¹Dental Biomaterials Research Lab, University of Manitoba, Winnipeg, Canada; ²University of Ernst Mortiz Arndt Greifswald, Germany).
19. Monomeric and Oligomeric Enriched Proanthocyanidins Primers on Long-Term Dentin Adhesion. A.A. Leme¹, P.V.F. Braz¹, B. Aydin¹, R. Phansalkar², A. Casaclang¹, J. Mcalpine², S.N. Chen², G.F. Pauli², **A. Bedran-Russo**^{*1} (¹University of Illinois at Chicago, College of Dentistry, Chicago, USA; ²University of Illinois at Chicago, College of Pharmacy, Chicago, USA).
20. Phase Partitioning of Material Properties in Enamic. **R. Belli**^{*1}, L. Haunschild², A. Petschelt¹, T. Fey², U. Lohbauer¹ (¹University of Erlangen-Nuremberg, Dental Clinic¹, Germany, ²University of Erlangen-Nuremberg, Institute for Glass and Ceramics, Germany).
21. Antibacterial Activity of Endodontic Sealer Modified with Nanoparticles. L.T.S. Silva¹, K.Cogo-Muller², W.C.Brandt¹, L.M.P. Campos³, D.F.Parra³, M.Santos⁴, **L.C.C. Boaro**^{*1} (¹University Santo Amaro, Br; ²University of Campinas, Br; ³Ipen-USP, Br; ⁴University of São Paulo, Br).

22. Longitudinal Effect of Er: YAG Laser on Dentin Micromorphology and Bonding. L.T. Trevelin, B.T.F. Silva, **A.B. Matos*** (Department of Operative Dentistry at the School of Dentistry, University of Sao Paulo, Br).
23. Physicochemical Properties of Methacrylate Resin-Based Root Canal Sealers. **C.C. Borges***, Y.T.C. Silva-Sousa, F.C. Lopes, A.C. Silva-Sousa, R.G. Silva, I.M.V. Soares, M.D. Sousa-Neto (School of Dentistry of Ribeirão Preto, University of São Paulo, Ribeirão Preto, Brazil).
24. Resin Materials Containing Calcium Phosphate Nanoparticles Functionalized with EGDMA Derivatives. L.C. Natale, M.C. Rodrigues, Y. Alania, **R.R. Braga*** (University of São Paulo, Department of Biomaterials and Oral Biology, São Paulo, Brazil).
25. TiF⁴ Pretreatment Followed by Self-Etching Adhesive System: Nanomechanical Properties. **E.C. Bridi*¹**, A.A. Leme-Kraus², R.T. Basting¹, A.K. Bedran-Russo² (¹São Leopoldo Mandic Dental School and Research Center, Brazil, ²University of Illinois at Chicago, USA).
26. Microhardness of Gypsum Submitted to Different Methods of Pouring. **G. Bruzi*¹**, L.F. Pottmair², M.V. Martins², H.P. Maia², L.C.C. Vieira² (¹Federal University of Alfenas, Brazil, ² Federal University of Santa Catarina, Brazil).
27. Residual Stresses in Full-Arch Ceramic Prosthesis with Zirconia Framework. **R.A. Caldas*¹**, V.F. Reginato¹, V.A.R. Barão¹, M.F. Mesquita¹, A. Bacchi², R.L.X. Consani¹ (¹ Piracicaba Dental School, São Paulo, Br, ²Meridional Faculty, Passo Fundo, Br).
28. Mechanical Properties of Dental Enamel after Hybridization using Electrokinetic Flow. **H.L. Carlo*¹**, G.A. Gadelha², M.F.L. Moura², F.G. Carvalho¹, F.B. Sousa² (¹ Federal University of Juiz De Fora, Brazil, ²Federal University of Paraíba, Brazil).
29. Staining Solutions and Bleaching Agents: Enamel Microhardness and Roughness Effects. **N.R. Carlos***, F.L.B. Amaral, F.M.G. França, C.P. Turssi, R.T.Basting (São Leopoldo Mandic Dental School and Research Center, Brazil).
30. Flexural Strength of CAD/CAM and Pressed Novel Lithium Disilicate. **M. Carrabba*¹**, Y. Nagasawa², J. Julosky³, M. Ferrari¹(¹University of Siena, Department of Medical Biotechnologies, Siena, Italy, ²Meikai University, School of Dentistry, Sakado, Saitama, Japan, ³Clinic for Paediatric and Preventive Dentistry, School of Dental Medicine, University of Belgrade, Serbia).
31. In Vitro Effect of Chitosan Nanoparticles on Tooth Enamel Bio-corrosion. **F.G. Carvalho*¹**, R.C.S. França², R.A. Tibau², H.L. Carlo¹, R.L. Santos¹ (¹ Federal University of Juiz De Fora, Brazil, ²Federal University of Paraíba, Brazil).
32. Chlorhexidine-Containing Electrospun Nanofibers: Effect of Production Mode on Chlorhexidine Release. L.D. De Carvalho¹, B. Urbanetto Peres¹, H. Maezomo³, Y. Shen¹, M. Haapasalo¹, A.P. Manso¹, F. Ko² and **R.M. Carvalho*¹** (¹Faculty of Dentistry, University of British Columbia, Vancouver, Canada; ²Osaka University Graduate School of Dentistry, Osaka, Japan; ³Faculty of Materials Engineering, University of British Columbia, Vancouver, Canada).
33. Bond Strength of Zirconia to Pressed Veneering Ceramic: Microshear Test. P.H.C. Oliveira¹, J.F. Roulet², J.A. Rodrigues¹, **A. Cassoni*¹** (¹University of Guarulhos, Brazil, ²University of Florida, USA).
34. PEG effects on Ca⁺² Release from PLGA-Calcium Hydroxide-Loaded Nanoparticles. **B.I. Cerda-Cristerna***, S.D. Cabo-Araoz. (Universidad Veracruzana, School of Dentistry Orizaba-Córdoba, Río Blanco, México).
35. Fatigue Limit of Y-TZP Reinforced with Carbon Nanotubes. L.H. Silva¹, D.R.R. Lazar², V. Ussui², W. K. Yoshito², R.N. Tango³, R. Belli⁴, U. Lohbauer⁴, **P.F. Cesar*⁵** (¹ University City of São Paulo/UNICID, Brazil, ²Institute for Energetic and Nuclear Research/Ipen, Brazil, ³University of the State of São Paulo/UNESP, Brazil, ⁴Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany, ⁵University of São Paulo, Brazil).
36. Characterization and Cellular Response of ³D-Scaffold Functionalized with PLA Nanofibers. F.C. Vazquez-Vazquez¹, **D. Chavarria-Bolaños*²**, D. Villalobos-Vega², J. Vega-Baudrit³, A. Pozos-Guillén⁴, D. Masuoka-Ito⁵, M. Álvarez-Pérez¹ (¹Universidad Nacional Autónoma De México, CDMX, México; ²Universidad De Costa Rica, San José, Costa Rica; ³Centro Nacional De Alta Tecnología, Laboratorio Nacional De Nanotecnología, San José, Costa Rica; ⁴Universidad Autónoma De San Luis Potosí, San Luis Potosí, México; ⁵Universidad Autónoma De Aguascalientes, Aguascalientes, México).
37. Bond Strength of Calcium-Releasing Self-Adhesive Cement after Accelerated Aging. **L. Chen***, C. Gleave, B.I. Suh (Bisco Inc, Schaumburg, IL, USA).
38. Reciprocity Studies on Polymerization Properties of BiSGMA/TEGDMA based Composites. S.V. Palagummi¹, T. Hong¹, L. Jiang², E. Song¹, **M.Y.M. Chiang*¹** (¹National Institute of Standards and Technology, Gaithersburg, USA; ²West China College of Stomatology, Sichuan University, China).
39. Improvement of Physical Properties of MTA Incorporated by **ELP. J.-Y. Choi***, H.-J. Kim, C.-O. Lee, S. Oh¹, S.-Y. Kim (Department of Conservative Dentistry, Kyung Hee University, Seoul, Korea).
40. Effect of Acrolein-Based Primer as Collagen Cross-Linker on Dentin Adhesion. **A. Comba*¹**, T. Maravic¹, A. Mazzoni¹, M. Cadenaro², C. Nucci¹, N. Scotti³, L. Breschi¹ (¹DIBINEM, University of Bologna; ²University of Trieste, Italy; ³University of Turin, Department of Surgical Sciences, Dental School).
41. Bond Strength of a Self-Adhesive-Cement to a CAD-CAM Composite Block. **L. Cortines-Laxe*¹**, R. Aguiar², H. Costa², M.C. Andrade³, C.E. Sabrosa⁴ (¹Federal University of Juiz de Fora, Department of Dentistry, Governador Valadares, Brazil; Centro Federal de Educação Tecnológica Celso Suckow da Fonseca, Department of Mechanical Engineering and Materials Technology, Rio de Janeiro, Brazil; ³State University of Rio de Janeiro, Department of Materials Science and Technology, Nova Friburgo, Brazil; ⁴State University of Rio de Janeiro, Department of Dentistry, Rio de Janeiro, Brazil).
42. Polish Retention and Wear of Several Bulk Fill Composite Materials. B.D. Craig, T.D. Dunbar, K. Dede, **C. Thalacker***, J. Kittelson, (³M Oral Care Solutions, USA).
43. Effect of Radiotherapy on Endogenous Matrix Metalloproteinases of Restored Dentin. **S.R. Cunha*¹**, E.R. Fregnani², A.C. Aranha¹, A. Mazzoni³, L. Breschi³. (¹Department of Restorative Dentistry, School of Dentistry, University of São Paulo, Br, ²Department of Oral Medicine, Hospital Sírio Libanês, Br, ³Biomedical and Neuromotor Sciences Department, University of Bologna, It).

- 44.** Bulkfill Composites are affected by Low Power Density of Light. M. Strykowska¹, S. Kubanek¹, G. Burdzinski², J.W. Nicholson³, **B. Czarnicka***¹ (¹Department of Biomaterials and Experimental Dentistry, Poznan University of Medical Sciences, Poland; ² Quantum Electronics Laboratory, Faculty of Physics, Adam Mickiewicz University In Poznan, Poland; ³Bluefield Centre for Biomaterials, ^{67,68}Hatton Garden, London, UK and Dental Physical Sciences, Barts and the London School of Medicine and Dentistry, Queen Mary University of London, UK).
- 45.** Long-Term Bond Strength of Glass-Ceramic Treated with Acid Ceramic Primer. **M. De Goes***¹, F. Murillo-Gómez^{1,2} (¹Piracicaba Dental School, University of Campinas, Brazil; ²School of Dentistry-University of Costa Rica, San José, Costa Rica).
- 46.** Chelating Solutions Effect on Bond Strength in Irradiated Teeth. **F.G. Paiola***¹, F.C. Lopes¹, J.F. Mazzi-Chaves¹, R.D. Pereira¹, H.F. Oliveira², A.M. Queiroz¹, M.D. Sousa-Neto¹ (¹School of Dentistry of Ribeirão Preto, University of São Paulo, Brazil; ²Department of Internal Medicine, Faculty of Medicine of Ribeirão Preto, University of São Paulo, Brazil).
- 47.** Lack of 10-MDP Primers Neutralization by Zirconia. **D. De Paula***¹, A.D. Loguercio², a Reis², K. Yoshihara³, V.P. Feitosa^{1,4} (¹Federal University of Ceara, Brazil, ² State University of Ponta Grossa, Brazil, ³Center for Innovative Clinical Medicine, Okayama University Hospital, Japan, ⁴Paulo Picanço School of Dentistry, Brazil).
- 48.** Adhesion and Mechanical Properties of CAD-CAM Resin/Ceramic Hybrid Materials. **E.F. De-Castro***¹, V.L.B. Azevedo¹, G. Nima¹, O.W.S. De-Andrade², G.M.B. Ambrosano¹, F.A. Rueggeberg³, M. Giannini¹ (¹Piracicaba Dental School, State University of Campinas, Piracicaba, Brazil; ²National Service for Commercial Education, São Paulo, Brazil; ³Dental College of Georgia, Augusta University, Augusta, USA).
- 49.** Reactivity of Dental Silane Coupling Agents. **M. Dimitriadi***¹, G. Eliades (Department of Biomaterials, School of Dentistry, National and Kapodistrian University of Athens, Greece).
- 50.** In Vivo Color Stability in Composite Restorations: 12Month Results. **G.Dondi Dall'orologio***¹, F. Fazzi², R. Lorenzi² (¹University of Bologna, Bologna, Italy; ²Private Practice, Bologna, Italy).
- 51.** Evaluation of Gutta Percha-Sealer Interface Using SEM. **M. Eltair***¹, V. Pitchika, R. Hickel, J. Kühnisch, C. Diegritz (Department of Operative Dentistry and Periodontology, University Hospital, Ludwig-Maximilians-Universität München, Germany).
- 52.** Impact of Coloring/Fluorescence-Liquids and Aging on Fracture Resistance of Zirconia. **M.L.P.D. Engler***¹, C.F. Rafael², J. Mesquita-Guimarães³, B. Henriques³, P.F. César¹, A. Liebermann¹, C.A.M. Volpato² (¹ Ludwig-Maximilians University, Department of Prosthodontics, Munich, Germany; ²Federal University of Santa Catarina, Dentistry Department, Florianópolis, Brasil; ³Federal University of Santa Catarina, Materials Engineering Department, Florianópolis, Brasil; ⁴University of Sao Paulo, Biomaterials and Oral Biology Department, Sao Paulo, Brasil).
- 53.** Effect of Immersion Media on Color Stability of Bulk-Fill Composites. **U. Erdemir***¹, A. Ozsoy², M.M. Eren³, G.S aygi¹, E. Yildiz¹ (¹University of Istanbul, Faculty of Dentistry, Istanbul, Turkey, ²Medipol University, Faculty of Dentistry, Istanbul, Turkey, ³Kemerburgaz University, Faculty of Dentistry, Istanbul, Turkey).
- 54.** Simulation of Development of Internal Stresses within Zirconia FPD's. **A. Eser***¹, H. Renan², L. Chao¹, B. Jiang¹, S. Heintze¹ (¹R&D, Ivoclar Vivadent AG, Schaan, Liechtenstein; ²Cadferm (Suisse) AG, Aadorf, Switzerland).
- 55.** Influence of Nanotopography Implants on Biomechanical Parameters in Diabetes. **P.G.F.P. Oliveira***^{1,2}, P.G. Coelho¹, E.T.P. Bergamo¹, L. Witek¹, F.B. Bezerra², M.S.M. Soares², S.L.S. Souza ²(¹ New York University, Department of Biomaterials and Biomimetics, New York, USA; ²School of Dentistry of Ribeirao Preto, University of Sao Paulo, Ribeirao Preto, Brazil).
- 56.** Polymerization of Universal Adhesive: Effect of Enamel and Curing Light. **L. Fanfoni***¹, L. Breschi², M. Cadenaro¹ (¹University of Trieste, It; ²University of Bologna, It).
- 57.** Dissolution Behaviour of a Novel Sol-Gel Derived Phosphate Glass. **V. Farano***^{1,2}, K. Gritsch^{1,2,3}, P. Jackson⁴, M. Cresswell⁴, N. Attik², B. Grosgeat^{1,2,3}, J.-C. Maurin^{1,2,3} (¹Laboratoire Des Multimatériaux Et Interface, Université Claude Bernard Lyon, Lyon, France; ²Faculté D'Odontologie, Université Claude Bernard Lyon, Lyon, France; ³Service D' Odontologie, Hospices Civils De Lyon, Lyon, France; ⁴Lucideon Limited, Queens Road, Penkhull, Stoke-On- Trent, UK).

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- 58.** New Biomimetic Analog for Self-Etch Dentin Bonding and Remineralization. **V.P. Feitosa***^{1,2*}, M.E.M. Moura¹, D.M. De-Paula¹, M.V.S. Lemos¹, K. Yoshihara³, L.K. Rodrigues¹, S. Sauro^{1,4} (¹ Federal University of Ceara, Fortaleza, Brazil; ²Paulo Picanço School of Dentistry, Fortaleza, Brazil; ³Center for Innovative Clinical Medicine, Okayama University Hospital, Okayama, Japan; ⁴Departamento De Odontologia, University Ceu-Cardenal Herrera, Valencia, Spain).
- 59.** Hydrolytic Stability of Novel Methacrylamide Monomers for Dental Adhesives. W. Mbiya, O. Navarro, V. Huynh, **J.L. Ferracane***¹, C.S. Pfeifer (Oregon Health & Science University, Portland, USA).
- 60.** Physicochemical Characterization of DMLS Dental Implants. **C. Fiuza***¹, S. Fiuza¹, M. Aramfard², C. Deng², R. França¹ (¹Department of Restorative Dentistry, University of Manitoba, Winnipeg, Canada; ²Department of Mechanical Engineering, University of Manitoba, Winnipeg, Canada).
- 61.** Repair Bond Strength of Resin Composite to Various Restorative Materials. **S. Flury***¹, F.A. Dulla, A. Peutzfeldt, A. Lussi (Department of Preventive, Restorative and Pediatric Dentistry, School of Dental Medicine, University of Bern, Switzerland).
- 62.** Clinical Performance of Structurally Optimized Three-Unit Fiber-Reinforced Composite Bridge. **A. Fok***¹, Y. Chen², G. Sacco³ (¹ University of Minnesota, USA; ²National Cheng Kung University, Taiwan; ³ Università Degli Studi Di Bari Aldo Moro, Italy).
- 63.** Phase Characterization of Li-Si Systems using X-Ray Photoelectron Spectroscopy. M. Bebsch, A. Haimeur, **R. França***¹ (Department of Restorative Dentistry, University of Manitoba, Winnipeg, Canada).

64. Effect of Doxycycline-Containing 35% Phosphoric Acid on Dentin Bond Strength. **P.H. Freitas**^{*1,2}, C.B. Andre¹, B.M. Fronza¹, R. França², M. Giannini¹, S. Consani¹ (¹Piracicaba Dental School of State University of Campinas, Br, ²University of Manitoba, Ca).
65. Cells and Biomaterial for Bone Repair under Osteoporotic Conditions. **G.P. Freitas**^{*}, H.B. Lopes, A. Almeida, L.G. De Souza, S. Siéssere, M.M. Beloti, A.L. Rosa (School of Dentistry of Ribeirao Preto, University of Sao Paulo, Ribeirao Preto, Brazil).
66. Ceramic Occlusal Veneers– Influence of The Thickness in Fatigue Resistance. **M.S Freitas**^{*}, LN Baratieri, JK Bernardon, S Monteiro (Department of Operative Dentistry, Federal University of Santa Catarina, Florianopolis, Brazil).
67. Long-Term Bond Strengths of Novel Methacrylamide-Based Adhesives. **A. Fugolin**^{*}, A. Dobson, W. Mbiya, J. Ferracane, C.S. Pfeifer (Oregon Health & Science University, Restorative Dentistry, Portland, USA).
68. Evaluation of Zirconia Reinforced Mica Glass Ceramics for Veneering Zirconia. **S. Gali**^{*1}, K. Ravikumar², B.V. Sreenivasamurthy¹, B. Bikramjit² (¹Faculty of Dental Sciences, Ramaiah University of Applied Sciences, Bangalore, India; ²Laboratory of Biomaterials, Indian Institute of Science, Bangalore, India).
69. Physical Tests and Characterization for Experimental-Material to Use in Stereolithography. **K.G. Juárez**^{*1}, C.A. Morales-Zavala¹, C. Alvarez Gayosso¹, S. Espinosa-Matías² (¹ Facultad De Odontología, Universidad Nacional Autónoma de México (UNAM), México; ²Facultad De Ciencias, Universidad Nacional Autónoma de México (UNAM), México).
70. Differences in Spectral Absorbance of Esthetic Restorative Materials. E.F. Castro¹, V.L.B. Azevedo¹, **M. Giannini**^{*1}, B.C. Mendonça¹, O.S. Andrade², F.A. Rueggeberg³ (¹ State University of Campinas, Brazil; ² Senac University Center, Brazil; ³Augusta University, USA).
71. Manufacturing Process Influence on Co-Cr Base-Alloy Mechanical Properties. **X. Han**^{*1}, T. Sawada¹, R. Ebert², T. Wiest³, M. Kaiser³, J. Geis-Gerstorf¹, S. Spintzyk¹ (¹ University Hospital Tübingen, Section Medical Materials Science & Technology, Germany; ²Laser Add Center, Selb, Germany; ³Dentaurum, Ispringen, Germany).
72. Fatigue Resistance of CAD/CAM All-Ceramic Molar Crowns of Reduced Thickness. **S.D. Heintze**^{*}, M. Reinhardt, A. Peschke (Ivoclar Vivadent, Research & Development, Liechtenstein).
73. How to Optimize Curing Parameters for Resin-Based Composites? **T.G. Hollaert**^{*1}, O. Dewaele¹, G. Leloup¹, W.M. Palin², J.G. Leprince¹ (¹Université Catholique De Louvain, Brussels, Belgium, ² University of Birmingham, UK).
74. Curing Quality in Peripheral Zones of large Bulk-Fill Resin-Composite Fillings. **N. Ilie**^{*} and B. Luca (Dental School of the Ludwig-Maximilians-University, Munich, Germany).
75. Effects of Pre-Silanized Lithium-Disilicate Ceramic Contamination on Resin Bond Strength. **R.E. Ilkiu**^{*1}, J.C. Romanini-Junior¹, R.Y. Kumagai¹, C. Ely¹, R. Hirata², A.F. Reis¹ (¹UNG University, Br, ²New York University, USA).
76. Differences in Glossiness of Ceramics with Differing Polishing Methods. **A. Ishikawa**^{*} (Nippon Dental University Hospital, General Dentistry, Japan).
77. Antibiotic-Eluting Matrices for Treating Periodontitis -Biocompatibility Studies. **K.Z. Kantorski**^{*1}, M.C. Bottino², P.C. Passos¹, R. Barcelos¹, M.E. Burger¹, R.M. Maciel¹, C.C. Danesi⁴ (¹Federal University of Santa Maria, Brazil; ²Dept. of Biomedical and Applied Sciences, Division of Dental Biomaterials, Indiana University School of Dentistry, USA).
78. Evaluation of Gloss Retention of Indirect Composite after Toothbrush Abrasion. **H. Kato**^{*}, T. Ueno, T. Kumagai (GC Dental Co, Japan).
79. In-Vitro Evaluation of Mechanical Quality of Casted/Laser-Sintered Clasps for Removable Dentures. J. Schweiger, **A.E.C. Kauling**^{*}, K. Erdelt, J.F. Güth (Ludwig-Maximilians Universität, Munich, Germany).
80. Resin Infiltration Analysis into Carious Lesions by Optical Coherence Tomography. G.S.Galvão¹, **L.K. Siriani**^{*1}, B.T.F. Da Silva¹, L.T. Trevelin¹, A.Z. De Freitas², M.R.L. Simionato³, A.B. Matos¹ (¹Operative Dentistry Department at FOU SP, Br, ²Energetic and Nuclear Research Institute, Br; ³Biomedical Sciences Institute at USP, Br).
81. Salivary Esterases Modulate Biofilm Structures On Adhesive And Composite Resins. R. Hiers, P. Pai, **S.S. Khajotia**^{*} (University of Oklahoma Health Sciences Center, USA).
82. Synthesis and Characterization of Novel In-Situ Grafted Bioactive Dental Fillers. **H. Khalid**^{*1}, N. Hussain¹, A.S. Khan² (¹Interdisciplinary Research Centre In Biomedical Materials, Comsats Institute of Information Technology, Lahore Pakistan; ²Department of Restorative Dental Sciences, College of Dentistry, University of Dammam, Saudi Arabia).
83. Evaluation of Ions Release and pH of Fluoride-Based Bioactive Glass. H. Gul¹, S. Zahid², M. Kaleem¹, A.T. Shah², **A.S. Khan**^{*3} (¹ National University of Medical Sciences, Pakistan; ²Comsats Institute of Information Technology, Pakistan; ³College of Dentistry, University of Dammam, Saudi Arabia).
84. New Methodology in Dental Ceramic Sintering–The Decoupled Drying Process. **T. Klinke**^{*}, A. Quooss, R. Biffar (Greifswald University Hospital, Center of Oral Health, Department for Prosthodontics, Gerostomatology and Biomaterials, Germany).
85. Shear Bond Strength to Different Types of Zirconia Restorations. R. Hecht, G. Raia, B. Theelke, **T. Kuretzky**^{*} (³M Oral Care, ³M Deutschland GmbH, Seefeld, Germany).
86. High Temperature Silicization of Zirconia-Surface to Improve Veneering Strength. **K. Kvam**^{*}, (Nordic Institute of Dental Materials, NIOM, Norway, Oslo)
87. Effect of PWM-Controlled Light on the Polymerization Kinetics of Composite. **I.B. Lee**^{*}, C.H. Lee (School of Dentistry, Seoul National University, Korea).
88. Effect of Chitosan Solution as Irrigant on Dentin Surface. **V.L.C. Araújo**^{*}, R.G. Palma-Dibb, R.G. Silva (University of São Paulo, Brazil).

- 89.** Effects of Camphorquinone Concentrations on Resins Containing Diphenyliodonium Hexafluorophosphate. **A.F. Lima**^{*1}; D. Dressano²; M. Hadis³; W. Palin³; G.M. Marchi² L.S. Gonçalves⁴ (¹Paulista University, Sao Paulo, Brazil; ²Piracicaba Dental School, State University of Campinas, Piracicaba, Brazil; ³University of Birmingham, Birmingham, UK; ⁴Federal University of Rio Grande Do Sul, Porto Alegre, Brazil).
- 90.** Borosilicate Phase-Separated Glasses for GICs: Ion-Release under Acid Condition. **F. Lizzi**^{*1,2}, P. Jackson², I. Campbell², N. Attik³, C. Villat^{1,3,4}, B. Grosgeat^{1,3,4}, C. Goutaudier¹ (¹Université Claude Bernard Lyon, Lyon, France; ²Lucideon Inc., Stoke-On-Trent, UK; ³Faculté D'Odontologie, Lyon, France; ⁴Service D'Odontologie, Lyon, France).
- 91.** Bulk Fill vs Incremental Layering in Posterior Restorations: Systematic Review. **A.D. Loguercio**^{*}, Y.L. Gruber, R.T. Jitumori, T.E. Bakaus, G.M. Gomes, A. Reis (State University of Ponta Grossa, Brazil).
- 92.** Development of a Hoop-Strength Test for a Crown-Like Model Geometry. R. Belli¹, S. Csato¹, A. Petschelt¹, D. Klein², S. Tremmel², **U. Lohbauer**^{*1} (¹Friedrich-Alexander University Erlangen-Nuremberg (Fau), Research Laboratory for Dental Biomaterials, Erlangen, Germany; ²Friedrich-Alexander University Erlangen-Nuremberg (Fau), Institute for Mechanical Technology (KTMfk), Erlangen, Germany).
- 93.** Participation of ITGAV on Osteoblast Induction by Titanium with Nanotopography. **H.B. Lopes**^{*1}, D.M. Fantacini², G.P. Freitas¹, V. Picanço-Castro², D.T. Covas², C.N. Elias³, P.T. De Oliveira¹, A.L. Rosa¹, M.M. Beloti¹ (¹School of Dentistry of Ribeirao Preto, University of Sao Paulo, Ribeirao Preto, Brazil; ²School of Medicine of Ribeirao Preto, University of Sao Paulo, Ribeirao Preto, Brazil; ³Department of Biomaterials, Military Institute of Engineering, Rio De Janeiro, Brazil).
- 94.** Shrinkage Stress Control in Dental Composite by Polymerizable Stable Radical. **H. Lu**^{*}; D.M. Reid (Dentsply Sirona, Restorative SBU, Milford, USA).
- 95.** How TiO₂ Nanotubes Addition Affects Y-TZP and Resin-Based Materials Biocompatibility. **F.S. Lucena**^{*1}, P.N. Lisboa-Filho², R.C. Oliveira¹, A.F.S. Borges¹, A.Y. Furuse¹ (¹Bauru School University, University of São Paulo, Br, ² São Paulo State University, Br).
- 96.** Combination of Surface Treatments for Cementation of Zirconia Restorations. **N. Lümkmann**^{*}, M. Eichberger, B. Stawarczyk (Ludwig-Maximilians-University Munich, Dental School, Department of Prosthodontics, Munich, Germany).
- 97.** Clinical Effectiveness of Dentin Roughness in Non-Carious Cervical Lesions. **I. Luque-Martinez**^{*1}, M.A. Muñoz², S. Fuentes¹, A. Reis², A.D. Loguercio² (¹Universidad De Valparaiso, Chile, ²Universidade Estadual De Ponta Grossa, Brasil).
- 98.** Silica-Coating of Y-TZP before Final Sintering: Monoclinic Content. S.M. Salazar-Marcho², P.F. Cesar¹, **D.S. Manarão**^{*1}, J. Griggs² (¹University of São Paulo, Brazil, ²University of Mississippi Medical Center, USA).
- 99.** Effect of a Chlorhexidine-Based Adhesive on Dentin Hybrid Layer Stability. **T. Maravic**^{*1}, A. Comba¹, A. Mazzoni¹, M. Cadenaro², N. Scotti³, V. Checchi¹, L. Breschi¹ (¹Dibinem, University of Bologna; ²University of Trieste, Department of Medical Sciences; ³University of Turin, Department of Surgical Sciences, Dental School).
- 100.** Effect of the Resin Impregnation Technique for Enamel Micro-Crack. **T. Maseki**^{*}, T.Kawai, M.Maeno, Y.Nara (The Nippon Dental University, Tokyo, Japan).
- 101.** 3D Abrasion of Zirconia Posterior Bridge after 10 Years. **R.E. Matta**^{*}, S. Stelzer, W. Adler, M Wichmann, S Eitner, L. Wolf (University Clinic of Erlangen Nuremberg, Germany).
- 102.** Influence of Conservative Endodontic Access on Dental Color Stability. **J.F. Mazzi-Chaves**^{*}, I.M.V. Soares, F.A. Curylofo-Zotti, R.G. Palma-Dibb, M.D. Sousa-Neto (Department of Restorative Dentistry, School of Dentistry of Ribeirão Preto, University of São Paulo, Ribeirão Preto, Brazil).
- 103.** Endogenous Enzymatic Activity on Deciduous and Permanent Dentin. **A. Mazzoni**^{*1}, A. Comba¹, T. Maravic¹, M. Cadenaro², N. Scotti³, L. Breschi¹ (¹University of Bologna, Dibinem, Italy; ²Department of Medical Sciences, University of Trieste, Italy; ³Dental School, University of Turin, Italy).
- 104.** Effect of Etching Time on MMPs Activity and Radicular Bond-Strength. **R. Michelotto Tempesta**^{*1}, A. Comba², T. Maravic², A. Mazzoni², N. Scotti¹, L. Breschi² (¹Dental School, University of Turin, Italy; ²Dibinem, University of Bologna, Italy).
- 105.** Mechanical Properties of Y:ZP/TiO₂ Coated With Hydroxyapatite for Dental Implants. **R.B.P. Miranda**^{*1}, J. Marchi², V. Ussui³, D.R.R. Lazar³, W.G.J. Miranda¹, P.F. Cesar¹ (¹University of São Paulo, Brazil; ²Federal University of ABC, Brazil; ³Nuclear and Energy Research Institute, Brazil).
- 106.** Antibacterial Activity and Flexural Strength for Experimental Composites with Graphene. **M. Moldovan**^{*1}, C. Prejmerean¹, D. Prodan¹, L. Slilaghi Dumitrescu¹, R. Carpa¹, S.Pruneanu², C.Sarosi¹ (¹Babes Bolyai University, Cluj-Napoca, Romania ²National Institute for Research and Development of Isotopic and Molecular Technologies, Cluj-Napoca, Romania).
- 107.** NaOCl Pretreatment and ³Year Retention of Cervical Composite Restorations. M. Favetti¹, T. Schroeder¹, A.F. Montagner², **R.R. Moraes**^{*1}, T. Pereira-Cenci¹, M.S. Cenci¹ (¹Federal University of Pelotas, Brazil, ²Federal University of Santa Maria, Brazil).
- 108.** Resin Composite Restoration Survival: Preliminary Results on Systematic Review. **K.M.S. Moreira**^{*}, J. Puppini-Rontani, R.M. Puppini-Rontani (Piracicaba Dental School-University of Campinas, Brazil).
- 109.** Characterization of Lithium-Disilicate Ceramic Surface-Treatments via Contact-Angle Analysis. **M.B.P. Moreno**^{*}, F. Murillo-Gómez, M. De Goes (Piracicaba Dental School, UNICAMP, Brazil).
- 110.** Properties of Experimental Adhesive Containing Copper Oxides and Copper-Zinc Nanocomposites. **M.A. Munoz**^{*1}, I. C. Garin², A.L. Szesz³, A.D. Loguercio³, Luque-Martínez¹ (¹Universidad De Valparaiso, Chile; ²Pontificia Universidad Catolica De Valparaiso, Chile; ³Universidade Estadual De Ponta Grossa, Brazil).
- 111.** Effect of Acid-Etching Protocols on 3D Microstructure of Ceramic Materials. **F. Murillo-Gómez**^{*1,2}, R.G. Palma-Dibb³, M.F. De Goes¹ (¹Piracicaba Dental School-University of Campinas, Brazil; ²School of Dentistry, University of Costa Rica, San José-Costa Rica; ³Ribeirao Preto Dental School, University of Sao Paulo, Brazil).

112. Effect of Concentration of P-TSNa on Dentin Bond Strength. **H.N. Na**^{*1}, J.K. Yi¹, K.K. Choi², D.S. Kim², J.H. Jang² (¹Kyung Hee University Hospital at Gangdong, Department of Conservative Dentistry, Seoul, Korea, ²Graduate School of Dentistry, Kyung Hee University, Department of Conservative Dentistry, Seoul, Korea).

113. Bond Strength of Ceramic to Resin Composite for Core Build-Up. **Y. Nagasawa**^{*}, Y. Hibino, H. Shigeta, H. Nakajima (Meikai University School of Dentistry, Japan).

114. Effect of Home Whitening on Green Tea-Stained Composite Resin. **I. Nakanishi**^{*}, H. Setsu, K. Daijyu, I. Akiko (Nippon Dental University Hospital, General Dentistry, Japan).

115. Synthesis of Phosphate Based Bioactive Glasses. H.M.O. **Nasim**^{*1,2}, S. Ghafoor³, A.T. Shah¹, A.S. Khan⁴ (¹Interdisciplinary Research Centre In Biomedical Materials (IRCBM) Comsats Institute of Information Technology, Lahore, Pakistan; ²Department Science of Dental Materials, University of Health Sciences, Lahore, Pakistan; ³Department of Oral Biology, University of Health Sciences, Lahore, Pakistan; ⁴Department of Restorative Dental Sciences, College of Dentistry, University of Dammam, Saudi Arabia).

116. Differential Dentin Bond Strength of Bulk-Fill Composites in Class-I Cavities. **E.P. Beserra-Neto**^{*1}, J.S. Nojosa^{1,2}, L.V.B. Holanda¹, S. Sauro³, J.S. Mendonça², V.P. Feitosa^{2,4} (¹Dental School, Catholic University Center of Quixadá, Quixadá, Brazil; ²Federal University of Ceará, Fortaleza, Brazil; ³Dental Biomaterials, Departamento De Odontología, Facultad De Ciencias De La Salud, University Ceu-Cardenal Herrera, Valencia, Spain; ⁴ Research Division, Paulo Picanço School of Dentistry, Fortaleza, Brazil).

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117. Effect of Prolonged-Storage on Tensile Bond Strength of Adhesive Systems. **M. Noda**^{*}, N. Okada, M. Ito, R. Yagi, H. Sakurai, H. Shiga, A. Asano (Department of Conservative Dentistry, School of Dentistry, Iwate Medical University, Morioka, Japan).

118. Fractographic Analyses of Dentin. **M. Øilo**^{*1,2}, W. Yan², D. Arola² (¹University of Bergen, Norway; ²University of Washington, Seattle, USA).

119. Preparation of Nanocomposite Resin Block using the FPPI Method. **K. Okada**^{*1,2}, T. Kameya², H. Ishino², T. Hayakawa¹ (¹Department of Dental Engineering, Tsurumi University School of Dental Medicine, Yokohama, Japan, ²Kuraray Noritake Dental Inc., Tokyo, Japan).

120. Can Glass Ionomer Cements Inhibit Cariogenic Species? In Vitro Study. **N.A. Oliveira**^{*}, F.B. Andrade, I.F. Leão, S.K. Ishikiriyama, J.F.S. Bombonatti (Department of Operative Dentistry, Bauru School of Dentistry, University of São Paulo, Bauru, Brazil).

121. Adhesion of Resin-Resin and Resin-Lithium-Disilicate Ceramic: A Methodological Assessment. N. Al-Haj Husain, A. Alshihri, **M. Özcan**^{*} (Division of Dental Materials, University of Zurich, Zurich, Switzerland).

122. Hybrid Manufacturing of Metal Framework for Full Arch Dental Restoration. L. Ciocca¹, **C. Parisi**^{*1}, R. Meneghello², C. Monaco¹, P. Baldissara¹ (¹Department of Biomedical and Neuromotor Sciences, University of Bologna, Bologna, Italy; ²Université de Montréal, Montréal, Québec, Canada).

123. Effect of Radiotherapy on Resin Cements Bond Strength. **R.D. Pereira**^{*1}, P.A. Yamin¹, P.C. Saquy¹, H.F. Oliveira², A.M. Queiroz¹, M.D. Sousa-Neto¹ (¹School of Dentistry of Ribeirão Preto, University of São Paulo, Ribeirão Preto, Brazil; ²Faculty of Medicine of Ribeirão Preto, University of São Paulo, Ribeirão Preto, Brazil).

124. Thiourethane-Functionalized Fillers as Toughening Agents in Dental Composites. M.G.R. Da Silva¹; A.P.P.Fugolin³; A.R. Costa-Correr²; M.C. Erhardt¹; J.L. Ferracane³; **C.S. Pfeifer**^{*3} (¹Federal University of Rio Grande Do Sul, School of Dentistry, Brazil; ²University of Campinas, Piracicaba Dental School, Brazil; ³Biomaterials and Biomechanics, Oregon Health and Science University, USA).

125. Direct Measurements of Intra-Canal Circumferential Strains Created along the Post. **R. Pilo**^{*}, Z. Metzger, T. Brosh (Goldschleger School of Dental Medicine, Tel-Aviv University, Tel-Aviv, Israel).

126. Hydroxyapatite Ceramic Reinforced by ZnO/ TiO² Nanoparticles and TiO² Nanotubes. **L.A. Pires**^{*1}, R. Erbereli², O.P. Gomes³, P.N. Lisboa-Filho³, C.A. Fortulan², A.F.S. Borges¹ (¹Department of Operative Dentistry, Bauru School of Dentistry, University of São Paulo, Bauru, Brazil; ²Department of Mechanical Engineering, São Carlos School of Engineering, University of São Paulo, São Carlos, Brazil; ³Department of Physics, Faculty of Sciences, São Paulo State University, Bauru, Brazil).

127. One-Step Surface Conditioning of two Glass-Ceramics: Resin Bond Durability. **C. Prochnow**^{*1}, M. Prado¹, A.M.E. Marchionatti¹, V.F. Wandscher¹, P. Baldissara², L.F. Valandro¹ (¹Dept. of Restorative Dentistry, Federal University of Santa Maria, Brazil; ²Dept. Biomedical Sciences and Neuromotor, Alma Mater Studiorum University of Bologna, Italy).

128. S Mutans Virulence Decreased by a Novel Antimicrobial Monomer-Containing Composite. I.J.S. Araújo, A.B. Paula, R.C.B. Alonso, L. Mei, J.R. Taparelli, R.N.Stipp, **R.M. Puppini-Rontani**^{*} (University of Campinas, Br).

129. Biological, Physical and Chemical Properties of Chlorhexidine-Adding Commercial Infiltrant. **J. Puppini-Rontani**^{*}, V.B. Dainezi, L.T. Inagaki, A.B. De Paula, F. Miori-Pascon, L. Correr-Sobrinho, R.M. Puppini-Rontani (University of Campinas, Br).

130. Nanohardness of Dual-Curing Resin Cement Light-Cured through Nano Ceramic. G.G.M. Chraim¹, **R.Q. Ramos**^{*1}, G.C. Lopes¹, J.C. Hoepfner², A.A.C. Recco², S.H.Pezzin² (¹Federal University of Santa Catarina, Florianópolis, Brazil; ²Santa Catarina State University, Joinville, Brazil).

131. Moist vs Over-Dried: FE-SEM/TEM and µTBS Evaluation of Universal Adhesives. R.Y. Kumagai, **A.F. Reis**^{*} (Guarulhos University, Brazil).

132. Randomized Clinical Trials in Bleaching: Compliance with the Consort Statement. A. Reis¹, A.D. Loguercio¹, B.M. Maran¹, T.A. Hanzen¹, A.M. Paula¹, J. Perdigão² (¹State University of Ponta Grossa, Brazil; ²University of Minnesota, USA).

- 133.** Exploring Fatigue Limits of CAD/CAM Ceramic Endocrowns. **G.T. Rocca***, C.M. Saratti, R. Daher, R. Sedlacek, T. Suchy, A. Feilzer, I. Krejci (School of Dentistry, University of Geneva).
- 134.** Effect of Synergism of CQ-Amine and TPO on Physico-Chemical Properties of Experimental Bulk-Fill. **M.G. Rocha***, D.C.R.S. Oliveira, M.A.C. Sinhoreti, A.B. Correr (Piracicaba School of Dentistry, State University of Campinas, Brazil).
- 135.** Clinical Evaluation of Restorations with Ormocer or Methacrylate Based Materials. **C.R.G. Torres***, A.L.B. Jurema, M.Y. Souza, R.D. Nicolo, A.B. Borges (Sao Paulo State University – UNESP, Institute of Science and Technology, Department of Restorative Dentistry, Sao Jose Dos Campos, Brazil).
- 136.** Reliability and Failure Modes of Anterior Monolithic CAD/CAM Veneer. **J.C. Romanini-Junior*¹**, D. Bordin¹, A.F. Reis¹, V.P. Fardin², E.A. Bonfante², R. Hirata³, P.C. Coelho³ (¹University of Guarulhos, Brazil; ²University of Sao Paulo, Brazil; ³New York University of College Dentistry, USA).
- 137.** Graphene Induces Spontaneous Osteogenic Differentiation in vitro and in vivo. **V. Rosa*^{1,2}**, H. Xie¹ (¹Faculty of Dentistry, National University of Singapore, Singapore, ²Centre for Advanced 2D Materials and Graphene Research Centre, National University of Singapore, Singapore).
- 138.** Quantitative Assessment of Misfits of Dental Restorations via Strain Measurement. **S. Rues***, K.N. Bechtel, P. Rammelsberg, F.S. Schwindling (Department of Prosthodontics, University of Heidelberg, Germany).
- 139.** Conversion of Endodontic Sealer Modified with Nanoparticles Carrying Antibacterial Drugs. **L.K.F. Sanches*¹**, L.M.P. Campos², D.F. Parra², R.R. Braga¹, M. Santos¹, L.C.C. Boaro³ (¹University of São Paulo, Br; ²IPEN-USP, Br; ³University Santo Amaro, Br).
- 140.** Biaxial Flexural Strength of Bilayered Commercial Porcelain/Ce-TZP/A Disks. **T. Sawada***, C. Schille, S. Spintzyk, V. Wagner, E. Schweizer, J. Geis-Gerstorf (University Hospital Tübingen, Section Medical Materials Science & Technology, Germany).
- 141.** Assessment of Tooth-Composite Bond vs. Clinical Performance of Composite Restorations. **H. Schneider***, G. Schmalz, M. Häfer, C. Rüger, C. Köhler, R. Haak (University of Leipzig, Germany).
- 142.** Conversion and Color Stability of Luting Agents for Aesthetic Rehabilitations. R. Ribeiro¹, V.E. Salgado², L.M. Cavalcante^{1,2,3}, **L.F. Schneider*^{1,3}** (¹Veiga De Almeida University, Nucleous for Dental Biomaterials Research, Rio De Janeiro, Brazil; ²Salgado De Oliveira University, Niterói, Brazil; ³ Federal Fluminense University, Niterói, Brazil).
- 143.** Do GIC last longer than Resin (NCCL Restorations) A Meta-Analysis. **M. Schroeder*¹**, T.F. Boing², J.L. De Geus², L.M. Wambier², A.D. Loguercio², A.Reis², O.M.M. Gomes² (¹Department of Prosthodontics and Dental Materials, Universidade Federal Do Rio De Janeiro, Brazil; ²Department of Restorative Dentistry, State University of Ponta Grossa, Parana, Brazil).
- 144.** Retention of All-Zirconia Prosthesis Retained by Conical Crowns. **F.S. Schwindling*¹**, K.N. Bechtel¹, P. Rammelsberg¹, S. Rues¹ (¹ Heidelberg University Hospital, Germany).
- 145.** Curing Protocol Effect on Self-Adhesive Cement Adhesion to Radicular Dentin. **N. Scotti*¹**, A. Comba², R. Michelotto Tempesta¹, V. Ibbi¹, L. Breschi², M. Alovizi¹, E. Berutti¹ (¹Department of Surgical Sciences, Dental School Lingotto, University of Turin, Italy; ²DIBINEM, Alma mater Studiorum, University of Bologna, Italy).
- 146.** Effect of Er:YAG Laser Pulse width on Zirconia Bond Strength. **B.T.F. Silva***, L.T. Trevelin, P.F. Cesar, P.M. Freitas, A.B. Matos (University of Sao Paulo, Br).
- 147.** Mechanical Behavior of Endodontically Treated Teeth with Different Endocrowns Extensions. **Y. Silva-Sousa*¹**, E.A. Gomes¹, N.R. Dartora¹, M.B.C. Ferreira¹, I.C.M. Moris¹, A.O. Spazin², M.D. Sousa-Neto³ (¹University of Ribeirão Preto, Ribeirão Preto, Brazil; ²Meridional Faculty, Passo Fundo, Brazil; ³University of São Paulo, Ribeirão Preto, Brazil).
- 148.** Mercury Vapours Measurement during Amalgam Removal in Dental Clinic. **A. Krah-Sinan*¹**, M. Adou-Assoumou¹, F.K. Kouakou¹, M-C. Avoaka-Boni¹, D. Kpokpro² (¹University of Félix Houphouët, Côte D' Ivoire; ²JVE Côte D' Ivoire).
- 149.** Color Stability of Hybrid and Lithium Disilicate Ceramics Veneers. I.B.L. **Soares Rusu***, R.F. Rodrigues, C.A. Villavicencio-Espinoza, A.F.S. Borges, P.A.S. Francisconi (Bauru School of Dentistry, University of São Paulo, Bauru, Brazil).
- 150.** Biomimetic Remineralizing Agents Influence the Wettability of Artificial Caries-Affected Dentin. **J.P. Sousa*¹**, L.F. Barbosa-Martins¹, F.D. Nascimento², R.M. Puppini-Rontani¹ (¹University of Campinas, Piracicaba Dental School, Piracicaba, Brazil; ²University of Mogi Das Cruzes, Center for Biomedical Sciences, Mogi Das Cruzes, Brazil).
- 151.** Ultrasonic Activation Effect on Physicochemical Properties of Root Canal Sealers. M.D. **Sousa-Neto***, C. Zangirolami, F.C. Lopes, J.F. Mazzi-Chaves, A.C. Silva-Sousa, B.M. Crozeta, Y.T.C. Silva-Sousa (School of Dentistry of Ribeirão Preto, University of São Paulo, Ribeirão Preto, Brazil).
- 152.** Photo-Activated Dark Curing of Dimethacrylates. K. Kim¹, C. Musgrave², **J Stansbury*^{2,3}** (¹University of Colorado, Chemistry and Biochemistry, Boulder, Colorado, USA; ²University of Colorado, Chemical and Biological Engineering, Boulder, Colorado, USA; ³University of Colorado, School of Dental Medicine, Craniofacial Biology, Aurora, Colorado, USA).
- 153.** Novel Fast-Sintered Zirconia for Chair-Side Dentistry. **I. Suzuki***, A. Matsumoto, Y. Ito, Y. Yamada (Kuraray Noritake Dental Inc., Miyoshi, Japan).
- 154.** Microtensile Bond Strength of three Universal Adhesive Systems. T.S. Santos, **C.M.C. Taguchi***, M.S. Freitas, G.C. Lopes, S. Monteiro Jr (¹University of Santa Catarina, Dentistry, Brazil).
- 155.** Detection of Oral Bacterial Flora using DNA Array. **K. Takayama***, N. Sasabe, S. Hotta, K. Yokonuma, H. Funabashi and T. Kumagai (GC Corporation, Tokyo, Japan).
- 156.** Effect of Molding Temperature on Peeling Energy of Laminated Mouthguards. **G. Tanabe*¹**, T. Hata⁴, P.S. Tun¹, H. Churei¹, T. Wada², M. Uo², H. Takahashi³, T. Ueno¹, (¹Tokyo Medical and Dental Univ, Department of Sports Medicine/Dentistry, Tokyo, Japan; ²Tokyo Medical and Dental Univ, Department of Advanced Biomaterials, Tokyo, Japan; ³Tokyo Medical and Dental Univ, Department of Oral Biomaterials, Tokyo, Japan; ⁴Tokyo Medical and Dental Univ, Department of Gerodontology and Oral Rehabilitation, Tokyo, Japan).

- 157.** Fracture Resistance of Teeth Restored with Different Post-Cores Materials. **K.N. Teixeira**^{*1}, H.P. Maia¹, S. Monteiro Jr.¹, A. E. C. Kauling² (¹UFSC, Brazil; ²LMU, Germany).
- 158.** Effect of Zirconia Surface Pre-Treatments on Bonding to Composite Cement. **P. Thammajaruk**^{*1}, S. Buranadham², M. Guazzato³ (¹the University of Sydney, Department of Bioengineering, Sydney, Australia; ²Prince of Songkla University, Department of Prosthodontics, Songkhla, Thailand; ³the University of Sydney, Discipline of Prosthodontics, Sydney, Australia).
- 159.** Effects of Alcoholic and Acidic Drinks on Microhardness of Bulkfill-Composites. **M. Tiryaki**^{*1}, U. Erdemir¹, A. Ozsoy², S. Ozel Yildiz³, E. Yildiz¹ (¹Istanbul University, Faculty of Dentistry Dept. of Restorative Dentistry, Istanbul, Turkey; ²Medipol University, Faculty of Dentistry Dept. of Restorative Dentistry, Istanbul, Turkey; ³Istanbul University Faculty of Medicine Dept. of Biostatistics, Istanbul Turkey).
- 160.** Shark Fin Test Analysis: Thixotropic Behavior of Elastomeric Impression Materials. **K. Tzimas**^{*}, P. Gerasimou, K. Tolidis (Aristotle University of Thessaloniki, Department of Operative Dentistry, School of Dentistry, Greece).
- 161.** Evaluation of Propolis Dental Varnish against Streptococcus Mutans in Children. **L.A.R. Valadas**^{1,2*}, E.M. Rodrigues Neto¹, M.A.L. Lotif¹, S.G.C. Fonseca¹, F.O. Chagas¹, F.V. Fachine¹, C.B.M. Carvalho¹, M.A.M. Bandeira¹, M.M.F. Fonteles¹, P.L.D. Lobo¹ (¹Federal University of CEARA; ²Kings College of London).
- 162.** Fatigue-Failure-Load of Lithium-Disilicate Crowns Etched by Hydrofluoric Acid Concentrations. C. Prochnow¹, A.B. Venturini¹, L.F. Guillard¹, C.J. Kleverlaan², **L.F. Valandro**^{*1} (¹Dept. of Restorative Dentistry, Federal University of Santa Maria, Brazil; ²Dept. of Dental Materials Science, Academic Centre for Dentistry Amsterdam, University of Amsterdam and VU University Amsterdam, the Netherlands).
- 163.** Microstructure of Dental Cements from Small-Angle Scattering And X-Ray Tomography. **A. Viani**^{*}, K. Sotiriadis, I. Kumpová (Institute of Theoretical and Applied Mechanics As Cr, Centre of Excellence Telc, Czechia).
- 164.** Bonding of Universal Adhesives to Dentine: A First-Time user Outcome. **W.D. Vila**^{*1,2}, C.H. Dietrich^{2,3}, A.P. Manso², R.M. Carvalho² (¹Private Practitioner, Goiania, Brazil; ²University of British Columbia Dentistry, Oral Biological and Medical Sciences, Vancouver, Canada; ³Pontifical Catholic University of Parana, Curitiba, Brazil).
- 165.** Periodontal Pathogens Colonization on Resin Composite and Hybrid CAD/CAM Blocks. **G. Vourtsa**^{*1}, E. Tsitrou¹, M. Arsenakis², D. Sakellari³ (¹Aristotle University of Thessaloniki, Department of Operative Dentistry, Greece; ²Aristotle University of Thessaloniki, Department of Genetics, Development and Molecular Biology, Greece; ³Aristotle University of Thessaloniki, Department of Preventive Dentistry, Periodontology and Implant Biology, Greece).
- 166.** Biomechanical Properties of a Novel Bis-GMA-Free Fiber Reinforced Composites. **T. Wang**^{*1}, J. He², J. P. Matinlinna¹, K.E. Ahmed¹ (¹University of Hong Kong, Hong Kong Sar, Pr China; ²South China University of Technology, Pr China).
- 167.** Variables Influencing Development of Residual Stresses During Crystallization Firing. **M. Wendler**^{*1,2}, M. Goediker³, A. Petschelt¹, R. Belli¹, U. Lohbauer¹ (¹Dental Clinic, University of Erlangen-Nuremberg, Erlangen, Germany; ²Department of Restorative Dentistry, Faculty of Dentistry, University of Concepción, Concepción, Chile; ³Research and Development Department, Vita Zahnfabrik, Bad Saeckingen, Germany).
- 168.** Dental Resins affect differently the Expression of Chemokines and Chemokine-Receptors. M.C.R. Horta¹, **M. Yamauti**^{*2}, T.C.M. Sa^{1,2}, M.A. Lima¹, L.M.D. Magalhaes³, W.O. Dutra³, K.J. Gollob³, A.N. Moreira², C.S. Magalhaes², P.E.A. Souza¹ (¹Pontifícia Universidade Católica De Minas Gerais, School of Dentistry, Belo Horizonte, Brazil; ²Universidade Federal De Minas Gerais, Faculty of Dentistry, Belo Horizonte, Brazil; ³Universidade Federal De Minas Gerais, Instituto De Ciências Biológicas, Belo Horizonte, Brazil).
- 169.** Effect of ELP on Physical Properties of CPC. **S.Y. Yoon**^{*}, H.-J. Kim, S.-M. Shin, S. Oh, S.-Y. Kim (Kyung Hee University, Seoul, Korea).
- 170.** Influence of Saliva Contamination on Resin Bonding to Zirconia. **K. Yoshida**^{*1}, T. Sawase² (¹Nagasaki University Hospital, Clinic of Fixed Prosthodontics, Nagasaki, Japan; ² Nagasaki University, Graduate School of Biomedical Sciences, Department of Applied Prosthodontics, Nagasaki, Japan).
- 171.** Effects of Zirconia Nano-Filler on Mechanical Properties of Heat-Cured Denture Base. **S. Zidan**^{*}, N. Silikas, Julian Yates (School of Dentistry, University of Manchester, Manchester, UK).
- 172.** Self-Adhesive Resin Cements: Hygroscopic Expansion-Stress Impact on Ceramic Crown Integrity. M. Kirsten, R.E. Matta, R. Belli, M. Wichmann, A. Petschelt, U. Lohbauer, **J. Zorzin**^{*} (Dental Clinic, Friedrich-Alexander University Erlangen-Nürnberg, Germany).
- 173.** In Vivo low Thermal Degradation of Monolithic Zirconia Restorations. C. Wulfman¹, V. Koenig², N. Dupont², S. Bekaert², S Le. Goff¹, M. Eldafrawy², G. Martin², A. Vanheusden², **A. Mainjot**^{*2} (¹Faculté De Chirurgie Dentaire, Université Paris Descartes, Sorbonne Paris, France; ² Institute of Dentistry, University of Liège (Ulg) and University of Liège Hospital (Chu), Liège, Belgium).
- 174.** Chlorohexidine Enhances Antibacterial and Antifungal Activities of Maxillofacial Silicone Elastomer. **M. Hatamleh**^{*1}, A. Alnazzawi², H. Alzoabi³, D.C. Watts⁴ (¹Department of Oral and Maxillofacial Surgery, King's College Hospital, UK; ²Faculty of Dentistry, Taibah University, Saudi Arabia; ³Faculty of Medicine, Mu'tah University, Jordan; ⁴School of Dentistry, University of Manchester, UK).

Paffenbarger Award Finalists

P1. Fractal Analysis at Varying Locations on Clinically Failed Zirconia Implants. **K.S. Jodha**^{*1}, S.M. Salazar Marocho¹, S.S. Scherrer², Y. Duan¹, J.A. Griggs¹ (¹ University of Mississippi Medical Center, Biomedical Materials Science, Jackson, USA, ²University of Geneva, University Clinic of Dental Medicine, Division of Fixed Prosthodontics-Biomaterials, Geneva, Switzerland).

P2. From Blue to Red: New Photoinitiator Systems for Dental Materials. **D. Oliveira**^{*1}, M.R. Rocha¹, A.B. Correr¹, A.C. Silvino², M.A.C. Sinhoreti¹ (¹Piracicaba Dental School, State University of Campinas, Brazil; ²Professor Eloisa Mano Macromolecules Institute, Federal University of Rio De Janeiro, Brazil).

P3. Development and Evaluation of new Intracanal Formulation of Silver Nanoparticles. **A.C. Silva-Sousa**^{*1}, J.F.B. Bruniera¹, Y. Silva-Sousa¹, E.G. Stehling², M.G Lara², L.M.S. Castro-Raucci¹, A. Pitondo-Silva², C.E.S. Miranda¹ (¹University of Ribeirão Preto, Ribeirão Preto, Brazil, ²University of São Paulo, Ribeirão Preto, Brazil).

P4. Effect of Niobium Containing Bioactive Glasses in Pre-Osteoblastic Cell Behavior. **G.S. Balbinot**^{*1}, F.Visioli¹, A.S.Takimi², S.M.W.Samuel¹, F.M. Collares¹, V.C.B. Leitune¹ (¹Universidade Federal Do Rio Grande Do Sul, School of Dentistry, Brazil; ²Universidade Federal Do Rio Grande Do Sul, School of Engineering, Brazil).

P5. Characterization and Bioactivity of a Novel Paste Containing Nanoscale Medications. **M. Cuppini**^{*}, L.B. Mestieri, F.S. Grecca, S.M.W Samuel, V.C.B Leitune, F.M Collares. (Universidade Federal Do Rio Grande Do Sul, Conservative Dentistry, Porto Alegre, Brazil).

P6. Modification of Filler-Matrix Interphase of Restorative Composites Using Reactive Nanogels. **B. M. Fronza**^{*1}, M. Giannini¹, J. Stansbury² (¹State University of Campinas, Restorative Dentistry, Piracicaba, Brazil; ² University of Colorado, Craniofacial Biology, Aurora, USA).

P7. The Limits of Luting-Composite Photopolymerization through Indirect Restorative Materials. **C.M.F Hardy**^{*1,2}, S. Bebelman¹, M.A. Haddis³, WM Palin³, G. Leloup^{1,2}, J.G. Leprince^{1,2} (¹Louvain Drug Research Institute, Université Catholique De Louvain, Belgium; ² School of Dental Medicine and Stomatology, Université Catholique De Louvain, Belgium; ³School of Dentistry, University of Birmingham, UK).

P8. Regenerative Potential of Simvastatin-Loaded Nano-Fibrous Scaffolds with LPS-Stimulated Pulp Cells. **D.G. Soares**^{*1,2}, Z. Zhang², F. Mohamed², C.A. De Souza Costa¹, P.X. Ma² (¹Araraquara School of Dentistry/Unesp, Araraquara, Brazil; ²University of Michigan, Ann Arbor, USA).

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1

Laser-activated bleaching effect on intracoronal dentin chemical stability, morphology

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Purpose/aim: To evaluate the effect of bleaching with 35% hydrogen peroxide either activated or not by a 970 nm diode laser on the chemical stability and dentin surface morphology of intracoronary dentin.

Materials and methods: Twenty-seven slabs of intracoronary dentin specimens (3 × 3 mm) were distributed into



three groups (n=9), according to surface treatment: HP – 35% hydrogen peroxide (1 × 4'), DL – 970 nm diode laser (1 × 30"/0.8 W/10 Hz), HP + DL – 35% HP activated with 970 nm diode laser (1 × 30"/0.8 W/10 Hz leaving the gel in contact to the surface for 4' after activation). Three spectra from each fragment were obtained to calculate the mean intensity of peaks of inorganic component (a.u.), organic collagen content (a.u.), and the ratio of inorganic/organic content, before and after treatment. Analyses of the samples by confocal laser microscopy were performed to evaluate the surface roughness, percentage of tubules, perimeter and area percentage of tubules, before and after treatment. Data were analyzed by Kruskal–Wallis, Dunn's, and Wilcoxon test ($P < 0.05$) (Table 1).

Results: Data analysis showed that HP + DL did not change the inorganic content peaks (8.31 [29.78]) or the inorganic/organic ratio (3.37 [14.67]) ($P > 0.05$). Similarly, DL did not affect the chemical stability of the dentin surface ($P > 0.05$). However, HP significantly increased inorganic content peaks (10.87 [22.62]), as well as the inorganic/organic ratio (6.25 [27.78]) ($P < 0.05$). Regarding the morphological alterations, all surface treatments increase tubules exposure; HP treatment significantly increases perimeter and area percentage; and HP + DL increases surface roughness.

Table 1 – Median (interquartile interval) of inorganic content (arbitrary unit – a.u.), organic content (a.u.), inorganic/organic ratio roughness (μm), number of tubules (relative quantity), perimeter (μm) and area (μm^2) of tubules before and after treatment, alteration, difference percentage, and p value ($n = 10/\text{group}$).

	Before treatment	After treatment	Alteration	% difference [§]	P*
Inorganic content					
HP	1317.37 (373.75)	1498.40 (473.90)	163.20 (248.6)	10.87 (22.62) a	0.038
DL	1183.00 (425.05)	1225.00 (161.85)	9.80 (395.65)	0.86 (29.81) a	0.767
HP + DL	1124.40 (394.65)	1324.60 (543.90)	104.00 (295.10)	8.31 (29.78) a	0.051
Organic content					
HP	135.60 (22.25)	133.80 (21.55)	4.30 (19.00)	3.17 (14.24) a	0.515
DL	133.50 (24.75)	134.80 (12.00)	4.50 (23.75)	3.83 (20.04) a	0.260
HP + DL	140.70 (36.5)	155.00 (45.80)	9.00 (20.30)	6.40 (14.16) a	0.038
Inorganic/organic ratio					
HP	9.00 (2.10)	10.60 (3.20)	0.40 (1.20)	6.25 (27.78) a	0.021
DL	9.30 (2.95)	9.00 (1.15)	-0.30 (1.45)	-3.26 (14.05) a	0.375
HP + DL	8.50 (2.70)	8.70 (2.40)	0.00 (0.85)	3.37 (14.67) a	0.213
Roughness					
HP	0.083 (0.040)	0.100 (0.030)	0.005 (0.020)	4.505 (25.910) ab	0.106
DL	0.084 (0.030)	0.089 (0.070)	-0.003 (0.050)	-5.000 (43.63) a	1.000
HP + DL	0.079 (0.030)	0.1040 (0.130)	0.022 (0.150)	22.35 (173.220) b	0.011
Number of tubules					
HP	49.00 (93.5)	266.00 (77.00)	190.00 (133.50)	476.92 (1297.74) a	0.008
DL	56.00 (134.50)	224.00 (246.00)	109.00 (113.00)	202.70 (263.42) a	0.008
HP + DL	61.00 (75.00)	219.00 (97.50)	136.00 (63.50)	196.72 (921.36) a	0.008
Perimeter					
HP	4.75 (0.90)	5.61 (1.76)	1.03 (1.11)	25.54 (27.61) b	0.021
DL	4.95 (1.20)	6.06 (3.78)	1.07 (1.87)	11.76 (33.40) ab	0.051
HP + DL	5.29 (2.04)	5.06 (1.27)	-0.19 (1.87)	-3.65 (30.41) a	0.441
Area					
HP	0.77 (0.21)	1.02 (0.50)	0.21 (0.23)	34.23 (37.93) b	0.008
DL	0.85 (0.31)	1.31 (1.38)	0.25 (1.10)	23.62 (103.99) ab	0.110
HP + DL	0.96 (0.76)	0.91 (0.60)	-0.02 (0.75)	-2.31 (60.14) a	0.407

* P value to the Wilcoxon test.

§ Different letters indicate significant difference for the Dunn's test ($P < 0.05$).

Conclusions: Bleaching HP combined with DL offers an improvement in terms of intracoronal dentin surface protection, yielding better maintenance of dentin chemical stability and morphology.

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2

Superior hardness of UDMA dentures over PMMA dentures



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Purpose/aim: The vast majority of denture wearers clean their dentures using a brush. This brush leaves scratches on the surface that are retentive to plaque and *Candida albicans* predisposing for denture stomatitis. This scratching occurs as a result of the surface of commonly used denture base material, heat-cured polymethylmethacrylate (PMMA), being less resistant to wear. In this study, we compared the hardness of newly developed light-cured urethane dimethacrylate (UDMA)

denture base material with that of heat-cured and cold-cured PMMA.

Materials and methods: Disc specimens ($n = 10$, diameter = 20 mm, thickness = 5 mm) were made from heat-cured PMMA (HC, John Winter & Co. Ltd.), cold-cured PMMA (CC, John Winter & Co. Ltd.), and Eclipse (Dentsply International). HC and Eclipse samples were produced following manufacturer's instructions. CC specimens were fabricated using 2:1 g/ml mixing ratio and cured at 3 bar pressure for 15 min at room temperature (RT). After polishing, samples were stored in distilled water at RT for 2 days, and at 37 °C for 1 week, 1 month, and 3 months. Samples were tested before and after storage with Vickers hardness tester (Zwick Z 2.5, Zwick GmbH & Co., Ulm, Germany) under 200 g indentation load for 20 s dwelling time.

Results: Eclipse material was the hardest material at each time point ($P < 0.05$, ANOVA) with HC being harder than CC specimens, as in the table. Eclipse specimens' hardness did not significantly change over 3 months water storage ($P > 0.05$), while HC and CC exhibited significant differences in each individual material between different storage time points (Table 1).

Table 1 – Mean hardness values and SD at different storage intervals.

Material	Storage group	Vickers hardness [kgf/mm ²] mean (SD)
HC	Just produced	19 (0.7)
	2 days	19 (0.5) ^a
	1 week	18 (0.4)
	1 month	19 (0.6) ^a
	3 months	17 (0.3)
CC	Just produced	18 (1)
	2 days	16 (0.9)
	1 week	14 (0.7) ^b
	1 month	15 (1.1) ^b
	3 months	14 (1.1) ^b
Eclipse	Just produced	21 (1.4) ^c
	2 days	21 (1.1) ^{cd}
	1 week	20 (0.9) ^{cde}
	1 month	22 (0.9) ^{cdef}
	3 months	20 (1.4) ^{cdef}

Conclusions: Within the limitations of the current study:

- Eclipse is more resistant to scratching than HC within 3 months of water storage.
- Eclipse hardness are unaffected by water storage over 3 months.

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3

Analysis of monomer elution from CAD/CAM hybrid ceramics using HPLC



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Purpose/aim: Biocompatibility is an important property of the newly emerged hybrid ceramics as CAD/CAM blocks for indirect aesthetic restorations. However it is poorly explored in the literature, in particular, few data are available regarding monomer elution. The aim of this study was to assess monomer elution from CAD/CAM composite blocks compared to conventional indirect composite (used as a control) using high performance liquid chromatography (HPLC) after storage in different media for one month.

Materials and methods: Nine materials with different filler loading were tested: 6 CAD/CAM composite blocks and 3 conventional indirect resin-composites were tested. 45 samples were prepared with 10 × 10 × 3 dimensions. All specimens had standardised geometry, were highly polished and cleaned in an ultrasonic water bath. All samples were then immersed in 3 ml water, 75% ethanol/water solution (75% E/W), and artificial saliva and stored at 37 °C for 1 month. Monomer release in the storage media was quantified by high performance liquid chromatography. Data were analysed with one-way ANOVA, and Bonferroni post hoc test at $\alpha = 0.05$.

Results: No or minimal monomer was detected in the different storage media for the different hybrid ceramic materials tested. All monomers showed a variable extent of elution

Table 1 – The mean and standard deviation values of monomer elution after one month storage in 75%:25% (ethanol:water). Values with the same superscript letters/numbers represent non-significantly different groups for each individual monomer (Bonferroni post hoc test at significance level (α) of 0.05) [ND stands for not detected].

Material tested	UDMA conc (μg/ml)	TEGDMA conc (μg/ml)	BisGMA conc (μg/ml)
EN	3.1 (1.8) ^A	ND	ND
LV	ND	3.7 (0.08) ^a	ND
BC	ND	ND	3.2 (0.6) ¹
CS	7.3 (1.3) ^A	ND	ND
SH	5.7 (0.2) ^A	9.2 (0.49) ^a	ND
CMG	93.2 (3.3) ^B	ND	ND
GRA	60.2 (6.36) ^C	124.6 (11) ^b	67.9 (6) ²
TET	269.8 (32) ^D	ND	645.5 (75) ³
DK	No other ether ketone monomer detected		

into 75% E/W with significantly higher amounts than those detected in water and artificial saliva (Table 1). The amount of monomers detected in the conventional composites was significantly higher than those detected in hybrid ceramics.

Conclusions: The results confirmed that CAD/CAM composite materials (hybrid ceramics) have a comparable biocompatibility to CAD/CAM ceramics, as confirmed by minimal or no monomer release.

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4

Degree of conversion and microhardness mapping within a resin-matrix composite



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Purpose/aim: Investigate the relationship of an irradiance-beam-profile area from multiple light-emitting-diode (LED) curing-units on the degree of conversion (DC) and Knoop microhardness (KH) uniformity within a resin-matrix composite (RMC) at clinically relevant distances.

Materials and methods: A mapping approach was used to investigate the DC and KH within a nano-hybrid dual photoinitiator RMC (Tetric-EvoCeram bleaching shade XL) (5 × 5 × 2 mm). The radiant exposure was maintained (10–11J/cm²) by adjusting the curing time according to the manufactures instructions for the RMC used. DC was measured using micro-Raman Spectroscopy, and microhardness was measured utilizing a hardness tester. Specimens were cured using one of six LCUs; one quartz-tungsten-halogen, three multiple emission peak LED LCUs and two single emission peak LED LCUs at 2 and 8 mm curing distances ($n = 3$). Irradiance beam profile was generated from the LCUs investi-

Table 1 – Number of significant comparisons^a among the DC and KH measurement points of the RMC samples cured using the LCUs explored at 2 and 8 mm distances.

LCU type	LCU	Manufacturer	Number of significant comparisons			
			DC		KH	
			2 mm	8 mm	2 mm	8 mm
QTH Multiple emission peak LED	Optilux 401	Kerr, Orange, CA	212	150	155	60
	Bluephase Style	Ivoclar, Amherst, NY	162	224	85	481
	SmartLite Max	Densply, York, PA	101	159	54	115
Single emission peak LED	VALO Cordless	Ultradent, South Gordon, UT	194	205	233	105
	DEMI	Kerr, Orange, CA	149	194	221	149
	Demi Ultra	Kerr, Orange, CA	213	108	167	120

^a 3288 total comparisons from all measurements across each surface and depth/LCU/distance. Fewer significant differences indicate that a more consistent DC and KH values observed within the specimens for a LCU at any given distance.

gated using a camera-based beam profiler system combined with the corresponding power measurements obtained using an integrating-sphere/spectrometer assembly at 2 and 8 mm curing distances. ANOVA was used to analyze the effect of the LCU and distance on the DC and microhardness by depth for each measurement. Measurement points across each depth were analyzed using Repeated measure ANOVA. Correlations across multiple locations, and associations between beam uniformity from the LCUs with the corresponding measurements were calculated using linear mixed models and Pearson correlation coefficients.

Results: Non-uniform polymerization pattern was exhibited within the RMC and were significant at various locations and depths that did not follow a specific pattern (Table 1). DC mapping showed a non-uniform DC values distribution within the RMC specimens regardless of the LCU used or curing distance. For KH, specimens cured with the multiple emission peak LED LCUs demonstrated a gradual increase in KH values from the top to the bottom of the RMC unlike the single emission peak LED LCUs regardless of the curing distance. At 2 mm distance, the localized DC = 52.7–76.8% and KH = 39.0–66.7 kg/mm². At 8 mm distance, the localized DC = 50.4–78.6% and KH = 40.3–73.7 kg/mm². Light beam irradiance profiles were weakly correlated with the corresponding DC and KH measurements.

Conclusions: Beam profile from the LCUs explored did not seem to have a major influence on the localized polymerization discrepancies with respect to DC and KH of the RMC and curing distances investigated. Also, the area assessed from the LCUs explored did not result in uniform polymerization within the RMC investigated, which may potentially increase the risk of RMC fracture.

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5

Effect of grinding and LTD on SCG of zirconia



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Purpose/aim: The aim of this study was to investigate the slow crack growth behavior of zirconia ceramic after grinding with diamond bur and simulated LTD.

Materials and methods: Disk shaped specimens of Y-TZP were fabricated (15 × 1.2 mm) and after sintering were divided into 4 groups (n = 40): Ctrl – control group, no additional treatment; Ctrl/LTD – samples were submitted to LTD in autoclave (134 °C, 2 bar, 20 h); grinding (G) abrasion with diamond bur (3101 FF KG Sorenson, 25 μm grit); G LTD – grinding followed by LTD. Samples were evaluated regarding crystalline phase, deep of transformed layer, hardness and indentation toughness tests, and slow crack growth test in stress rates of 100, 10, 1 and 0.1 MPa/s (piston-o-three ball biaxial assembly). Strength and parameter “n” were calculated in each group.

Results: Ctrl presented absent of monoclinic phase, Ctrl LTD presented the highest content of monoclinic phase (81%). G and G LTD presented 12.3 and 59.9% of monoclinic phase respectively. Depth of transformed layer followed the same ranking. Vicker's hardness and fracture toughness were similar between groups (p = 0.595/p = 0.665). Ctrl presented the lowest strength values in all stress rates. Ctrl LTD presented the highest strength in all stress rates but the lowest “n” value – highest SCG behavior. G and G LTD presented similar “n” values, with G LTD presenting slightly lower strengths. Curves from graph of logarithmic function strength vs. stress rate show that every group presented decrease in strength as the stress rate decreased.

Conclusions: Samples without abrasion after sintering presented the highest strength values after degradation, but also the worst SCG behavior.

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6

Ultrafine ceramic restoration behavior under fatigue bonded in posterior teeth



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Purpose/aim: Restorations in thin thicknesses have been used as a form of minimally invasive clinical approach. The aim of this study was to compare hybrid and ceramic crowns according to the thickness of the posterior restoration under fatigue loading.

Materials and methods: To evaluate the fatigue behavior of these restorations, 60 standard preparations were machined in G10 resin, and 60 partial table top restorations of different thicknesses (0.5 and 1.0 mm) were machined. After scanning a master preparation in the model and scanning the restoration waxing, they were machined by Cerec 3 CAD/CAM system (Cerec v3.03; Syrona Dental Systems GmbH, Bensheim, Germany) in ceramic-based lithium silicate reinforced by zirconia (SUP – Suprinity Vita) and polymer-infiltrated ceramic (EN – Enamic Vita); both, Vita Zahnfabrik, Bad Sackingen, Germany). From each material, 15 sets of G10 preparations and respective restorations with thickness 0.5 or 1.0 mm were obtained, generating the four groups: SUP.5, SUP1, EN.5, and EN1. After finishing and polishing, the restorations were cleaned in an ultrasonic bath with isopropyl alcohol for 10 min. SUP restorations were crystallized according to the manufacturer's recommendations. The samples were then bonded to the G10 preparations using Panavia F 2.0 (Kuraray Noritake, Okayama, Japan). From the mean values of maximum load for compression fracture ($n=3$), the parameters for stepwise stress fatigue test were determined. The test evaluated the fatigue strength ($n=12$) of the restorations submitted to the load of 450 N during the mechanical cycles. By the number of mechanic cycles at 450 N required for the fracture of the specimens or considered the test suspended upon reaching 1.5×10^6 cycles. The presence of cracks and/or fractures was checked with interruption of the test and adequate light, and evaluated in a stereomicroscope every 5×10^5 cycles. The failure modes of all specimens were checked and representative samples were also evaluated in scanning electron microscopy.

Results: The comparison between the experimental groups by the Mantel-Cox statistic detected a statistically significant difference between the analyzed conditions (Log-Rank test, $X^2 = 11.2$, $df = 3$, $p = 0.0107 < 0.05$). EN1 survived longer than SUP.5, other groups were similar to all.

Conclusions: Thicker hybrid ceramic crowns survived more than thin ceramic ones.

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7

Incorporating compounds in restorative materials that modify streptococcus mutans virulence



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Purpose/aim: The objectives of this *in vitro* study were to evaluate the effect of the addition of two natural antimicrobial compounds derived from Brazilian propolis (Apigenin (A) and tt-Farnesol (T)) on the properties of resin composites (CO), resin cements (CE), and adhesives systems (Clearfil S3 Bond Plus – CS3; Optibond S – OPT); and on the virulence of *Streptococcus mutans* biofilm.

Materials and methods: A and T were added separately or in combination into CS3, OPT, CO and CE; and combined with fluoride (F) into CO and CE. Dry weight (DW), bacterial viability (BV), alkali soluble (ASP) and intracellular (IPS) polysaccharides were determined from *S. mutans* biofilms grown for five days on resin composites and resin cements disks, and on adhesive-coated hydroxyapatite disks. The A or T addition effects were analyzed by flexural strength (FS) and flexural modulus (FM) of CO and CE, dentin bond strength (BS) of CS3 and OPT, immediately and after one year of water storage, curing kinetics (CK) and polymerization rate (PR).

Results: The DW, IPS and ASP decreased when A, AT and ATF were added to CO and CE compared to the control group. DW decreased when A or AT were added to CS3 and when A or T were added to OPT. ASP decreased with the addition of A to CS3 and T to OPT. A or AT into CS3 decreased the IPS. No statistical difference was observed for BV, except when ATF was added to CE. No addition interfered with BS, FS and FM. OPT showed higher BS for both storage times. No BS reduction observed after one year of water storage for CS3. No difference was observed for CK and PR for either material tested.

Conclusions: The addition of A and T to CO and CE significantly decrease the amount of DW and polysaccharides of *S. mutans* biofilm, which may impair the *S. mutans* virulence, without suppressing the target organism. The addition of A or AT to CS3 showed better results, comparing to OPT, regarding the reduction of virulence of *S. mutans* biofilm.

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New method for depth analysis of Y-TZP t-m phase transformation



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Purpose/aim: The aim of this study was to validate the optical coherence tomography (OCT) as a nondestructive method of analysis to evaluate the depth of tetragonal to monoclinic (t-m) transformed zone and to calculate the kinetics of phase transformation of a monolithic Y-TZP after hydrothermal aging. Specifically, to compare the activation energy of t-m transformation calculated by the depth of the transformed zone using scanning electron microscopy (SEM) and OCT.

Materials and methods: Fully sintered (1450 °C/2 h) discs of dental Y-TZP (LAVA PLUS, 3M-ESPE) were aged in hydrothermal pressurized reactor to follow the phase transformation kinetics at 120 to 150 °C. Four samples per aging time were analyzed by OCT (OCP930SR, Thorlabs Inc.), $\lambda = 930$ nm, spectral bandwidth (FWHM) of 100 nm, nominal resolution of 6 μm (lateral and axial) in air, declared digital resolution 3.09 μm (axial). Three areas of 3 mm (lateral) were observed to calculate the phase transformation depth (Image J). X-ray diffraction analysis (XRD) were performed, Cu-K α , 20° to 80°, 2 θ . The data were refined using the Rietveld method (GSAS). The transversal section of one specimen of each group was submitted to backscattered SEM analysis to calculate the phase transformation depth (Image J). The speed of the transformation zone front was determined plotting the phase transformation depth versus aging time.

Results: XRD results indicated that Y-TZP that 66% is the maximum value of monoclinic phase concentration for all aged Y-TZP. The activation energy for the monolithic Y-TZP was 107.53 kJ/mol. One year and 5 years of hydrothermal aging at 37 °C will present approximately 4.21% and 15% of monoclinic phase, respectively. The comparison of the depth of the transformed zone using SEM and OCT were similar, showing a linear behavior and providing information that the opaque layer observed by OCT is related to the depth of the transformed zone (Fig. 1), any difference among the results could be a result of the refraction index correction. The energy of activation calculated by SEM and OCT were 114 kJ/mol and 100 kJ/mol, respectively. The speed calculated for the phase transformation into the bulk of the transformed zone estimated for 37 °C was 0.04 $\mu\text{m}/\text{year}$ (SEM) and 0.16 $\mu\text{m}/\text{year}$ (OCT).

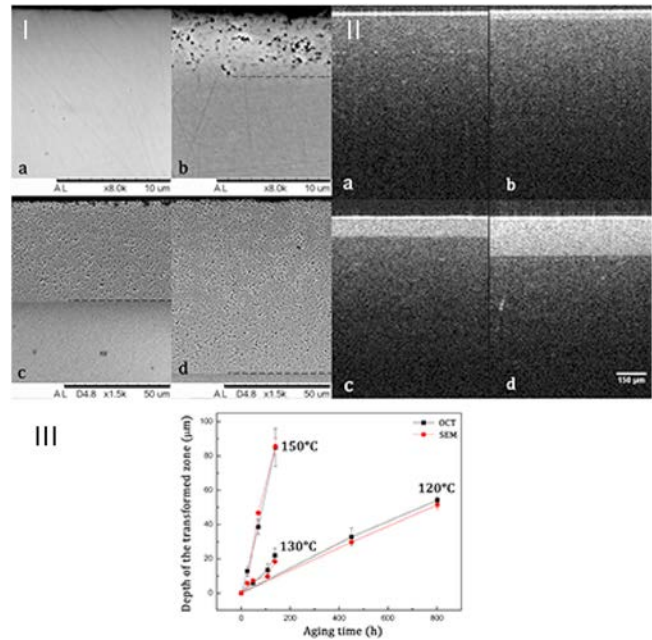


Fig. 1 – (I) SEM images comparing the depth of phase transformation zone after hydrothermal aging at (a) 0 h; (b) 25 h; (c) 70 h; (d) 140 h. (II) OCT images comparing the depth of phase transformation zone after hydrothermal aging at (a) 0 h; (b) 25 h; (c) 70 h; (d) 140 h. (III) Comparison between SEM and OCT data of the t-m phase transformation depth after aging as a function of hydrothermal aging time in different temperature.

Conclusions: The results indicate that activation energy values determined by SEM and OCT observations were similar allowing the use of the OCT as a tool for monolithic Y-TZP t-m phase transformation kinetic evaluation. Moreover, OCT method has the advantage of a shorter analysis time, without the need of sample preparation steps.

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9

Bulk-fill composite modulates specific virulence factors of *S. mutans* biofilm



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Purpose/aim: The aim of this study was to evaluate the effect of two bulk-fill composites in gene expression of *Streptococcus mutans* (*S. mutans*) at 24 h.

Materials and methods: Eighteen disks (4 × 2 mm) were prepared for each group: Filtek Bulk Fill (3M ESPE) and Tetric N Ceram Bulk Fill (Ivoclar Vivadent), experimental groups, and IPS e-MAX (Ivoclar Vivadent), control group. Following ceramic disks production, the composites disks were made in a laminar flow hood under aseptic conditions according to manufacturer's instructions. All the samples were sterilized by UV light and left into wells of a 24-well microplate. Medium

BHI was supplemented with 1% sucrose and *S. mutans* UA159 was inoculated in this broth. The biofilm was formed on disks' surface during 24 h using 1.5 ml of BHI with inoculum for each disk. Biofilm was collected and pellets ($n = 5$) were stored at -80°C . Then, RNA was purified by RNeasy Mini Kit and converted to cDNA with iScript cDNA Synthesis Kit. Gene expression analysis was performed using specific primers for the genes 16S (housekeeping), *gtfC*, *gtfD*, *covR*, and *vicR*. Data were analyzed by One-way ANOVA and Dunnett to comparison with control ($\alpha = 0.05$).

Results: There was no significant difference between groups for *gtfC* and *covR* expressions. However, the expressions of *vicR* and *gtfD* were down-regulated by Filtek Bulk fill when compared with IPS e-MAX and Tetric N Ceram Bulk fill.

Conclusions: In conclusion, we demonstrate that the substrate can modulate virulence factors of biofilm cells at molecular level.

<http://dx.doi.org/10.1016/j.dental.2017.08.010>

10

An automated method to analyze root filling voids and gaps



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Purpose/aim: This study evaluated the reasonability of an automated method to delimit the required area to quantitatively analyze root filling voids and gaps from cross-sectional confocal laser scanning microscopy (CLSM) images.

Materials and methods: Root canals of maxillary canine were biomechanically prepared with rotary instruments and filled by lateral compaction technique using gutta-percha and AH Plus sealer. The roots were stored (100% humidity, 37°C) for a period of 24 h and then sectioned transversally to obtain 2-mm-thick slices from the apical and middle thirds. The areas corresponding to filling materials, gaps and voids were manually delimited or automatically demarked by ImageJ software after images conversion to RGB color system. Based on manual and automatic delimitations, the percentages of voids and gaps were calculated. For both methods of area delimitation, data of voids and gaps between middle and apical thirds were individually compared by paired t-test. Pearson's correlation test was used to assess the correlation of data between the methods (Fig. 1).

Results: Irrespective the method to area delimitation, no difference was observed between the root thirds apical ($0.87 + 2.04$ and $0.92 + 2.07$ for manual and automatic method respectively) and middle ($1.61 + 1.81$ and $1.73 + 1.74$ for manual and automatic method respectively) for voids analyze. The same was observed for the presence of gaps in the apical ($1.00 + 1.17$ and $0.96 + 1.24$ for manual and automatic method respectively) and middle thirds ($0.85 + 1.31$ and $0.79 + 1.22$ for manual and automatic method respectively). Almost perfect

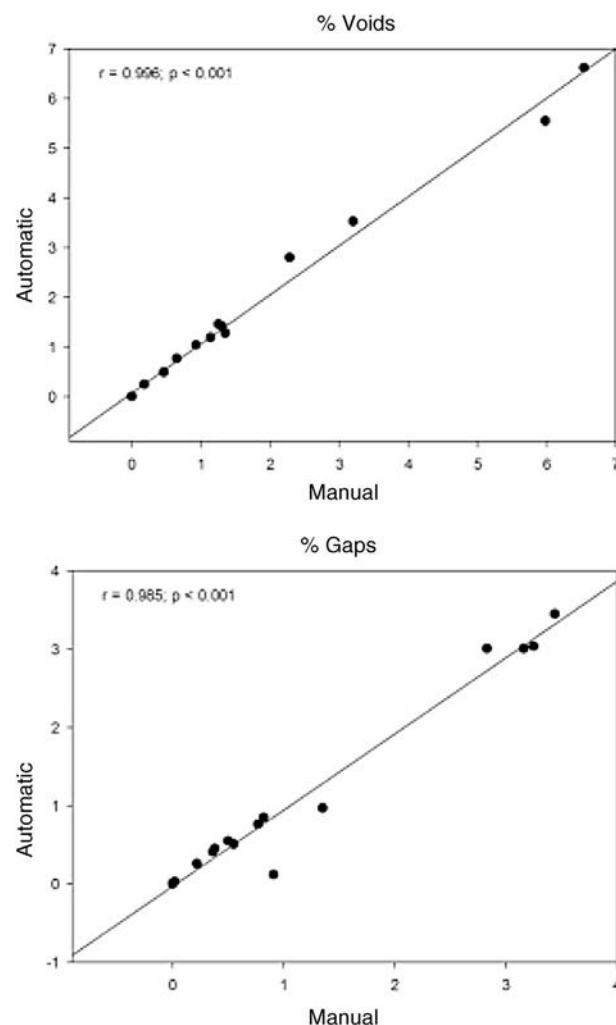


Fig. 1 – Pearson's correlation among the percentage of voids and gaps measured with manual or automatic area delimitation. Note the proximity of data (black points) from line corresponding to correlation between the methods used.

correlations between the methods were observed for voids ($r = 0.996$) and gaps ($r = 0.985$).

Conclusions: The proposed method to automatically delimit the areas corresponding to filling material, voids and gaps seems reasonable to facilitate the quantitative analysis of defects in root canal fillings using topographic CSLM images.

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11

Evaluation of machinable lithium disilicate glass ceramic block for CAD/CAM



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Purpose/aim: Today, lithium disilicate (LDS) based glass ceramic materials for chair-side CAD/CAM technology have become very popular because of its excellent physical and optical properties. However, 1-day appointment dentistry has not sufficiently spread among general practices due to time consuming heat-treatment for crystallization. The purpose of this study was to evaluate newly developed fully crystallized LDS glass ceramic material for CAD/CAM.

Materials and methods: The experimental LDS material (LiSi Block, GC Corp, MT-A3, LOT 1702151) and heat-treated e.max CAD (htEMCAD, Ivoclar Vivadent, LT-A2, LOT V13493) were prepared for this study. X-ray diffraction (XRD) analysis was performed to identify main crystal phase of both materials. Molar shape crown restorations were fabricated with CEREC MC XL (Sirona-Dentsply) and grinding times were measured. To confirm the possible clinical indications of LiSi Block, flexural strength and chemical solubility were determined following ISO6872: 2015, Dentistry – Ceramic materials.

Results: LDS was detected as main crystal phase from both materials. Clinically acceptable crowns were machined from LiSi Block with mean grinding time 15 min. Conversely, no crown was fabricated from EMCAD on account of significant damage of grinding burs. LiSi Block exhibited 448 MPa ($n=10$) and 8.8 g/cm^2 ($n=3$) in biaxial flexural strength and chemical solubility, respectively. These results indicate that LiSi Block conforms to Class 3 in ISO6872, namely this material is applicable for almost all clinical cases expected in chair-side CAD/CAM dentistry.

Conclusions: LiSi Block can demonstrate great physical and chemical properties without crystallizing heat-treatment, so that this material might be very promising to implement real 1-day appointment dentistry.

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Fracture resistance of translucent zirconium-dioxide crowns with different semi-monolithic designs



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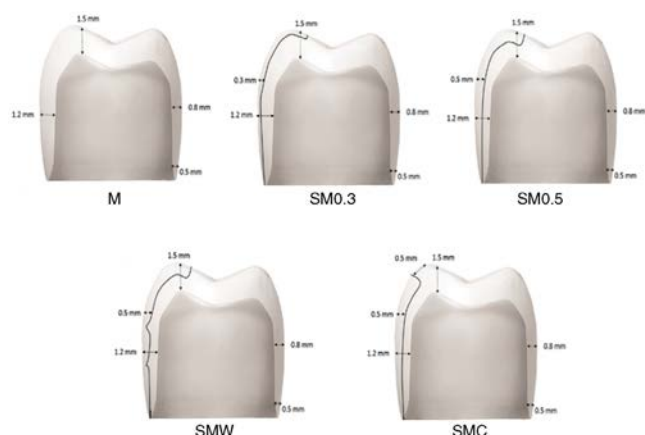
Purpose/aim: The use of semi-monolithic designs for translucent zirconia restorations is suggested as a way of overcoming the clinical limitations, in terms of veneer fracture and poor aesthetics, of traditional bi-layered and monolithic designs for zirconia. Therefore, the aim of the study was to describe and evaluate the fracture resistance of translucent and high-translucent zirconium-dioxide crowns with different semi-monolithic designs.

Materials and methods: One hundred zirconium-dioxide crowns were produced and divided as follows into five groups ($n=20$) according to five different designs: monolithic (control), semi-monolithic with 0.3 mm micro-coating buccal veneer thickness (SM0.3), semi-monolithic with 0.5 mm-buccal veneer thickness (SM0.5), semi-monolithic with 0.5 mm-buccal veneer thickness supported by a wave design (SMW), semi-monolithic with 0.5 mm-buccal veneer thickness supported by occlusal cap design (SMC). Each group was divided into two subgroups ($n=10$) according to the materials used, translucent and high-translucent zirconium-dioxide. All crowns were subjected to artificial aging: thermocycling and cyclic pre-loading. After aging, all crowns were loaded to fracture, and the load data were analyzed using two-way ANOVA test ($p < .05$).

Results: The results showed that there were significant differences among the groups depending on the different designs tested and the materials used ($p \leq .05$). Crowns made of translucent zirconium-dioxide generally showed significantly higher fracture load values compared to those made of high-translucent zirconium-dioxide, regardless of design ($p < .001$). Semi-monolithic crowns with a micro-coating porcelain layer withstood the highest fracture loads ($3702 \text{ N} \pm 312$) among the semi-monolithic crowns tested, close to the loads seen in the monolithic crowns ($3905 \text{ N} \pm 226$). Semi-monolithic crowns with 0.5 mm buccal veneer thickness showed significantly lower fracture loads ($2325 \text{ N} \pm 361$) in contrast to the crowns with same buccal veneer thickness but with different supporting designs, the wave ($3492 \text{ N} \pm 300$) and the cap designs ($2780 \text{ N} \pm 340$).

Conclusions: Translucent and high-translucent zirconium-dioxide crowns can be used in combination with 0.3 mm micro-coating porcelain-layer with semi-monolithic design to enhance aesthetic properties of restorations without significantly decreasing fracture resistance of crowns. If porcelain layers thicker than 0.3 mm are needed for semi-monolithic crown, wave design or cap design can be used to enhance fracture resistance of crowns. In both cases, strength gained is

clinically sufficient with the vast margin of safety in relation to expected loads under clinical use.



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Wear and fatigue behavior of monolithic zirconia crown restorations



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Purpose/aim: This study evaluated the wear and fatigue behavior of anatomically-correct monolithic zirconia (Y-TZP) crowns with three different occlusal surface treatments: polishing only (PolZ), polishing and glass infiltration (PolGZ), and glass infiltration on as machined surface (NoPolGZ). The wear behavior of intact natural molar teeth was investigated as reference.

Materials and methods: Zirconia crowns (Lava Plus, 3M ESPE) were sintered (PolZ) or sintered and glass infiltrated (PolGZ and NoPolGZ) at 1450 °C for 2 hours. PolGZ crowns were polished (Dialite ZR, Brasseler) in the pre-sintered state, before glass infiltration and final sintering. Whereas, PolZ crowns were polished (Dialite ZR) after sintering. All crowns were cemented to dentin-like composite (Filtek Z100, 3M ESPE) abutments, using a resin-based cement (Multilink Automix, Ivoclar Vivadent). Zirconia crowns ($n=5$ /group) and teeth ($n=15$) were then subjected to contact-slide-liftoff fatigue test at 200N loads for 1.25 million cycles using a steatite sphere ($r=3$ mm) as antagonist. Wear damage was investigated on both crowns and antagonists using optical and scanning electron microscopies. The crowns and teeth were cross-sectioned along the direction of sliding and polished up to the center of the wear scar to observe subsurface fatigue damage. Volume loss of the antagonists and teeth was calculated based on micro-CT scans, mesh editing, and topographic reconstruction.

Results: Surface micrographs showed that PolGZ and NoPolGZ crowns had shallow wear scars, where the superficial glass layer was removed and material loss remained within the surface of the zirconia-glass graded layer. PolZ

crowns did not undergo wear damage. Subsurface investigation on the cross-sectioned crowns revealed no crack or fatigue assisted subsurface damage for any of three zirconia groups. Microscopy observation of the antagonists, showed wear scars for all groups. Volume loss (mm^3) of the antagonist was quantified as follows: PolZ=0.022 (0.007)^a, PolGZ=0.011 (0.004)^b, and NoPolGZ=0.014 (0.006)^{ab}. For the reference teeth group, a very shallow wear scar (not measurable) was observed on the surface of the antagonist, consisting more of a “polishing” effect than material loss. The wear scar on the teeth itself was greater than that observed on the zirconia crowns. Measurements of volume loss varied significantly among teeth, ranging from 0.7 to 1.81 mm^3 , which seemed to be related to the variations in anatomy – thus contact area.

Conclusions: The combination of polishing and glass infiltration on the occlusal surface of monolithic zirconia crowns yielded reduced wear of on both crown and antagonist.

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Novel glass-ceramics materials characterization for dental applications



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Purpose/aim: The purpose of this study was to characterize two innovative glass-ceramics suitable for dental applications from a chemical, microstructural, and mechanical point of view.

Materials and methods: Two novel glass-ceramics were studied and compared to a commercially available glass-ceramic (IPS e.max CAD; Ivoclar Vivadent) developed for dental restoration applications. The chemical characteristics were evaluated by X-ray diffraction – XRD (Ultima IV; Rigaku) and microstructural features were analyzed by Scanning Electron Microscopy – SEM (XL 30 CP; Philips) after a 20 s HF-containing water solution etching. The elastic modulus and flexural strength were determined by four-point bending tests by a universal mechanical testing machine (MTS 810) using an actuator speed of 0.75 mm/min. Cyclic fatigue behavior was tested in flexure by using bars in which two Vickers micro-indentations were produced in the perspective tensile surface. The obtained data were analyzed by multiple t-test and one-way ANOVA ($p=0.05$).

Results: XDR analysis pointed out that the two glass ceramics contain, respectively, lithium disilicate and lithium metasilicate crystals. The former, being substantially similar to commercially available IPS e.max CAD material, after

SEM observations revealed the needle-like morphology of the crystalline phase. Conversely, in the second one, platelet-like crystals were revealed. The mechanical properties (strength, elastic modulus and fatigue) of the two innovative glass-ceramics are very similar to those of the commercially available one.

Conclusions: The innovative glass-ceramics analyzed in the present work appear to be good candidates to be used in dental restoration application similarly to the commercially available IPS e.max CAD material.

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Biomimetic agents can slow down degradation of caries-affected dentin-resin interfaces



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Purpose/aim: The mineral reinforcement of caries-affected dentin is a proposed strategy for restoring conditions similar to sound dentin. This *in vitro* assessed the effect of 0.2% NaF (NF), MI Paste™ (MP) and Curodont™ Repair (CR) on the durability of resin-demineralized dentin bonds by microtensile bond strength (μ TBS) and nanoleakage (NL) methods.

Materials and methods: One hundred and ten mid-coronal dentin surfaces were randomized into 10 groups ($n=8$) for μ TBS and NL tests ($n=3$), according to remineralizing agents (NF, MP and CR), storage time (24 h and 6 months-6 m) and control groups [demineralized (DD)/sound (SD) dentin]: G1:SD-24 h; G2:DD-24 h; G3:RD/NF-Dentin pre-treated with 0.2% NF for 1 min-24 h; G4:RD/MP-Dentin pre-treated with MP for 1 min-24 h; G5:RD/CR-Dentin pre-treated with CR for 5 min associated Ca⁺⁺ and PO₄-3 solution for 1 min-24 h; G6:SD-6 m; G7:DD-6 m; G8:RD/NF-6 m; G9:RD/MP-6 m; and G10:RD/CR-6 m. Dentin surfaces were demineralized by *S. mutans* biofilm for 7 days, producing a simulated caries-affected dentin, except for SD groups. A 4 mm height composite (Filtek Z350XT) block was built, bonded (Adper Single Bond 2) and stored in deionized water for 24 h and 6 months. Composite/dentin sets were sectioned obtaining beams (1 mm² cross-sectional area) and μ TBS tested was conducted in a universal testing machine (1 mm/min/50 kgF load). Failure sites were evaluated by SEM (150x). Three dentin slices obtained from each composite/dentin set were immersed in 50% silver nitrate for 24 h, photo-developed for 8 h and NL was measured by SEM/EDS. μ TBS (MPa) and NL data were analyzed by factorial ANOVA/Tukey and t-tests ($\alpha=0.05$), respectively.

Results: There was significant interaction between storage time and dentin treatment for μ TBS and NL results ($p<0.05$). The highest μ TBS were found for

MP (47.95 ± 6.69)/(35.86 \pm 2.92)-24 h/6 m, followed by CR (42.07 ± 7.83)/(31.98 \pm 3.44), regardless of storage time ($p<0.001$). After 6 m storage, μ TBS decreased significantly for all groups ($p<0.001$), and in higher proportion for NF (13.92 ± 2.66). There was no significant difference between CR and SD (43.32 ± 4.35)/(36.77 \pm 3.16), and MP and SD μ TBS values after 24 h and 6 m storage times, respectively ($p>0.001$). MP (15.41 ± 2.27)/(19.35 \pm 9.37) showed no significant difference between 24 h and 6 m storage time on NL ($p>0.05$). All other groups showed an increased NL at the hybrid layer after 6 m storage ($p<0.001$).

Conclusions: The biomimetic remineralization approach on demineralized dentin surface favored the bonding performance, improving the long-term caries-affected dentin bond degradation, restoring conditions similar or above those found for sound dentin.

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Evaluation of bond-strength of universal adhesives after thermal cycling



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Purpose/aim: To evaluate the short-term *in vitro* durability of multi-mode universal adhesives under thermal cycling degradation condition.

Materials and methods: One hundred twelve non-carious human third molars were assigned to five groups based on the universal adhesives (Prime&Bond Elect, Scotchbond Universal, All-Bond Universal, Clearfil Universal Bond). Two bonding modes (etch-and-rinse and self-etch) were employed for each adhesive group. Bonded specimens were stored in deionized

Table 1 – Microtensile bond strength of the four universal adhesives bonded to dentine using two application modes, with and without thermocycling.

Adhesive	Etch-and-rinse mode (MPa)		Self-etch mode (MPa)	
	No thermocycling	After thermocycling	No thermocycling	After thermocycling
Prime & Bond Universal	33,85 \pm 3,59 Aa*	29,62 \pm 6,57 Aa	21,74 \pm 7,04 Aa*	22,65 \pm 4,46 Aa
Scotchbond Universal	33,40 \pm 4,31 Aa	31,63 \pm 3,06 Aa	27,82 \pm 9,95 Aa	27,03 \pm 8,68 Aa
All-Bond Universal	34,09 \pm 7,76 Aa*	29,73 \pm 9,51 Aa	23,85 \pm 4,92 Aa*	26,88 \pm 5,71 Aa
Clearfil Universal Bond	34,62 \pm 4,64 Aa	27,59 \pm 6,96 Ab	28,64 \pm 9,27 Aa	24,06 \pm 7,96 Aa

Identical capital letters in a column indicate the absence of any statistically significant difference. Identical lowercased in a row within the same application mode between no thermocycling and after thermocycling indicate the absence of any statistically significant difference. Comparisons within the same adhesive and the same degradation condition marked with an asterisk are statistically significant.

water for 24 h or underwent a 10,000-cycle thermal cycling ageing process prior to testing ($n=10$). Microtensile bond testing (μ TBS) non-thermocycled and thermocycled specimens were performed (Table 1).

Results: Application mode (etch-and-rinse/self-etch) has significant influences on μ TBS of the Prime&Bond Universal and the All-Bond Universal adhesives without thermal cycling condition. The testing condition (with/without thermal cycling) was statistically significant only for the Clearfil Universal Bond on etch-and-rinse application mode.

Conclusions: Universal adhesives containing MDP showed more stable μ TBS under different application modes and without thermal cycling condition.

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Arrabidaea chica incorporated into a total-etch adhesive: Influence on bonding



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Purpose/aim: The purposes of this study were to evaluate the immediate bond strength to dentin of *Arrabidaea chica* (AC) extract in aqueous solution as a dentin pretreatment or incorporated into the acid or primer of a three-step total-etch adhesive system to dentin, the failure mode after microtensile bond strength test and the micromorphological features of the hybrid layer.

Materials and methods: Fifty dentin surfaces received five different treatments ($n=10$): SB (Adper Scotchbond Multipurpose Adhesive/3M ESPE); W (dentin pretreatment with water + SB); ACSB (dentin pretreatment with 2.5% AC aqueous solution + SB); ACA (AC incorporated into the phosphoric acid of SB), ACP (AC incorporated into the primer of SB). After 24 h, sticks from the bonded area were submitted to microtensile bond strength tests and the failure mode was recorded. The slabs obtained from the dentin-resin interfaces of each group were examined under scanning electron microscopy. One-way ANOVA was applied to the microtensile bond strength data, and Fisher's exact test was applied to evaluate failure mode.

Results: There was no difference in microtensile bond strength among the groups ($p=0.4205$). Prevalence of early failures was low for all groups. The failure mode showed significant differences among groups ($p=0.0001$). Mostly adhesive failures were observed for all groups, especially for ACSB, ACA and ACP. Group W presented more cohesive in resin failures than other groups, and group SB showed more cohesive in dentin failures than other groups. Micromorphological features of the hybrid layer were similar among the groups.

Conclusions: AC aqueous solution used as a dentin pretreatment or incorporated into the acid or primer of a three-step self-etching adhesive system presented similar microtensile bond strength to dentin, compared to SB. Failure mode was mostly adhesive when using AC. Micromorpholog-

ical features were not affected by the use of AC as a dentin pretreatment or when incorporated into the acid or primer.

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Shear bond strength of lithium disilicate using various adhesive cement



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Purpose/aim: The aim of this study was to evaluate and compare the shear bond strength (SBS) of lithium disilicate (IPS e.max CAD, Ivoclar Vivadent, Liechtenstein) with three different adhesive resin cements

Materials and methods: Thirty specimens of IPS e.max CAD were prepared. Specimens were divided in to two main groups. Group (A), it was investigated the bond strength at the interphase resin cement and ceramic. Group (B), it was investigated the bond strength between ceramic and dentin of extracted-human-molar teeth. All specimens were etched by hydrofluoric acid 5% for 20s and a silane coupling agent (MonoBond Plus, Ivoclar Vivadent) applied according to manufacturer's instructions. Both groups were assigned to three groups according to the resin cement applied. (i) Multilink[®] Automix (Ivoclar Vivadent), (ii) Panavia V5 (PV5) (Kurarary Dental), (iii) RelyX[™] Ultimate (3M ESPE). Cemented specimens were stored in distilled water at 37 °C for 1 week. Shear bond strength test (MPa) was performed using a universal testing machine. Atomic force microscopy (AFM) and scanning electron microscopy and optical microscopy (SEM) have been used to characterize the surface roughness and fracture patterns. Statistical comparisons were made with ANOVA and TUKEY test.

Results: Panavia V5 and Mutilink demonstrated higher bond strength on the dentin, however their bond strength at the ceramic interface were lower values. There is no significant difference in the bond strength between both interfaces for RelyX Ultimate. AFM results have shown roughness averages: Ra_control: 35 nm (± 12.2) and Ra_etched: 120.5 nm (± 44.9).

Conclusions: With the limitations of this study, we can conclude that Panavia V5 and Multilink shown better performance at dentin interphase than ceramic interface. RelyX Ultimate had the same SBS values at both interfaces.

<http://dx.doi.org/10.1016/j.dental.2017.08.019>

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Monomeric and oligomeric enriched proanthocyanidins primers on long-term dentin adhesion

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Purpose/aim: Plant derived proanthocyanidins (PACs) are well-established compounds exhibiting high dentin biomodification potency; particularly compounds extracted from grape seed extract. The stereochemistry of PAC compounds affect their interactivity with dentin matrix. Here, we assessed over 18-month period, the effects of monomeric and mid-size oligomeric PACs on the dentin-resin bond strength of methacrylate resins blend.

Materials and methods: Highly enriched monomeric (VVmon) and trimer/tetrameric (VV3+4) PACs fractions were fractionated from a PAC-enriched Vitis Vinifera grape seed extract (VVe). The fractions were lyophilized and powder utilized to prepare bioactive dentin primers at 15% (w/v). Primers were prepared at neutral pH (7.2) using 20 mM HEPES buffer. Forty-two extracted human molars ($n=7$) were selected and dentin exposed using a series of SiC-abrasive papers (#180, 320, 600). The dentin surface was etched with glycolic acid for 15 s, primed for 1 min, rinsed for 15 s and kept moist. Two drops of an experimental dental adhesive were immediately applied over the primed surface; the excess solvent was evaporated and surface light-cured for 40 s. The experimental dental adhesives contained Bis-GMA, TEGDMA and ethanol. Filtek Supreme Ultra (3M) was used to incrementally build-up 5 mm resin composite core. Each increment was light-cured for 40 s. A control group was prepared and restored in the same manner, but using primer without bioactives. After 24 h, specimens were sectioned into resin-dentin beams of $0.8 \pm 0.05 \text{ mm}^2$ cross-sectional areas and kept in a simulated body fluid at 37 °C. The microtensile bond strengths (TBS) were assessed at 24 h, 6 m, 12 m and 18 m storage in media. Specimens were tested in tensile at 1 mm/min. TBS data were statistically analyzed using two-way ANOVA and Scheffe post hoc at $\alpha=0.05$.

Results: There were no significant interaction between factors (primers vs. time, $p=0.863$) and no statistically significant differences among the aging time points ($p=0.821$). However, there were statistically significant differences among the bioactive primers ($p<0.001$). VV3+4 and VVe primers resulted in statistically similar ($p=0.726$) TBS, which were significantly higher than the other primers ($p<0.001$). VVmon primer was statistically higher than HEPES-only primer ($p<0.001$).

Conclusions: Trimeric/tetrameric PACs exhibit the highest bioactivity found in the VVe. While monomeric PACs resulted in TBS higher than control group, the bond strength were higher than control. Bond strength were remarkably stable over a



18-month period. Research supported by NIH/NIDCR research grant DE021040.

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Phase partitioning of material properties in Enamic

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Purpose/aim: To investigate the polymer-infiltrated ceramic network (PICN) material Enamic and relate its physical and mechanical properties to those of its constituent phases. A fit to existing models for matrix-reinforced composites is attempted regarding elastic modulus and fracture toughness.

Materials and methods: Specimens for elastic modulus measurement and fracture toughness testing were produced from the commercial CAD/CAM material Enamic (Vita Zahnfabrik), and from its phases, namely polymer (UDMA 75:25 TEGDMA), ceramic (Vitablocs MarkII, Vita), and interface (silanized ceramic sandwich of a polymer film). Beams were produced for elastic modulus measurements using the impulse excitation technique and the pulse-echo technique. Compact Tension specimens were produced for fracture toughness testing at two loading rates (1 mm/min and 0.01 mm/min) using the J-Integral method. The weight percent of phases in Enamic was determined by ashing the polymer phase out of the composite at 500 °C and the volume percent by digital processing of scanning electron microscopy images.

Results: A 14–17 vol.% of polymer phase in Enamic[®] was obtained by digital processing of SEM images, whereas a 26 vol.% was determined by the point-counting method. Ashing of the polymer resulted in a mass loss of the composite of 13.5 wt.%. XRD and Raman spectroscopy revealed that the crystalline phase of Enamic[®] and Vitablocs Mark II are slightly different, but both belong to the tectosilicate family. The elastic modulus of Enamic[®], ashed Enamic[®], polymer and ceramic were, respectively: 34.8 GPa, 12.1 GPa, 2.53 GPa and 64.3 GPa. Fracture toughness using the linear elastic solution (K_{Ic}) of Enamic[®], polymer, Vitablocs MarkII and interface did not vary with the loading rate, and were, respectively: 1.03 MPa m, 0.59 MPa m, 1.01 MPa m and 1.95 MPa m. The polymer, Enamic[®] and the interface showed substantial plastic deformation, resulting in the following elastic-plastic fracture toughness (K_{Ic}), respectively: 1.30 MPa m, 0.65 MPa m and 1.39 MPa m. The elastic modulus of Enamic[®] showed a best fit to the Sigmoidal Average of the Hashin-Shtrikman model. Fracture toughness (K_{Ic}) showed a good fit to an energy model based on the volume fraction of particulate-reinforced matrices (Bowen-Ortiz) if the polymer is used as the reinforced phase. Models based on deflection, interface fracture and the rule-of-mixtures rendered poor fits to the K_{Ic} of Enamic[®]. Fractography of Enamic[®]



showed a straight fracture path involving the ceramic and the polymer without deflecting at the interface.

Conclusions: The improvement in fracture toughness of Enamic over Vitablocs MarkII is attributed to the elastic-plastic behavior of the polymer.

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Antibacterial activity of endodontic sealer modified with nanoparticles



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Purpose/aim: The aim of this study was to evaluate the antibacterial activity of a commercial endodontic sealer modified with montmorillonite nanoparticles carrying to different drugs: chlorhexidine (CHX) and metronidazole (MET).

Materials and methods: The sealer used was AH Plus sealer, and 5% in weight was added of the nanoparticles carrying one of the drugs CHX or MET. Cylindrical specimens were made with 5 mm diameter and 1 mm thick ($n=5$). 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 were the *E. Fecallis* which is the most frequently bacteria found in recidivate apical infection. Discs specimens were positioned over the agar and plates were incubated in the appropriate conditions for 48 h. After this period, inhibition zones were measured using a calliper rule. A group with no modification by the nanoparticle was added as a control. The data was analyzed using Mann-Whitney ($\alpha=5\%$).

Results: Results are presented in Table 1. For the control group no inhibition zone was formed, so the statistical analyze was performed only between the experimental groups.

Table 1 – Means (SD) for inhibition halo (mm). No statistical difference was presented between the drugs.

Drug	Inhibition halo (mm)
Control	0
CHX	4.8 (1.4) A
MET	4.0 (1.6) A

Conclusions: Within the limitations of this study it can be concluded that the addition of the nanoparticle carrying both drugs added an antibacterial activity that was not found in the commercial sealer.

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Longitudinal effect of Er:YAG laser on dentin micromorphology and bonding



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Purpose/aim: Er:YAG laser with controlled pulse duration can interact with dentin with less thermo mechanical damage for pulp and surrounding tissues. Analyzing the long term of both micro morphological features and bond strength of Er:YAG irradiated dentin is fundamental to determine the stability of composite restorations. This study investigated the longitudinal effect of laser pulse duration on micro morphology and bond strength of a composite bonded to irradiated dentin.

Materials and methods: Sixty caries-free human molars were cut to obtain middle flat dentin discs, polished to obtain standard smear layer. Samples were randomly divided into 4 groups according to dentin pre-treatment ($n=12$): G1 (without laser); G2 (80 mJ-2 Hz-50 μ s); G3 (80 mJ-2 Hz-300 μ s) and G4 (80 mJ-2 Hz-600 μ s). The laser wavelength was 2.94 μ m, working in focused distance and cooling of 21 ml/s. Subsequently, self-etch adhesive system (Scotchbond Universal-3M/ESPE) was applied and 8 cylinders of composite (Z350-3M/ESPE) were built and tested in micro shear bond strength (SBS) after 12 months of storage in artificial saliva. Moreover, 3 dentin discs per group were prepared to perform the analysis of collagen fibrils by second harmonic generation (SHG) (Maitai Deep See microscopy, at 380 nm excitation) and the morphology of the hybrid layer using confocal laser (at 800 nm excitation). For both analyses, fluorochrome Rhodamine-B was compounded into the adhesive (0.0016 g/ml).

Results: One-way ANOVA and post-hoc Tukey's test ($\alpha=0.05$) did not detect statistical difference for the factor dentin pre treatment ($p=0.000$). After 12 months of saliva storage, experimental groups presented similar bond strength, irrespective of dentin pre-treatment (Group 1: $24.97 \pm 4.7A$; Group 2: $22.85 \pm 2.94A$; Group 3: $22.13 \pm 2.98A$; Group 4: $23.01 \pm 2.94A$). The micro morphology images revealed a thin hybrid layer and sparsely resin tags for G1, while irradiated groups showed longer resin tags. For SHG, G1 and G2 showed no alterations of collagen fibrils and organic matrix, while G3 and G4 showed a permanent modification of the organic matrix below the irradiated surface.

Conclusions: Although hybrid layer/resin tags were present in all experimental groups and Er:YAG laser pretreatment did not impair bond strength to dentin, organic matrix changes were observed in groups with higher pulse durations (300 and 600 μ s). Thus, a pulse width of 50 μ s is the best irradiation protocol to pre treat dentin before bonding procedures, preserving the integrity of collagen fibrils.

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Physicochemical properties of methacrylate resin-based root canal sealers



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Purpose/aim: The aim of this study was to evaluate the following physicochemical properties of the methacrylate resin-based root canal sealers Hybrid Root SEAL (Sun Medical) and Real Seal XT (SybronEndo) compared to epoxy resin-based sealer AH Plus, according to the ANSI/ADA standards: setting time (ST), dimensional change (DC) and solubility (SB).

Materials and methods: For analysis of ST, the sealers were placed inside cylindrical stainless steel molds and tested with a Gilmore needle (100 g). For DC, the sealers were placed inside cylindrical molds, measured for length, immersed in distilled water for 30 days, dried and measured again to determine the percentage of the dimensional alterations. For SB, circular molds were filled with the sealers, weighed, immersed in water, reweighed after 7 days, and the liquids were analyzed by atomic absorption spectrometry. Data were analyzed statistically by ANOVA and Tukey's test ($\alpha = 5\%$).

Results: The ST means for Hybrid Root SEAL, Real Seal XT, and AH Plus, were 67.00 ± 6.96 , 39.00 ± 4.18 , and 530.20 ± 44.98 , respectively. For DC (Hybrid Root SEAL 4.51 ± 1.03 ; Real Seal XT 3.32 ± 0.24 ; and AH Plus 1.31 ± 0.20) and SB (Hybrid Root SEAL -1.24 ± 0.38 ; Real Seal XT -0.90 ± 0.14 ; and AH Plus 0.39 ± 0.083), AH Plus presented better results. There was statistically significant difference between the sealers for the physicochemical properties ST, DC and SB, with lower DC and higher ST and SB values for AH Plus ($p < 0.05$) (Table 1). The results of the atomic absorption spectrometry showed greater release of Na^+ ions from Hybrid Root SEAL compared to Real Seal XT and AH Plus sealers ($p < 0.05$). For Ni^+ ions no significant release was found for the sealers tested (< 0.5 ppm), as well as the Ca^{2+} release from Hybrid Root SEAL sealer.

Table 1 – Physical properties of the sealers (mean \pm standard deviation).

	Hybrid Root SEAL	Real Seal XT	AH Plus
Setting time (min)	67.00 ± 6.96^b	39.00 ± 4.18^b	530.20 ± 44.98^a
Dimensional change (%)	4.51 ± 1.03^b	3.32 ± 0.24^b	1.31 ± 0.20^a
Solubility (%)	-1.24 ± 0.38^b	-0.90 ± 0.14^b	0.39 ± 0.083^a
Lowercase letters indicate statistically significant difference in columns ($p < 0.05$).			

Conclusions: Only AH Plus fulfilled all ANSI/ADA recommendations relative to the physicochemical properties evaluated in this study.

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Resin materials containing calcium phosphate nanoparticles functionalized with EGDMA derivatives



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Purpose/aim: The incorporation of calcium orthophosphate nanoparticles (NPs) to restorative composites has been investigated over the years as a possible approach to protect the enamel against the development of new caries lesions at the tooth–restoration interface. However, the lack of chemical interaction between the nanoparticles and the resin matrix significantly reduces the mechanical properties of the resulting material. Recently, dicalcium phosphate dihydrate (DCPD) nanoparticles functionalized with triethylene glycol dimethacrylate (TEGDMA) were synthesized. Copolymerization of the monomers grafted on the NP surface with those from the resin matrix allowed for a 32% increase in material's fracture strength. The aim of the present study was to investigate the effect of DCPD NPs functionalized with different ethylene glycol dimethacrylate (EGDMA) derivatives on the mechanical properties of a dimethacrylate-based resin.

Materials and methods: DCPD NPs functionalized with DEGDMA, TEGDMA or TETDMA were synthesized by a sol–gel method using calcium nitrate and ammonium phosphate solutions as precursors. Monomers were added to the ammonium phosphate solution in 1:1 (DEGDMA) or 2:1 (DEGDMA, TEGDMA and TETDMA) molar ratios in relation to ammonium phosphate. NPs (30 vol%) were incorporated to a photocurable BisGMA:TEGDMA mixture (1:1 in mol). The unfilled resin and a material containing non-functionalized (NF) DCPD were tested as controls. Disc-shaped specimens (12×1.2 mm, $n = 10$) were aged for 24 h in water prior to testing on a “disc on three spheres” device. Biaxial flexural strength (BFS) and flexural modulus (FM) data were analyzed using Kruskal–Wallis test, with multiple comparisons performed using Dunn's test ($\alpha = 5\%$).

Results: Results are shown in Fig. 1. Averages followed by the same letter are not statistically different ($p > 0.05$). Fracture strength of the resin-based material containing 2:1 DEGDMA-functionalized DCPD increased 44% in comparison to the use of non-functionalized NPs (73.3 and 52.8 MPa, respectively).

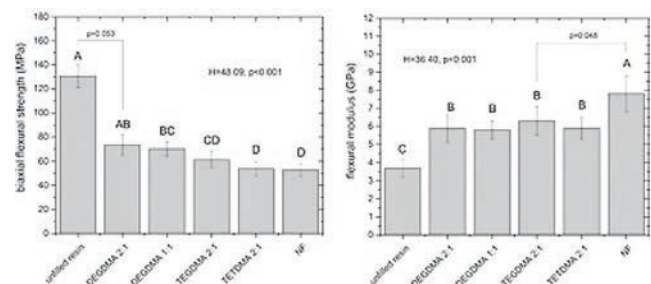


Fig. 1

Among DCPD-filled materials, flexural modulus was 24–35% higher for the material with non-functionalized NPs.

Conclusions: DCPD nanoparticles functionalized with DEGDMA were successful in increasing the material's fracture strength compared to the use of non-functionalized nanoparticles. Flexural modulus was not improved by nanoparticle functionalization (FAPESP 2015/15019-4).

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TiF₄ pretreatment followed by self-etching adhesive system: Nanomechanical properties



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Purpose/aim: The purpose of this study were to investigate the effects of dentin pretreatment with an aqueous solution of 2.5% of titanium tetrafluoride (TiF₄) followed by one- and two-steps self-etching adhesive systems on nanomechanical properties of the adhesive layer, hybrid layer and underlying dentin after long-term storage up to 6 months.

Materials and methods: Twelve extracted sound human third molars were used. The occlusal surfaces were ground flat to remove enamel and expose dentin surface. The teeth were randomly assigned into four groups ($n=3$) according to the restorative procedure described previously. A block of composite was built and sectioned into 3 slabs, and then evaluated at 24 h, 3 months and 6 months storage. The reduced elastic modulus and hardness of dentin, hybrid layer and adhesive layer were measured using a customized Triboindenter. For statistical analysis it was performed ANOVA and Tukey test considering the level of significance of 5%.

Results: Reduced elastic modulus (GPa) showed no significant differences between adhesives systems and among groups with or without TiF₄ ($p>0.05$). For hardness (MPa), no significant difference was found between adhesive system and among groups with or without TiF₄ ($p>0.05$).

Conclusions: It was concluded that dentin pretreatment with 2.5% of TiF₄ followed by self-etching adhesive systems did not influence nanomechanical properties of all hybrid layer components, over time.

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Microhardness of gypsum submitted to different methods of pouring



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Purpose/aim: Compare the superficial microhardness (Knoop) of gypsum Type IV submitted to different methods of pouring and storage.

Materials and methods: Seventy five specimens were made with gypsum Type IV (Herostone, Coltene) and distributed in 5 groups ($n=15$). A metal device was made to simulate the try and standardize the impression procedures. A polyvinil siloxane (PVS; Expresse XT, 3M ESPE) was manipulated according to the manufacture instructions. After the setting time, the impression was removed and cleaned with water, dry and disinfected with 2% glutaraldehyde. Control/15 – the die was removed from the impression material 15 min after pouring cast; 4 h – the die was removed from the impression material 4 h after pouring cast; 40 °C – the die was removed from the impression material, and storage during 30 min at 37 °C; potassium sulphate/2% – the impression was immersed in potassium sulphate 2% solution during 5 min, after that the gypsum was pouring and removed from the PVS after 15 min; calcium sulphate 2% – the impression were immersed in calcium sulphate 2% solution during 5 min, after that the gypsum were pouring and removed from the PVS after 15 min. The microhardness test Knoop was performed in 3 different points. The average was used to the statistical analysis. Statistical differences between groups were analyzed by one-way ANOVA. The details of the analysis were performed using the Dunnett test and the Tukey HSD test. All tests were performed with significance level of 5%.

Results: The lowest microhardness values were observed with the control group (38.9). The comparison between the other groups: 4 h (58.8); 40 °C (66.8); sulphate/K2% (69.4) and sulphate/Ca2% (70.3), showed no statistically significant difference between them.

Conclusions: All the treatments methods increased significantly the surface microhardness of the gypsum Type IV.

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WITHDRAWN



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Mechanical properties of dental enamel after hybridization using electrokinetic flow



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Purpose/aim: The electrokinetic (EK) flow was used to hybridize enamel pores through electric voltage. However, the mechanical behavior of the tissue has not yet been analyzed.

Materials and methods: Icon dental resin (DGM, Hamburg, Germany) was infiltrated into enamel of extracted human teeth via EK flow and the microhardness and ultimate tensile strength of the tissue were evaluated. Thirty third molars were collected. For the Vickers microhardness test ten teeth were sectioned longitudinally to obtain two hemicrowns. These were divided into two groups ($n = 10$): Infiltrate Group (MH-IG) and Non-Infiltrate Group (MH-NIG). Microhardness was performed at different depths (50, 100, 200, 250 and 500 μm). For ultimate tensile strength, twenty teeth were used and divided into two groups: Infiltrated Group (UTS-IG) and Non-Infiltrated Group (UTS-NIG). Each group was divided into two subgroups ($n = 10$), according to the arrangement of the enamel prisms (parallel or perpendicular).

Results: The microhardness data was submitted to paired t-test. MH-IG presented higher values when compared to MH-NIG, regardless of depth. The analysis of the cohesive resistance was due to the correlation between the data obtained from UTS-IG and UTS-NIG specimens. A strong correlation was obtained, indicating that the EK flow did not alter the cohesive resistance of the tissue.

Conclusions: It was observed that the infiltration of resin into the enamel via EK flow was effective and increased the microhardness of the tissue without, however, interfering in the cohesive resistance, regardless of the orientation of the prisms.

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Staining solutions and bleaching agents: Enamel microhardness and roughness effects



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Purpose/aim: The aim of this study was to evaluate the in situ effects of staining solutions during dental bleaching with high or low peroxides concentrations on microhardness and roughness on enamel surface.

Materials and methods: Seven volunteers participated using an intraoral appliance, with nine bovine enamel blocks, during 15 days. The enamel blocks were randomly assigned among different groups according to the treatments: high hydrogen peroxide (OpalescenceBoost PF 40%/Ultradent) concentration for 40 min in 3 sessions (1st, 8th and 15th

day of treatment); low carbamide peroxide (Opalescence PF 10%/Ultradent) concentration for 60 min daily during 15 days; control, with no bleaching agent applied. The enamel blocks were immersed in different staining solutions (coffee or cola-based soda) or not (control) daily for 30 min during 15 days, in order to obtain a factorial scheme of the dental bleaching treatment and staining solution of 3×3 ($n = 7$). Roughness evaluations were performed using a roughness meter with static load of 5 N and speed of 0.25 mm/s, microhardness tests were also performed using a Knoop microhardness indenter, with static load of 25 g/s, assessed before and after treatment associated to the staining solutions. Tukey-Kramer test was performed for statistical evaluations, with a significance level of 5%.

Results: There were no significant differences of roughness values among the groups ($p = 0.3218$) at baseline, cola-based soda roughness values were higher ($p < 0.0001$) than other groups after treatments, but no significant differences were observed between the coffee solution and the control. There were no differences in microhardness values among treatments ($p = 0.3368$) at baseline. Roughness values for cola-based soda solution were significantly lower than coffee and control groups ($p < 0.0001$) after treatments. Cola-based soda group showed significant decrease of microhardness values regardless of the bleaching agents used ($p < 0.0001$).

Conclusions: It was concluded that cola-based soda solution decreased enamel microhardness surface and increased its roughness, regardless of bleaching agents used.

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Flexural strength of CAD/CAM and pressed novel lithium disilicate



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Purpose/aim: To compare flexural strength of CAD-CAM and heat-pressed lithium disilicates.

Materials and methods: For pressed specimens, acrylic polymer blocks were cut with a saw in bars shape. Sprueing, investing and preheating procedures were carried out following manufacturer's instructions. IPS e.max Press (Ivoclar-Vivadent) and Initial LiSi Press (GC) ingots were pressed following manufacturer's instructions. For CAD-CAM specimens, blocks of IPS e.max CAD (Ivoclar-Vivadent) and Initial LiSi Block 096Y (GC) were directly cut with slow speed diamond saw in bars shape. Final crystallization was performed following manufacturer's instructions. Both Press and CAD specimens were polished and finished with silica carbide papers of increasing grit. Final dimensions of the specimens

were $4.0 \times 1.2 \times 16$ mm. Specimens were tested using a three-point bending test (ISO 6872:2015). Flexural strength, Weibull modulus, and Weibull characteristic strength were calculated. Flexural strength data were statistically analyzed.

Results: The main flexural strength resulted in following order: LiSi Press A > IPS e.max Press A > Lisi Block B > IPS e.max CAD B. Statistical significant lower strength were recorded for the CAD/Block version in both materials.

Conclusions: Pressing lithium disilicates resulted in a significant higher flexural strength for both tested materials. Despite of the statistical significant differences, all the tested materials fulfil the ISO Class III requirements for ceramic materials.

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In vitro effect of chitosan nanoparticles on tooth enamel bio-corrosion



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Purpose/aim: The aim of this study was to evaluate the effect of chitosan nanoparticles (ChNPs) dispersed in solution on enamel wear submitted to the erosive challenge by citric acid.

Materials and methods: The ChNPs were synthesized by ionic gelation (3.85 mg/mL) and characterized by transmission electronic microscopy. Sixty blocks of human sound enamel (4×4 mm) were prepared and divided (2×4 mm) in treated and untreated area (control). The control area was covered with nail polish. Four groups were formed according to the application of solutions ($n = 15$): ChNPs (3.85 mg/mL); Chitosan (5 mg/mL); Sodium fluoride (NaF 0.5 mg/mL – positive control); and distilled water (negative control). Immediately prior to the experimental procedures, the samples were incubated in freshly collected human saliva (20 mL for 3 h, 37 °C, under constant shaking). For that, stimulated saliva was collected from one healthy adult donor (stimulated salivary flow). Next, the samples were immersed in 1% citric acid for 90 s, washed and immersed for 2 h in remineralizing solution (RE). This cycle was repeated 4×/day for 7 days. After the 1st and 4th exposure to the acid, the solutions were applied according to each group, for 2 min and immersed in RE. After the erosive challenge, Vickers hardness (VHN) and percentage of hardness loss (% SMH) were performed on treated and untreated surfaces. The wear was analyzed by optical profilometer. Data were analyzed by ANOVA and Tukey ($\alpha = 0.05$).

Results: The negative control group showed significant lower VHN values (258.3 ± 41.9) and higher %SMH values (34.5 ± 10.5) compared to the other groups. There was no statistically significant difference between the wear values of ChNPs ($5.5 \pm 1.7 \mu\text{m}$) and NaF ($5.0 \pm 1.4 \mu\text{m}$) groups. The highest wear occurred for negative control ($10.9 \pm 0.9 \mu\text{m}$), followed by chitosan group ($9.5 \pm 2.3 \mu\text{m}$).

Conclusions: The chitosan nanoparticles decreased the enamel wear caused by bio-corrosion with citric acid, and might be an alternative solution to prevent enamel erosion.

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Chlorhexidine-containing electrospun nanofibers: Effect of production mode on chlorhexidine release



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Purpose/aim: The aim of this research was to produce and characterize cellulose acetate electrospun nanofibers containing different amounts of chlorhexidine, and to evaluate how different methods of chlorhexidine incorporation affect the drug release and their antibacterial activity against oral pathogens.

Materials and methods: Cellulose acetate (CA) and polyethylene oxide (PEO) polymers were used to produce the nanofibers through electrospinning process. The polymers were diluted in N,N-dimethylformamide (DMF) to form a solution for electrospinning. Different amounts of chlorhexidine diacetate (CHX) were added to form the experimental groups. A binding agent (TTE) was used to allow the chlorhexidine to be bound to the polymers. The control groups were the polymers without chlorhexidine. A post-spinning treatment with 5% (w/v) chlorhexidine digluconate was performed at the cellulose acetate/polyethylene oxide fibers. The fibers were placed in the chlorhexidine digluconate aqueous solution for 1 h and cured at 90 °C for 30 min to immobilize the CHX via the titanate linkers (TTE). The five groups formed were: (1) CA-PEO; (2) CA-PEO-TTE; (3) CA-PEO-TTE-CHX0.3 (0.3 wt% CHX); (4) CA-PEO-TTE-CHX1.2 (1.2 wt% CHX); (5) CA-PEO with a post-spinning CHX (5%) treatment. The release of CHX was monitored over time using a UV-vis spectrophotometer with readings at 254 nm wavelength. The fiber mats with different concentration of chlorhexidine had their antibacterial action tested based on the inhibition halos formed around the nanofiber discs after the bacterial incubation period (*S. mutans* or *E. faecalis*).

Results: It was observed that cellulose acetate nanofibers with and without chlorhexidine were adequately produced through the electrospinning process and the concentration of 6 wt% cellulose acetate with 0.2 wt% of a high molecular weight polyethylene oxide in DMF was considered the ideal solution to allow the fibers production. The fibers presented adequate morphological characteristics (SEM) and the mats good handling characteristics. The fibers diameter was kept constant even with chlorhexidine addition. The

release experiment showed a higher CHX release from CA-PEO-TTE-CHX1.2 in the first 2 h. The CA-PEO post-spin treated fibers showed a gradual increase in release over the 90-days evaluation.

Conclusions: The electrospun nanofibers produced presented adequate handling characteristics, were highly reproducible and lead to efficient CHX release system, with a burst release from the fibers spun with CHX and an increased release over 90 days from the fibers treated with CHX after spinning. The CHX-containing fibers showed antibacterial activity against *S. mutans* and *E. faecalis*.

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Bond strength of zirconia to pressed veneering ceramic: Microshear test



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Purpose/aim: The objective of the present study was to evaluate the bond strength of zirconia to pressed veneering ceramic with or without liner application using a novel methodology of evaluation.

Materials and methods: 24 zirconia (IPS emax.ZirCAD, Ivoclar Vivadent) bars (10 mm × 6 mm × 4 mm) were prepared using a diamond saw (ISOMET, Buehler, Lake Bluff, IL, USA). In order to simulate the surface produced by a CAD/CAM system, a cylinder pointed bur (Sirona) compatible with CEREC[®] Inlab[®] Compacta (Sirona) was mounted into a low speed hand-piece and under water irrigation; the surface was ground to standardize the bonding surfaces. The bars were sintered (Sintramat, Ivoclar Vivadent) and randomly divided in two groups according surface treatment ($n=12$): G1 – as milled, no treatment (control); G2 – Liner application (ZirLiner, Ivoclar Vivadent). Three 0.8 mm diameter wax cylinders (Wax Shapes Kerr – USA) were attached to each bar and connected to a sprue. The zirconia bars were then invested with IPS Press Speed (Ivoclar Vivadent). Then the wax was burned out and veneering ceramic (IPS e.max ZirPres, Ivoclar Vivadent) was pressed onto the bars in a Programat EP5000 pressing oven (Ivoclar Vivadent), thus producing three microshear specimens/bar. Bars were evaluated by microshear bond strength test at 1 mm/min crosshead speed with a guillotine device (OMT-100; Odeme Dental Research). The failure mode was evaluated in a microscope (50× magnification) (VHX-5000, Keyence). The microshear values were submitted to Levene normality test. The statistical analysis was performed with one-way ANOVA using mean bar value ($\alpha=0.05$) and Tukey test ($p < 0.05$); the failure mode was expressed by descriptive analysis.

Results: Mean μ SBS (SD) in MPa were: G1 – 15.3(4.4)A; G2 – 8.7(1.5)B. Failure mode analysis showed a prevalence of adhesive failures.

Conclusions: The liner use improved the bond strength between zirconia and pressed veneering ceramic. Microshear test analysis can be used for bond strength resistance

evaluation between zirconia and pressed veneering disilicate ceramic.

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PEG effects on Ca²⁺ release from PLGA-calcium hydroxide-loaded nanoparticles



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Purpose/aim: Poly (lactide-co-glycolide) acid (PLGA) nanoparticles (NP) loaded with calcium hydroxide (CH) might be used for sustained releasing of Ca²⁺. The PLGA-NP have showed a sustained release of Ca²⁺ for 42 days, that behavior might be useful for apexification, because that treatment requires Ca²⁺ for long time to induce the apical closing. The use of polyethylene glycol (PEG) might help to modify the Ca²⁺ release profile from the PLGA-NP. We hypothesized that the PEG as a vehicle for NP decrease the Ca²⁺ release. Hence, the aim of this study was to evaluate the Ca²⁺ release and pH changes induced by PLGA-NP loaded with Ch, and mixed with PEG.

Materials and methods: Calcium hydroxide was mixed with PEG as a control paste. Experimental groups were PLGA-NP with CH (25 mg) mixed with PEG, and PLGA-NP with CH (25 mg). All samples (triplicate) were put in a dialysis membrane, and were suspended in deionized water in a plastic tube. The tubes were closed and put in an incubation chamber (37 °C) for 50 days. At specific experimental times, the deionized water was recovered and Ca²⁺ and pH were measured with an electrode (Orion Star A324). Fresh deionized water was added at every experimental time. Results were analyzed with a Kruskal-Wallis test.

Results: The control paste released 1171.46 ppm of Ca²⁺. The PLGA-NP with CH released 867.11 ppm of Ca²⁺. The PLGA-NP with CH and PEG released 1234.62 ppm of Ca²⁺. The control paste induced a pH of 11.36 at 1 h, and at final time it showed a 5.91 pH. The PLGA-NP with CH induced a pH of 7.33 at 1 h, and at final time its pH was of 2.76. The PLGA-NP with CH and PEG showed a pH pos 7.21 at 1 h, and at final time it had a 2.76 pH. Statistically significant differences were found between Ca²⁺ concentration of the control paste, PLGA-NP with CH and PEG and PLGA-NP with CH.

Conclusions: The PEG as a vehicle for the PLGA-NP with CH increased the Ca²⁺ release, thus we rejected our hypothesis. The PLGA-NP with CH and PEG released an amount of Ca²⁺ as similar as the control paste.

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Fatigue limit of Y-TZP reinforced with carbon nanotubes



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Purpose/aim: To compare the Cyclic Fatigue Limit (CFL) of a control yttria-stabilized tetragonal zirconia polycrystal (Y-TZP) with a composite produced by adding multi-walled carbon nanotubes (CNT) into Y-TZP.

Materials and methods: CNT were coated with zirconium oxide and yttrium oxide to form a powder (CNT/ZYO) using a hydrothermal co-precipitation method. Powders made of Y-TZP + (CNT/ZYO) were produced using 99 vol% of Y-TZP and 1 vol% of CNT/ZYO. CAD-CAM blocks (42.5 × 16.0 × 16.0 mm) were obtained by uniaxial pressing (67 MPa/30 s) of each powder in a steel matrix. These blocks were partially sintered at argon atmosphere (1100 °C/1 h/5 °C/s) and then sectioned to produce 14 bar-shaped specimens (3.0 × 4.0 × 25.0 mm/edges chamfered according to ISO6872:2008) of each material, which were sintered also in argon atmosphere (1.400 °C/4 h/5 °C/min). Density measured by Archimedes' method was used to calculate the relative density (RD), based on the theoretical values for both materials (6.06 g/cm³). Flexural strength (FS) was measured in four-point bending with specimens immersed in water at 37 °C (inner and outer supports of 10 and 20 mm). CFL was determined in four-point bending, using the staircase method (10,000 cycles/5 Hz). In each cycle, the stress varied between the maximum stress (MS) and 50% of MS. The applied stress in the first specimen was 50% of FS. After 10,000 cycles, in case the specimen did not fracture, 10 MPa was added to the next specimen. RD and FS were analyzed by Student's *t* test ($\alpha = 5\%$). CFL was calculated according to: $CLF = X0 + d(\text{SUMini}/\text{SUMni} \pm 0.5)$, where *X0* is the lowest stress value tested, *d* is the stress added or subtracted to each cycle and *n* is the number specimens that survived or failed in each stress level. The lowest stress level was computed as *i* = 0, and the next one was computed as *i* = 1, and so on. Fracture surfaces were fractographically analyzed.

Results: Specimens containing nanotubes showed significantly lower RD compared to the control ($p = 0.009$). Nanotube addition also caused a 50% significant decrease in FS ($p = 0.003$). However, the FS coefficient of variation for the control was higher (17%) compared to that of the composite (10%). CFL calculated for the control was 2.5 times higher than that of the composite. The %CFL (CFL in terms of percentage of the FS) was also higher for the control. Fractography indicated fracture origins associated to surface defects and porous regions related to nanotube agglomerates.

Conclusions: The processing method used to produce the composite Y-TZP/nanotubes needs to be improved since nanotube addition to Y-TZP caused a significant reduction of the relative density, strength and fatigue limit.

Material	Relative density (%)	Flexural strength (MPa)	CFL (MPa)	%CFL
Y-TZP (control)	98.6 ± 0.05 ^A	623.7 ± 108.8 ^A	439.0 ± 56.4	70%
Composite Y-TZP/nanotubes	97.4 ± 0.03 ^B	299.4 ± 30.5 ^B	179.4 ± 22.5	60%

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Characterization and cellular response of 3D-scaffold functionalized with PLA nanofibers



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Purpose/aim: Characterized the physicochemical properties, microtopography and cellular response of a 3D scaffold functionalized with PLA nanofibers.

Materials and methods: Cylindrical 3D scaffolds (5 mm diameter and 20 mm height) were designed and fabricated by PLA 3D printing. The scaffolds were then functionalized with 6% PLA nanofibers by airjet spinning. Samples of each scaffold were evaluated by thermogravimetric analysis (TGA) to determine onset point (To) inflection point and (Tp) mass loss temperature (Tmax). All specimens were then evaluated by differential scanning calorimetry (DSC) to determine glass transition temperature (Tg) and melting point (Tm). Tg was confirmed by dynamic mechanical analysis (DMA). Microtopography was evaluated by scanning electron microscopy (SEM) at 100×, 500×, 2000× and 5000×. Human osteoblasts (hOB) were selected to perform cellular adhesion assay and cellular proliferation evaluation by MTT assay. Data were analyzed and compared using two-way ANOVA test.

Results: To, Tp and Tmax were comparable between both scaffolds, as well as Tg and Tm. 3D scaffold showed homogeneous non-porous microtopography, with well adapted printing patterns. The PLA nanofibers layer was well adapted

on the 3D scaffold. The thickness and the distribution of PLA nanofibers were homogeneous in all the areas analyzed. The deeper nanofibers showed good adaptation and merge with printed scaffold. Functionalized scaffolds showed improved cellular adhesion and proliferation ($p < 0.05$) when compared with pure 3D scaffolds.

Conclusions: It was possible to functionalized 3D PLA cylindrical scaffolds, maintaining physical properties but improving the cellular response.

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Bond strength of calcium-releasing self-adhesive cement after accelerated aging



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Purpose/aim: Calcium-releasing bioactive dental cements may help prevent or decrease dental secondary caries. However, it is still unknown whether they have stable bond strengths. The purpose of this study was to evaluate bonding durability of a calcium-releasing self-adhesive resin cement (TheraCem).

Materials and methods: Yttria-stabilized zirconia ceramic was sandblasted with alumina sand, rinsed and dried. Shear bond strength was tested using the notched-edge shear bond strength test method (ISO 29022:2013). Self-adhesive cement (TheraCem, Bisco; or RelyX UniCem2, 3M Oral) was placed on the substrate surface and self-polymerized (15 min/37 °C). The specimens were then stored in water either at 37 °C for 24 h (initial bond strength) or at 80 °C for 6 days (accelerated aging), and tested by universal testing machine (Instron, crosshead-speed 1 mm/min). The data were analyzed statistically by one-way ANOVA and Student's t-test.

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

Table 1

Resin cement	TheraCem	UniCem2
Initial (37 °C for 24 h), n = 6	26.8 (8.9) a	16.7 (6.2) b
Aging (80 °C for 6 days), n = 7	19.1 (4.7) ab	6.0 (2.1) c
Mean bond value decrease	29%	64%

Conclusions: The calcium-releasing self-adhesive resin cement, TheraCem, had a more stable bond than RelyX UniCem2.

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Reciprocity studies on polymerization properties of BisGMA/TEGDMA based composites



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Purpose/aim: Exposure reciprocity law has often been used as a rationale to adjust the curing duration based on the curing light intensity available to the dentist. This study examines the clinical validity of this rationale by real time simultaneous measurement of the polymerization properties for different light intensities, under a constant dose. These properties include shrinkage stress (PS), degree of conversion (DC) and temperature change (TC) due to exotherm and energy absorption of model dimethacrylate-based composites during the polymerization process.

Materials and methods: Mixtures of BisGMA:TEGDMA (7:3, 1:1 and 3:7) with commercial silanized micro-sized glass filler loading levels of 50 wt% and 75 wt% each were investigated. NIST SRI 6005 (standard reference instrument, a cantilever-beam based instrument) with an in situ near infrared spectrometer and a microprobe thermocouple was used for simultaneous measurement of PS, DC, and TC in real time. Light irradiance intensities were varied from 500 mW/cm² to 4000 mW/cm² while maintaining a constant dose of 10 J/cm² and 20 J/cm². Initially, a standard continuous curing mode was considered in this study. Measurements were carried out under three instrumental compliances, 0.33 μm/N, 6.31 μm/N and 12.32 μm/N, that cover possible compliances of clinically prepared tooth cavities.

Results: The exposure reciprocity with respect to DC was observed for the composites, regardless the instrument compliance. The reciprocity with respect to PS was not followed under low compliance. However, the reciprocity with respect to PS at higher compliances was followed for the composites studied. The peak TC, which is independent of instrument compliance, increased significantly with intensity for all the composites tested.

Conclusions: Simultaneous and real-time measurements provide insight into inter-related kinetics of polymerization properties under various curing light intensities. Our preliminary results indicate that the exposure reciprocity studies should consider PS, DC and PE together to comment on its applicability for dental composites with varying constituents. More importantly, regarding the effects of reciprocity on PS with different curing light intensities, the relevant compliance of apparatus should always be considered.

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Improvement of physical properties of MTA incorporated by ELP



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Purpose/aim: The aim of this study is to investigate the effect of elastin-like polypeptide (ELP) based matrix on the physical properties of MTA.

Materials and methods: ELP synthesis: The pET28b vectors containing ELP sequences synthesized by genetic engineering were expressed in *E. coli* BLR (DE3) bacteria. The elastin-like polypeptide (ELP; V125, V125-E8) was then purified. The 10 wt% ELP solution was made with deionized water. Microhardness: Samples were prepared by mixing MTA (ProRoot MTA; Dentsply Tulsa Dental, OK) powder with three types of liquid (deionized water, 10 wt% V125, 10 wt% V125E8). Microhardness was measured with Vickers tester (HMV-2, Shimadzu Corp., Tokyo, Japan). Compressive strength: Each mixed sample was immediately transferred into the Teflon molds (3.0 mm in diameter and 7.0 mm in height) and compressive strength was then measured by using a universal tester (UH-X, Shimadzu Corp., Tokyo, Japan) at 0.5 mm/min of speed. Anti-wash out: The specimen placed into a simulated body fluid (HEPES) at 37 °C. After shaking the three specimens for 5 min, 1 h, and 24 h, washout ratio of the specimen was evaluated by measuring the weight.

Results: Microhardness, Compressive strength: As L/P decreased, the value of microhardness and compressive strength increased. At all L/P ratios, values were given in order of V125E8 > V125 > DW ($P < 0.05$). Anti-wash out: After 24 h, washout resistance of the samples increased in order of MTA + DW, MTA + V125, and MTA + V125E8 ($P < 0.05$).

Conclusions: The ELP supplemented MTA showed a significantly enhanced handling property, microhardness, compressive strength, anti-washout property. This study indicates that ELP can be used to develop the inorganic dental repairing cement to have improved physical properties.

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Effect of acrolein-based primer as collagen cross-linker on dentin adhesion



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Purpose/aim: In adhesive dentistry, the stability and integrity of collagen fibrils within the hybrid layer is crucial for the maintenance of bond effectiveness over time. MMPs

are a class of zinc- and calcium-dependent endopeptidases that are trapped within the mineralized dentin matrix during tooth development. Since type I collagen fibril network represents the backbone of dentin, the collagenolytic/gelatinolytic activity of these endogenous enzymes has been shown to be responsible for the *in vitro* and *in vivo* hybrid layer degradation causing slow hydrolysis of collagen fibrils over time. The aim of this study was to evaluate the effect of an acrolein-based primer pretreatment, used as a cross-linker, on the hybrid layer created by a two-step etch-and-rinse adhesive system.

Materials and methods: Dentin surfaces were etched with 35% phosphoric acid for 15 s, rinsed and blot dried. Specimens were then assigned to: Group 1: dentin was pretreated with 0.01% acrolein (ACR) water solution for 1 min, then bonded with Adper Scotchbond 1 XT (SB1XT), a 2-step etch-and-rinse adhesive system; Group 2: SB1XT was applied on untreated etched dentin (control group). Composite buildups were made using Filtek Z250. Specimens were subjected to microtensile bond strength test and stressed to failure immediately or after 1 year of storage in artificial saliva at 37 °C. To investigate dentinal matrix metalloproteinase activity (MMPs), zymographic assay was also performed on protein extracts obtained from etched dentin powder treated with or without ACR before SB1XT adhesive application. Finally, *in situ* zymographic assay was performed to investigate endogenous MMPs activity within the hybrid layer in accordance with Mazzoni et al., 2014. Results were statistically analyzed with ANOVA tests and statistical significance was set for $p < 0.05$.

Results: The use of 0.01% ACR as conditioning primer did not affect immediate bond strength (Group 1: 44.6 ± 14.2 MPa; Group 2: 40.1 ± 8.2 MPa) but contributed to stabilizing bond strength over time. After 1yr storage in artificial saliva, ACR bonded specimens showed no significant reduction of bond strength (Group 1: 46.4 ± 6.1 MPa), while the control group resulted in significant loss of bond strength values. Zymographic and *in situ* zymographic assays showed that when acrolein was used before adhesive application, dentinal MMPs activity was significantly reduced.

Conclusions: Dentinal collagen cross-linking induced by acrolein-based primer increased the durability of resin–dentin bonds by the reinforcement of the adhesive interface and inhibition of dentinal MMPs. Further studies are needed to evaluate the potential acrolein cytotoxicity both *in vitro* and *in vivo*.

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Bond strength of a self-adhesive-cement to a CAD-CAM composite block



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Purpose/aim: Compare the shear bond strength of a self-adhesive resin cement to a composite CAD-CAM material.

Materials and methods: Five slabs, measuring 15 mm × 10 mm × 1.5 mm, were made of A3-HT blocks. Slabs were divided into 3 different groups: (1) control; (2) OneCoat 7 for 15 s and (3) OneCoat 7 with a chemical activator for 15 s. Groups were subdivided into 3 subgroups: (a) 1 h, (b) 7 days and (c) 14 days of storage. Cement plugs measuring 2.3 mm in diameter and 5 mm in height were made with a jig (Ultradent, USA). The cement was injected into the jig with an automix tip and polymerized for 20 s with an LED unit (Elipar Deep Cure; 3M). Prior to dispensing the cement surface treatment was performed. Specimens were stored in deionized water at 37 °C. Shear bond test was performed in a universal testing machine (5566A, Instron) with a 1-kN cell, at 0.5 mm/min cross-head speed and a half-moon shear apparatus. The adhesive and/or cohesive failures were analyzed by an optical microscope. Data were analyzed by ANOVA followed by Tukey HSD test ($p < 0.05$).

Results: Means and standard deviations of shear bond strength values (MPa) are shown in Table 1. Values were statistically significant. The highest shear bond strengths were achieved when treatment of the surface was performed. Failures were mainly adhesive, except for groups 1b and 1c where cohesive failures were mainly observed. There was no statistical significant difference when the chemical activator was used in addition to the self-etch adhesive. Shear bond strength values for the group where no surface treatment was performed increased after 7 days and did not decrease after 14 days.

Table 1 – Means and standard deviations of shear bond strength (MPa) of tested groups.

Test/storage	Surface treatment		
	1 – control	2 – OneCoat	3 – OneCoat + Chemical activator
a – immediate (1 h)	3.20 ± 0.23	9.97 ± 1.90	8.29 ± 4.33
b – 7 days	14.29 ± 3.30	16.60 ± 4.50	15.70 ± 4.23
c – 14 days	15.21 ± 2.41	16.66 ± 3.89	16.42 ± 3.83

Conclusions: Within the limitations of this study, it was concluded that the shear bond strength of SoloCem to the CAD-CAM block was higher when surface treatment was performed. There were no changes in bond strength values after storage up to 14 days.

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Polish retention and wear of several bulk fill composite materials



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Purpose/aim: The objective of this work was to compare and contrast 6 bulk fill composites, and determine what role, if any, the filler package plays in the materials wear and polish retention characteristics.

Materials and methods: 5 tiles each of 6 commercially available composite materials were polished to a high initial gloss. An initial 60° gloss measurement was taken of these samples and the samples were toothbrush abraded under fixed conditions for 6000 strokes. The resulting gloss was then measured after brushing. Additionally, 3-body wear resistance was measured in micron loss for all of these composites, and micrograph images taken to evaluate the wear patterns and behavior of the composites.

Results: See Table 1.

Table 1 – Gloss and wear of bulk fill composites.

Composite	Lot#	Initial 60° gloss (SD)	60° gloss after 6000 toothbrush strokes (SD)	3-body wear depth at 200,000 cycles, microns (SD)
Filtek™ One	N762193	95.1 (1.5)	58.7 (7.2)	27.1 (0.6)
Sonic Fill™	5405042	90.1 (1.7)	28.9 (2.7)	37.9 (1.1)
Sonic Fill™ 2	5828280	90.7 (1.1)	18.1 (1.7)	27.5 (0.2)
Venus™ Bulk Fill	010109	89.5 (2.4)	13.7 (1.0)	73.0 (6.6)
Tetric™ EvoCeram Bulk Fill	U53768	90.6 (1.8)	14.3 (1.6)	50.0 (1.2)
X-Tra Fil™	1546660	50.3 (10.4)	16.4 (1.8)	21.6 (0.7)

Conclusions: When analyzed by ANOVA ($P < 0.05$), Filtek™ One showed higher gloss after brushing than the remaining composites. Only Filtek™ One exhibited a combination of high gloss retention and low wear rates among the composites tested. This is hypothesized to be due to the nanofiller used in the composite.

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Effect of radiotherapy on endogenous matrix metalloproteinases of restored dentin



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Purpose/aim: Head and neck cancer patients present high incidence of radiation-related caries and early restorations failures. So, the aim of the present study was to evaluate the effect of radiotherapy on dentinal matrix metalloproteinases (MMPs) activity of restored dentin with a self-etch and an etch-and-rinse adhesive using in situ zymography.

Materials and methods: Specimens were divided into 6 groups ($n=10$), according to its irradiation form (not irradiated, irradiated then restored, restored then irradiated) and the adhesive used (Adper Single Bond, 3M ESPE or ClearFill SE Bond, Kuraray). Cavities were standardized and restorations were performed according to the manufacturers instructions. Samples were irradiated submerged in distilled water with a total and single application of 70Gy with X-rays from a linear accelerator (Mevatron MX2 6 mV; Siemens Healthcare, Erlangen, Germany). One-mm-thick slabs were obtained from each tooth and polished until 500 μm . In situ zymography was performed with self-quenched fluorescein-conjugated gelatin as the MMPs substrate. Negative-control sections were incubated with either ethylenediaminetetraacetic acid (EDTA) dissolved in a mixture of quenched fluorescein-conjugated gelatin or standard non-fluorescent gelatin. The endogenous gelatinolytic enzyme activity was evaluated by examination with a confocal laser-scanning microscope (Zeiss LSM 780-NLO, Carl Zeiss Microscopy GmbH).

Results: The confocal microscope analysis showed that radiotherapy, both pre- and post-restoration, was unable to alter the gelatin hydrolyzation patterns at the hybrid layer at 24 h after restoration when compared to the not irradiated specimens. Regardless of irradiation form, Clearfil SE bond presented an intense green fluorescence within the hybrid layer indicating that the MMPs activity was strongly at these sites. Conversely, Adper Single Bond had an intense green fluorescence within the dentinal tubules, and lower fluorescence at the hybrid layer. No fluorescence could be detected in the negative control using EDTA-treated or standard non-fluorescent gelatin.

Conclusions: Radiotherapy did not influenced MMPs activity immediately after restoration. Further studies are currently ongoing to evaluate the effect after aging.

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Bulkfill composites are affected by low power density of light



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Purpose/aim: To evaluate microhardness of bulkfill composites light-cured with different LED lamps at various distances between lamp-tip and composite.

Materials and methods: Composites used; bulkfill: Filtek BulkFill (3M-ESPE) – A, SDR (Dentsply-Sirona) – B, Beautifill Bulk (Shofu) – C, Beautifill BulkFlow (Shofu) – D, conventional: Filtek Z550 (3M-ESPE) – E, Beautifill II (Shofu) – F, Filtek Flow (3M-ESPE) – G. Cylindrical samples of each material (4 mm diameter, 2 mm high and 4 mm diameter, 4 mm high) were prepared, light-cured from one side via plastic strip, with the lamp tip in contact, at 2 and 4 mm distance. LED lamps used; 3M-ESPE (1000 mW/cm² at lamp tip) – 1, MiniLed Aceton (2000 mW/cm²) – 2 and FlashMax P3 460 (4000–6000 mW/cm²) – 3. Curing times: 20 s for lamp 1, 10 s for lamp 2, 4 × 1 s for lamp 3. Light spectrum analysis was performed by Ocean Optics USB-650 UV. Microhardness tests were performed on both sides of the samples using Anton Paar Microhardness Tester and Nikon Eclipse Microscope. Statistical analysis: Student's *t* and ANOVA.

Results: All lamps emitted light within the range of 448–470 nm (FWHM). The range of microhardness (VHN) for 2 mm thick samples, measured at top with 0 mm distance and bottom of the sample with 4 mm distance, cured with lamp 1 was: for material A 47-41, B 20-17, C 50-44, D 40-26, E 78-42, F 61-50, G 34-26, cured with lamp 2 was: for material A 44-37, B 16-16, C 54-47, D 42-30, E 74-42, F 66-38, G34-18, cured with lamp 3 was: for material A 33-29, B 14-11, C 31-20, D 34-30, E 74-39, F 42-21, G 32-17. The range of microhardness (VHN) for 4 mm thick samples, measured at top with 0 mm distance and bottom of the sample with 4 mm distance, cured with lamp 1 was: for material A 54-29, B 21-11, C 40-19, D 36-23, E 73-36, F 60-49, G 36-22, cured with lamp 2 was: for material A 41-28, B 17-13, C 42-25, D 44-22, E 76-49, F 65-37, G 35-19, cured with lamp 3 was: for material A 40-17, B 16-6, C 38-11, D 32-17, E 69-36, F 42-18, G 34-0.1

Conclusions: Microhardness was found to depend on the sample thickness, type of curing lamp and distance from the sample (power density of light). All composites, including bulkfill, were most affected by large sample thickness and low power density of light. Significant differences in microhardness between top and bottom of the samples in majority

of the materials may indirectly indicate compromised polymerization.

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Long-term bond strength of glass-ceramic treated with acid ceramic primer



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Purpose/aim: The aim of this study was to evaluate the surface topography and long-term bond strength produced by hydrofluoric acid or acid built-in ceramic primer on CAD-CAM lithium disilicate-based glass-ceramic.

Materials and methods: Fifteen disc-shaped specimens, 2.0 ± 0.1 mm diameter and 0.5 ± 0.05 mm in thickness, were milled from lithium disilicate CAD/CAM blocks (IPS e.max CAD, Ivoclar/Vivadent) on an E4D Dentist System (D4D Technologies, LLC, Richardson, TX) using a custom-mill file and fired unglazed according to the manufacturer's instructions. All disks were polished with 1000 grit sandpaper and divided in three groups ($n=5$): (1) no etching (C); (2) hydrofluoric acid 5%/20 s (HF); (3) Monobond Etch & Prime (Ivoclar/Vivadent) for 60 s (MBEP). All specimens were ultrasonically cleaned in distilled water for 10 min and the surface was prepared to be analyzing in a scanning electron microscopy (SEM). Sixty ceramic sticks ($2 \times 2 \times 4 \pm 0.1$ mm) were cut from IPS e.max CAD ceramic blocks with a low-speed diamond saw, then divided into 2 groups (24-hours and 12-months). Each group was distributed into three sub-groups ($n=10$): (1) no etching (C); (2) hydrofluoric acid 5% for 20 s + silane (Monobond Plus) (HFS); (3) Monobond Etch & Prime (Ivoclar/Vivadent) for 60 s (MBEP). After treatment, composite blocks ($2 \times 2 \times 4 \pm 0.1$ mm) were bonded to the treated ceramic blocks using resin cement (Variolink II, Ivoclar-Vivadent). The ceramic-composite assemblies were stored for 24-hours and 12-months in 100% relative humidity at 37 °C prior tensile bond strength (TBS) testing. Statistical analysis was performed using 2-way ANOVA and Tukey test ($\alpha=0.05$). Failure pattern was analyzed on SEM.

Results: Two-way ANOVA showed that the factors "treatment" and "storage time" were statistically significant for bond strength ($p < 0.001$). However, their interaction was not statistically significant ($p < 0.001$). HFS and MBEP bond strength did not differ among them and were statically different compared with control group in both periods of time ($p < 0.05$). However, all groups (24 h: 13.0 ± 5.5 ; 12 mo: 10.9 ± 5.1) showed reduced bond strength after 12-mo water storage. The mixed patterns (adhesive and cohesive in cement) were predominant for experimental groups, except to the control group (adhesive) for both period of storage time. MBEP produced shallow irregularities. For the HF group, those irregularities appeared to be more pronounced.

Conclusions: Acid ceramic primer produced slight surface morphological irregularities. The HFS and MBEP treatment improved ceramic/resin cement bond strength after both

short- and long-term water ageing, but no difference was detected among them. Both treatments showed reduced bond strength from 24-hours to 12-months water storage.

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Chelating solutions effect on bond strength in irradiated teeth



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Purpose/aim: To evaluate the influence of radiation on push-out bond strength (BS) of root canal sealer to dentin and at the sealer-dentin interface after final irrigation with NaOCl, EDTA, and chitosan.

Materials and methods: 64 maxillary canines were selected and distributed into two groups ($n=30$)—non-irradiated and irradiated with 60 Gy. The canals were prepared with Reciproc (R50), and each group subdivided ($n=10$) for final irrigation (1% NaOCl, 17% EDTA, 0.2% chitosan) and filled. Three dentin slices (1 mm) were obtained from each root third. The first slice of each third was selected to BS evaluation, and failure mode was determined by stereomicroscope. In the remaining slices SEM analysis of sealer-dentin interface was performed. Data were analyzed by two-way ANOVA and Tukey tests ($\alpha=0.05$).

Results: Lower BS ($P < 0.0001$) was obtained after irradiation (2.07 ± 0.79 MPa), regardless of the final irrigation solution used. NaOCl group ($P < 0.001$) presented the lowest BS in irradiated (1.68 ± 0.72) and non-irradiated (2.39 ± 0.89) groups, whereas the EDTA (2.14 ± 0.77 irradiated and 3.92 ± 1.54 non-irradiated) and chitosan groups (2.37 ± 0.73 irradiated and 3.51 ± 1.47 non-irradiated) presented higher BS and were similar ($P = 0.9080$). Regarding root thirds, the highest values were observed in coronal (3.17 ± 1.38) when compared to middle (2.74 ± 1.36) and apical thirds (2.09 ± 0.97) ($P < 0.0001$). More cohesive failures occurred in the dentin, regardless of the final irrigation solution used. SEM revealed more gaps in irradiated specimens. Moreover, few spaced and irregularly arranged resin tags were observed.

Conclusions: Radiation was associated with a decrease in the BS, regardless of the final solution used, and chitosan increased BS in teeth subjected to radiation therapy when compared to NaOCl and EDTA.

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Lack of 10-MDP primers neutralization by zirconia

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Purpose/aim: To assess the effects of different concentrations of 10-MDP included in experimental and commercial ceramic primers on degree of conversion (DC) and microshear bond strength (μ SBS) of a conventional dual-cure resin cement and the acidity neutralization potential of zirconia (ZrO_2) and hydroxyapatite (HAp).

Materials and methods: Experimental ceramic primers were formulated containing 5, 10, 20, or 40 wt% of acidic functional monomer 10-MDP and camphoroquinone/amine (CQ) or 1-phenyl-1,2-propanedione (PPD) as photoinitiator systems. Clearfil Ceramic Primer (Kuraray) was used as commercial control primer. Micro-Raman spectroscopy analysis was used to assess the DC by the ratios between the heights of 1639 cm^{-1} and 1609 cm^{-1} peaks of uncured and light-cured resin cements applied after application of ceramic primers onto sintered zirconia surfaces. Previously to cement application, 10-MDP containing primers were actively applied onto Y-TZP surfaces and μ SBS were analysed using a universal testing machine. The pH of each primer (1 mL) was initially assayed and 10 aliquots of 0.1 g of ZrO_2 or HAp were added and pH variation was obtained. Statistical analysis was performed by two-way ANOVA and Tukey's test ($p < 0.05$).

Results: DC was not affected until 10-MDP concentration of CQ10 ($93.5 \pm 0.3\%$) and PPD5 ($92.1 \pm 3.2\%$), but higher concentrations induced significant DC reduction. CQ5 ($13.4 \pm 2.1\text{ MPa}$) and PPD5 ($12.8 \pm 1.8\text{ MPa}$) showed the highest μ SBS. HAp neutralized 10-MDP primers, but ZrO_2 left primers' pH with higher acidity.

Conclusions: 10-MDP monomer should be used in low concentrations in zirconia primers to avoid reduction on polymerization of the resin cement.

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Adhesion and mechanical properties of CAD-CAM resin/ceramic hybrid materials

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Purpose/aim: This study evaluated the flexural strength (FS) and elastic modulus (EM) of CAD/CAM Resin/Ceramic hybrid materials (RCHM) and investigated the effect of atmospheric pressure plasma application on shear bond strength (SBS) of two resin cements to RCHM.

Materials and methods: Three RCHM materials (Lava Ultimate, 3M ESPE; Enamic, Vita and Cerasmart, GC Corp.) and one regular indirect composite (Epicord, Kuraray Noritake) were tested. Plates ($14 \times 7 \times 1\text{ mm}$) were prepared for SBS test and submitted to three different surface treatments ($n = 10$): according to manufacturer's instructions (MI); argon plasma (30 s) (AP) and argon plasma (30 s) + adhesive primer (PA). A silicon mold with a 1.5 mm thick and 1.5 mm diameter hole was positioned on treated area of indirect materials and the uncured resin cement (Panavia V5, Kuraray Noritake or RelyX Ultimate, 3M ESPE) filled up the hole and was then light activated (Valo, Ultradent). Plates were water-stored for 24 hours before SBS test. Rectangular bars ($12 \times 2 \times 1\text{ mm}$) of all indirect materials were obtained ($n = 10$) and submitted to three-point flexural test at a universal testing machine (Instron 4411 – 1.0 mm/min) to obtain FS and EM values. FS and EM data were analyzed by one-way ANOVA and SBS data by three-way ANOVA and Tukey's test ($\alpha = 0.05$).

Results: SBS of Lava Ultimate for groups AP and PA yielded no significant difference compared to MI for both resin cements. For other indirect materials with Panavia V5, MI groups produced the highest SBSs. Groups AP and MI showed no significant difference for RelyX Ultimate bonded to Enamic. For Cerasmart and Epicord, AP and PA did not differ from MI, regardless of the resin cement. In general, RelyX Ultimate yielded higher SBS to indirect materials than Panavia V5. Epicord showed the lowest FS and EM values. Cerasmart presented the highest FS, but the lowest EM, while Enamic showed the lowest FS value and the highest EM.

Conclusions: SBS of resin cements to indirect materials according to the manufacturer's instructions always showed the best results. Plasma application can be an alternative surface treatment, depending on the RCHM and resin cement. The regular indirect composite presented lower FS and EM than those obtained with CAD-CAM materials.

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Reactivity of dental silane coupling agents

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Purpose/aim: To evaluate the reactivity of 6 commercially available silane primer formulations based on γ -methacryloxypropyl trimethoxysilane (MPTMS).

Materials and methods: The primers tested were Calibra Silane Coupling Agent/Dentsply (CL), Clearfil Universal Bond Quick/Kuraray Noritake Dental (CQ), G-Multi Primer/GC (GM), Kerr Silane Primer/Kerr (KS), Monobond Plus/Ivoclar Vivadent (MB) and Scotchbond Universal Bond/3M Espe (SB). The primers were analyzed by MIR-FTIR spectroscopy (Gemini-crystals) as received (T0), after 1 h storage (air/dark/37°C) plus ethanol rinsing to remove the loosely bound fractions (T1) and after 24 h storage (T24) as before.

Results: Si–OH (904 cm^{-1}) groups were identified only in CL at T0 as a result of Si–O–CH₃ ($2842, 1088, 817\text{ cm}^{-1}$) hydrolysis. Formation of Si–O–Si ($1120, 1043\text{ cm}^{-1}$) bonds (physisorbed) due to silanol condensation was found at T1 and further increased at T24. All other treatments, without Si–OH peaks in the as received state, provided evidence of Si–O–Si formation by condensates, with the characteristic peaks significantly increasing at T24, especially after GM and MB treatments. CL and MB, the latter to a smaller extent, showed evidence of chemisorbed Si–O– on Ge ($1095, 1020\text{ cm}^{-1}$).

Conclusions: Mixing of MPTMS with conventional or adhesive methacrylate monomers modifies the reactivity of silanols by formation of condensates, which may further react by physisorption of Si–O–Si groups on the substrate. Therefore, the main advantage of silanol chemisorption is diminished, apparently due to side reactions with other condensable chemical groups. This may have a detrimental effect on the bonding capacity of many modern silane formulations, incorporating conventional or adhesive monomers.

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In vivo color stability in composite restorations: 12-month results

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Purpose/aim: The aim of this in vivo study was to evaluate the color stability of an Ormocer-based composite and a composite resin. The null hypothesis was: no different behavior between restorations and enamel over a delta E 1.5, distributed between L* and b*.

Materials and methods: The explanatory trial concerned 20 people, 8 males and 12 females, between 25 and 60,



with the need of two similar restorations in upper frontal teeth, where the same operator applied Admira fusion and Futura Bond U (Voco) and Estelite Admira and EE bond (Tokuyama) with the appropriate shades. Exclusion criteria were smokers, consumers of coffee or tea (>2) and red wine (>1 glass) per day, liquorices. 20 teeth were treated: 13 central incisors, 5 lateral incisors, 2 canines. Restorations and teeth were tested with a reflectance spectrophotometer (Micro Spectro Shade, M.H.T.) using the same diameter of reading. The control was done after one week (baseline) at 6 and 12 months, the follow-up is scheduled for 3 years. A colorimetric evaluation according to the CIE L*a*b* system was performed. The total color differences were calculated as follows: $\Delta E: [(L^* - L^*_2)^2 + (a^* - a^*_2)^2 + (b^* - b^*_2)^2]^{1/2}$ and the translucency was calculated with the formula TP: $[(L^*_1 - L^*_2)^2 + (a^*_1 - a^*_2)^2 + (b^*_1 - b^*_2)^2]^{1/2}$ using the same grey paper as back. Data analysis was performed by ANOVA and Tukey's post-hoc test ($p < 0.05$)

Results: Delta E for enamel color varied from 0.5 to 0.8, for restorations from 0.5 to 1.2; translucency varied from 0.5 to 0.7 for enamel and from 0.8 to 1.3 for restorations without any statistical difference ($p < 0.02$) between enamel and materials and between materials.

Conclusions: The null-hypothesis was accepted. The color stability of enamel and composite was not significantly different. The limit of this research is concerning the short period of control and the criteria of an explanatory trial, but it is necessary to underline that an in vivo research is not available in the literature.

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Evaluation of gutta percha-sealer interface using SEM

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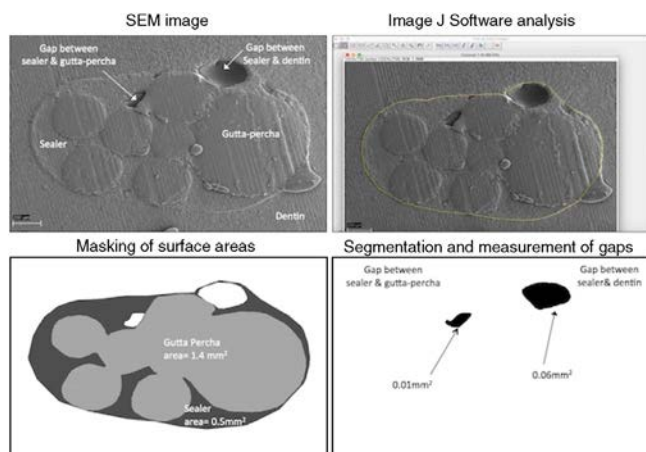


Purpose/aim: The aim of the present study was to evaluate the adaptation of a calcium silicate bioceramic (BC) sealer with either BC or conventional gutta-percha compared with that of AH Plus sealer in different root canal sections.

Materials and methods: Seventy-two extracted mandibular premolars were divided randomly into six groups. After standardized chemomechanical preparation, four groups were obturated with BC sealer and BC gutta-percha or conventional gutta-percha, and the other two groups were obturated with AH Plus sealer and conventional gutta-percha either in lateral condensation or in a single cone technique. Each root was sectioned into three sections. An impression was made from each section, and replicas were then made for scanning electron microscopy (SEM) analysis. Areas and interfacial gaps were identified using image analysis software. In addition to descriptive and explorative data analyses, linear regression analysis was performed.

Results: All specimens had measurable interfacial gaps. Significantly fewer gaps were found between conventional gutta-percha and sealer compared to those observed when using BC gutta-percha ($p < 0.001$). However, minor interfacial gaps between sealer and dentin were observed with BC sealer ($p = 0.04$). The technique of obturation in different root canal sections did not significantly affect the sealer adaptability.

Conclusions: The type of gutta-percha as well as the sealer had a noticeable impact on the adaptability.



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Impact of coloring/fluorescence-liquids and aging on fracture resistance of zirconia

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Purpose/aim: To achieve a satisfying esthetic appearance for tetragonal zirconia polycrystals stabilized with 3 mol% yttria (3Y-TZP), laboratorial pretreatments such as immersion in coloring and/or fluorescent liquids can be performed. It is essential to know the possible impact of aging and pretreatment with these coloring liquids on 3Y-TZP's mechanical properties. Therefore, the aim of this study was to evaluate the flexural strength of a pigmented and/or fluorescent 3Y-TZP before and after accelerated aging protocol.

Materials and methods: 80 zirconia discs (Prettau® Zirconia, Zirkonzahn, Italy) of 14 × 2.5 mm size were fabricated and divided into four groups ($N = 20$) according to the laboratorial treatment: ZN (no pretreatment); ZC (immersion in coloring liquid); ZF (immersion in fluorescent liquid); ZFC (immersion in coloring/fluorescent liquid) and sintered afterwards. Ten disks of each group were subjected to accelerated aging

protocol in an autoclave for 5 h. All discs were subjected to biaxial flexural strength testing (Ball-on-three-balls test). The resistance values obtained were analyzed by Two-way ANOVA and Tukey's HSD ($p < 0.05$). The Weibull modulus (m) was used to analyze the probability of fracture. The content of tetragonal and monoclinic phase was observed by XRD and the microstructure was observed by SEM.

Results: A significant increase in total flexural strength after aging ($p < 0.001$) was analyzed. However, when the laboratorial pretreatments applied were evaluated, no significant difference was observed ($p = 0.27$). At XRD analysis, specimens subjected to accelerated aging showed monoclinic content of 30%; non-aged specimens presented no content.

Conclusions: The increase in flexural strength of the groups subjected to accelerated aging for 5 h suggests that the increase of the monoclinic content, by being concentrated on the surface, generated compressive stresses that strengthened the material. Regarding laboratorial treatments, there was no significant difference in flexural strength, demonstrating that the use of coloring and fluorescence liquids did not influence the fracture resistance of the 3Y-TZP studied.

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Effect of immersion media on color stability of bulk-fill composites

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Purpose/aim: This study was to assess the color stability of three different types of bulk fill composites immersed in different types of beverages after one-week and 1-month periods.

Materials and methods: Bulk-fill composites tested were Tetric N-Ceram, Filtek Bulk Fill and Sonic Fill and, a packable composite (Solitaire 2) was used as control. A total of 160 specimens (8 mm × 4 mm bulk fill and 8 mm × 2 mm packable composite) were fabricated using cylindrical metal mold. All the specimens were stored in distilled water for 24 h at 37 °C. Thereafter, baseline color values of each specimen were measured using a spectrophotometer according to the CIE L*a*b* color scale. Then, 10 randomly selected specimens from each resin composite were immersed in one of the following media: Coffee, coke, red wine and distilled water as control for 1-week and 1-month. After each immersion period the color values of specimens were remeasured, and the color change value (ΔE) was calculated. Data were analyzed using Kruskal–Wallis and Mann–Whitney U tests at $p < 0.05$.

Results: According to 1 week results, Filtek bulk fill composites showed lower discoloration than coffee and red wine groups of Solitaire 2 and other bulk fill samples. There were no significant difference among the specimens that were immersed in cola and distilled water ($p > 0.05$). At 1-month,



Tetric N-Ceram Bulk showed significantly higher discoloration among the specimens immersed in coffee ($p < 0.001$). In red wine groups, Filtek bulk fill composite showed significantly lowest discoloration among the other specimens ($p < 0.05$). Regardless of the resin composites tested, distilled water resulted in the lowest level of discoloration after both immersion periods ($p < 0.05$).

Conclusions: The discoloration of bulk fill resin composites used in this study had lower discoloration compared to packable composite. Immersion in coffee and red wine showed noticeable staining on all the materials.

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Simulation of development of internal stresses within zirconia FPD's



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Purpose/aim: Full zirconia restorations that are fabricated chairside are becoming more and more popular. There is an increasing trend to develop translucent monolithic zirconia materials with superior esthetics, which, however, show inferior mechanical strength. Furthermore, the sintering process of zirconia restorations is time consuming and should be reduced for chairside applications. In this study the possible reduction of the cooling time of the FPDs after sintering was investigated, taking into account the mechanical strength of full-contour zirconia FPDs.

Materials and methods: In order to evaluate the development of internal stresses during the cooling phase, coupled computational fluid dynamics and finite element method (CFD-FEM) simulations were conducted using the FEM software Abaqus and the CFD software Fluent. The evolution of the temperature distribution during the cooling phase in a three-unit full zirconia molar FPD (IPS e.max ZirCAD MT) was simulated with CFD. Several different cooling processes were taken into account. Additionally, several temperature measurements were conducted. The simulated temperatures were verified with the measured temperatures. The verified simulated temperature distribution in the FPD was used as an input for the FEM simulations in order to calculate the internal stresses during the cooling phase. The calculated stress values were compared with the temperature dependent experimentally determined strength values. Furthermore, the internal stresses were used to calculate the fracture probability of the FPD during the cooling phase after sintering.

Results: The simulated temperature values favorably correlated with the temperature measurements. The maximum difference between the calculated temperature values and the measured temperatures was lower than 50 °C throughout the entire computation time. In the subsequent FEM simulations, the maximum value of the maximum principal stress was calculated as about 150 MPa for the FPD which was cooled down by opening the furnace for 2 min at 1200 °C. This value

is considerably lower than the corresponding strength value of 400 MPa at that temperature.

Conclusions: The simulation results showed that the opening of the furnace for 2 min at 1200 °C should be safe, as the fracture probability of the FPD was calculated to be less than 0.01%. Further simulations showed that the restoration material could even be cooled down faster without damaging the restoration.

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Influence of nanotopography implants on biomechanical parameters in diabetes



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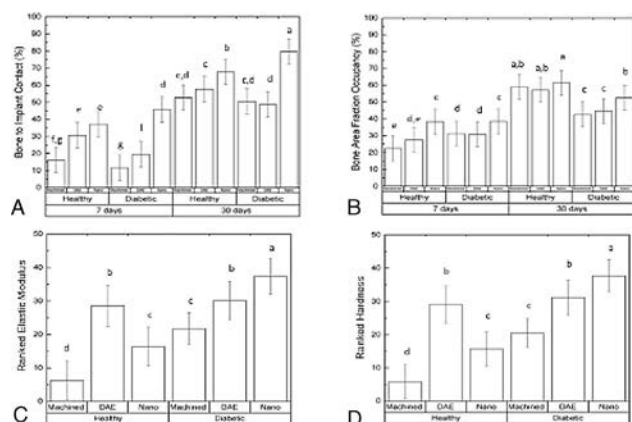
Purpose/aim: The aim of this study was to evaluate, in healthy and diabetic rats, (as a model of deficient bone repair) the response of a new topography implant surface (nano-hydroxyapatite coating), concerning to bone regeneration: bone to implant contact (BIC) and bone area fraction occupancy (BAFO); and nanomechanical properties: elastic modulus (EM) and hardness (H).

Materials and methods: Mini implants (MI) with 3 types of surface treatment (machined = M, double acid etched = DAE, and nano-hydroxyapatite coating = NANO) were installed in the tibias of healthy ($n = 36$) and diabetic rats ($n = 36$). The 72 rats were randomly divided into 6 experimental groups defined as follows ($n = 12$ /group): G1 (HM): M MI installed in healthy rats; G2 (HDAE): DAE MI installed in healthy rats; G3 (HN): NANO MI installed in healthy rats; G4 (DM): M MI installed in diabetic rats; G5 (DDAE): DAE MI installed in diabetic rats; and G6 (DN): NANO MI installed in diabetic rats. All the MI had the same macrostructure concerning to length, diameter and thread design (2.7×1.4 mm). The animals were euthanized 7 and 30 days (7d and 30d) after implant placement, and the specimens were histologically processed. Histological parameters (BIC and BAFO) and nanomechanical properties (EM and H) were evaluated. Data were assessed through analysis of variance + Tukey test and are presented as a function of mean and 95% confidence interval.

Results: Higher %BIC was evidenced for NANO group compared to M and DAE (data collapsed over systemic condition). Statistical analysis considering both factors, systemic condition and surface treatment, depicted that all NANO groups revealed higher %BIC. When all factors were evaluated, NANO groups showed statistical significant differences compared to other experimental groups, but G3 (HN) 7d. Higher %BAFO was shown for NANO group compared to M and DAE (data collapsed over systemic condition). Evaluating %BAFO as a function of both, systemic condition and surface treatment, demonstrated higher %BAFO for all NANO groups. When all factors were evaluated, NANO groups depicted significant

difference compared to other experimental groups, but G6 (DN) 30d. Evaluating H and EM, surface treated implants presented superior mechanical properties than machined, regardless systemic condition and time.

Conclusions: Nano-hydroxyapatite coated implants presented promising biomechanical results and can be considered an important tool to compensate impaired bone healing reported in diabetics.



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Polymerization of universal adhesive: Effect of enamel and curing light

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Purpose/aim: This study investigated the degree of conversion (DC%) and rate of cure of universal adhesives in relation to: (1) interaction with enamel; (2) irradiation with two different curing lights.

Materials and methods: Adhesives tested were Peak Universal (PK-U, Ultradent), i-Bond Universal (iB-U, Heraeus Kulzer), Scotchbond Universal (SB-U, 3M ESPE), Adhese Universal (AD-U, Ivoclar Vivadent). Curing lights tested were DemiTMUltra (1100 mW/cm² – Kerr) and VALOTM (1000 mW/cm² – Ultradent). DC% and photopolymerization kinetic were evaluated using FTIR-ATR equipment (Nicolet 6700-Thermo Fisher). Fitting of the kinetic plot with a secondary polynomial function provided the rate of cure at 5, 10 and 15 s. Adhesives were placed on the FTIR diamond both as neat and mixed 1:1 (w/w) with enamel powder and photopolymerized for 20 s either with VALOTM or DemiTMUltra. Specimens of different thickness were used: 0.12 × 3 mm and 2 × 4 mm. Infrared (IR) spectra were obtained between 4000–500 cm⁻¹ at a resolution of 6 cm⁻¹. DC% was calculated considering the ratio between the area of the reactive C=C peak (1635 cm⁻¹) and the internal reference C=O peak (1715 cm⁻¹).

Results: In thinner specimens, photocuring of PK-U using DemiTMUltra was significantly less efficient compared to VALOTM ($p < 0.05$); the presence of enamel did not affect both the final DC% and rate of cure ($p > 0.05$). Differently, a significant increase of DC% ($p < 0.05$) of the iB-U/enamel mixture was

achieved using VALOTM. The irradiation of SB-U with DemiTMUltra resulted in significantly higher DC% ($p < 0.05$) compared to that obtained with VALOTM, while the effect of enamel was not relevant also in this case. AD-U showed no significant difference ($p > 0.05$) in DC% when photopolymerized as neat adhesive with both lights, while when mixed with enamel and irradiated with VALOTM a significant DC% decrease ($p < 0.05$) was observed. Photopolymerization of thicker specimens resulted in a drastic drop of DC% for all tested materials. The PK-U/enamel mixture showed a clear acceleration of the polymerization reaction compared to the neat adhesive when cured with VALOTM ($p < 0.05$). Increasing the specimen thickness caused an inadequate polymerization of iB-U and no effect related to enamel was detected. When SB-U and AD-U were photopolymerized with DemiTMUltra, the positive effect of enamel emerged both in the DC% final value and in the reaction kinetic ($p < 0.05$) compared to the neat adhesives.

Conclusions: The influence of enamel and curing light was material dependent. The positive effect of the interaction between universal adhesives and enamel, probably due to the neutralization of acidic monomers, appeared only when the specimen thickness and light power were varied.

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Dissolution behaviour of a novel sol-gel derived phosphate glass

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Purpose/aim: The present abstract describes the relative leaching kinetics of a new sol-gel phosphate-based glass (PBG) for dental application. A possible explanation of the mechanism is also given based on available knowledge of the structure of the phosphate glass network.

Materials and methods: PBG (P₂O₅ 48%–CaO 28%–Na₂O 24%, mol%) was synthesized by a sol-gel approach as follows: butyl-phosphate was mixed with Na-methoxide (25 wt% in methanol) and left stirring for 1 h. Then, Ca-methoxyethoxide (20 wt% in methoxyethanol) was added and stirring continued. After 24 h, the temperature was raised up to 60 °C and further stirring applied for 1 week. Subsequently, the wet gel was placed in an oven at 126 °C. After 2 weeks, the dry gel was washed with ethanol and calcined at 250 °C for 15 min with a ramp-up rate of 1 °C/min.

The PBG generated was soaked in ultra-pure-water at a concentration of 1 mg/ml and 37 °C for 2, 6, 24, 48, 168, 336 and 504 h under continuous stirring at 120 rpm. Then, solu-

tions were filtered twice using a 0.2 μm filter. The solutions were diluted five times with 0.6% HNO_3 and analysed by ICP.

Results: PBG was found to degrade in water quickly, exhibiting a burst release: ions reached the highest level after 2 h. Deeper observation revealed a decrease over time of the ions maybe due to salt precipitation. The relative content of ions released into water reflected their concentration in the glass. The fast dissolution may be explained considering a glass structure largely comprising P-tetrahedron chains. Sol-gel PBGs contain a significant amount of OH groups which act as chain terminators and strongly reduce network connectivity. Furthermore, they diminish chain length: the bridging action of modifier ions is thus potentially weaker resulting in less connectivity. The combination of these factors determines a faster protonation of the most external NBOs that causes the instant hydrolysis of the network and the burst release of the ions. The quicker dissolution may be beneficial as it makes ions immediately available to stimulate cell growth.

Conclusions: The leaching kinetics of a new sol-gel phosphate-based glass was studied: the glass was found to show a burst release in water. A possible explanation was suggested based on lower network connectivity and a possible favourable effect for dental cells was proposed.

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New biomimetic analog for self-etch dentin bonding and remineralization



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Purpose/aim: Dentin biomimetic remineralization represents today a feasible strategy to improve durability of resin-dentin bonds. It uses commonly two biomimetic analogues of phosphoproteins to stabilize (chelant) and guide (polyphosphonate) intrafibrillar mineralization of collagen. Herein, we proposed a new reagent (chelant polyphosphonate) to be tested as both analogues added to a self-etching primer with an adhesive containing bioactive calcium phosphate fillers.

Materials and methods: EDTMP (ethylene-diamine-tetramethylene-phosphonic acid) was the new analog and prepared primers were: without analogues and adhesive without fillers (negative control, NC), one containing main analogues trimetaphosphate (TMP) and polyacrylic acid (PAA) (positive control, PC) and others containing TMP/EDTMP, EDTMP/PAA or only EDTMP. Fillers group contained CaP-fillers in adhesive and no analogues in primer. Adhesives were applied on caries-affected dentin (CAD) and on sound dentin of extracted human molars. After 24 h or 6 months water

storage, specimens were assessed by microtensile bond strength (μTBS), nanoleakage and Micro-Raman spectroscopy of interface (hybrid layer and underlying dentin). Data was statistically analyzed by two-way ANOVA and Tukey's test ($\alpha = 5\%$).

Results: Microtensile test of sound dentin showed statistical difference ($p < 0.05$) only for EDTMP/TMP with μTBS increase after aging and for EDTMP/PAA with decrease. In CAD, there was μTBS reduction in NC, EDTMP/TMP and EDTMP/PAA ($p < 0.05$). Nanoleakage revealed presence of gaps and degradation of adhesive layer and underlying dentin in NC specimens after aging; this was not observed in further groups. Micro-Raman spectroscopy depicted presence of more intense mineralization in PC, EDTMP, EDTMP/TMP and only Fillers, but no remineralization in NC and EDTMP/PAA groups.

Conclusions: In conclusion, best outcomes of adhesion and remineralization on caries-affected dentin were attained using two traditional analogues (TMP/PAA) or with EDTMP alone, proving the effectiveness of this new agent.

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Hydrolytic stability of novel methacrylamide monomers for dental adhesives



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Purpose/aim: The stability of the bonded interface in acidic environments is crucial for composite restoration longevity. In this study, newly synthesized methacrylamide monomers for adhesive applications were evaluated for their hydrolytic stability as a function of the pH using nuclear magnetic resonance (NMR). The effect of the alkyl substitution on the stability of the secondary methacrylamide was evaluated.

Materials and methods: A series of 6 different secondary, alpha-substituted methacrylamides (HPMAM, HBMAM, HMPMAM, HEMMAM, HEEMAM, HEPMP) were synthesized using previously published methods (Schotten-Baumann acylation). Commercially-available 2-hydroxyethyl methacrylate (HEMA) and 2-hydroxyethyl methacrylamide (HEMAM) were used as controls. 60 mM of each monomer were mixed with 1.2 mL of deuterated water at pH 1, 2, 4, 5 and 7 and stored in capped NMR tubes ($n = 3$) for up to 30 days at 37 °C. The degradation of the monomers was evaluated based on the appearance of new peaks corresponding to the formation of degradation products (methacrylic acid and amino-alcohol). Data were analyzed with one-way ANOVA and Tukey's test for each time interval and pH level ($\alpha = 0.05$).

Results: In all monomers, hydrolysis increased with decreasing pH, but no detectable hydrolysis was observed at pH 4–7. Results for degradation at pH 1 and 2 are shown in Fig. 1. In some monomers, hydrolysis was followed by the esterification reaction of the degradation products. The substitution of one proton on the nitrogen atom of the primary methacrylamide to give N-(2-hydroxyethyl)methacrylamide (HEMAM), resulted in an increased stability of the monomer to hydrolysis, whilst substituting HEMAM on the α -carbon to

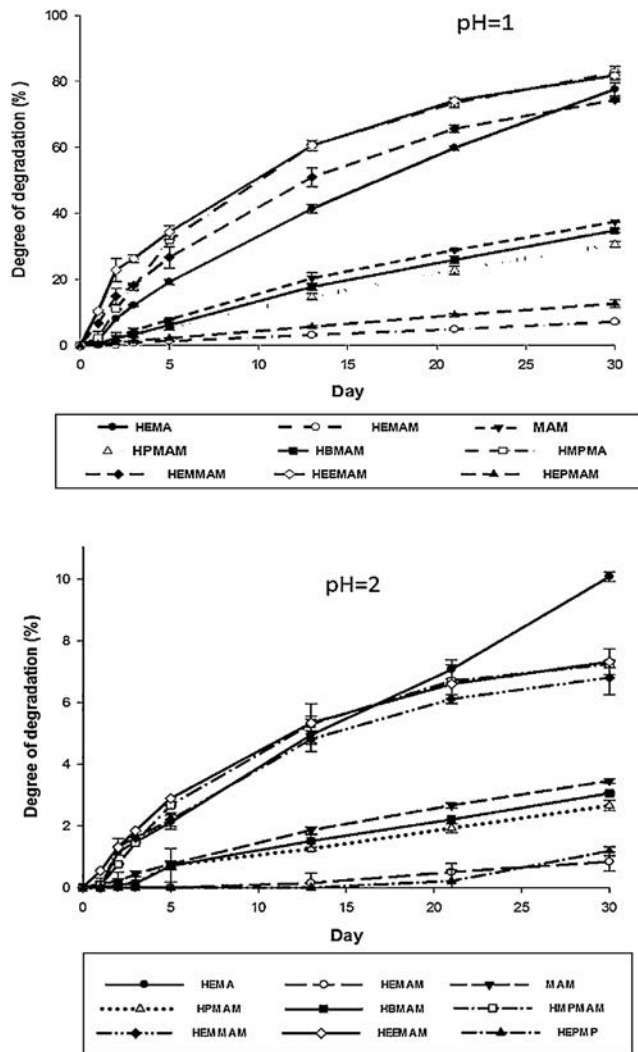


Fig. 1 – Percent degradation observed for the experimental and commercial monomers after 30 days storage in aqueous acidic solution as determined by the appearance of NMR peaks corresponding to the degradation products. Note the different scales on the Y axes for each graph, denoting a sharp decrease in degradation at pH 2 compared to pH 1.

the nitrogen with alkyl groups reduced the hydrolytic stability of the monomers. Substituting methyl and ethyl groups on the nitrogen of the HEMAM to form tertiary methacrylamdes increased the hydrolysis of the monomers more than substitution at the α -carbon.

Conclusions: The cyclic tertiary methacrylamide (HEPMP) and the secondary methacrylamide without alpha-substitutions (HEMAM) proved to be the most resistant of all the monomers in terms of hydrolysis, and can be considered good candidate co-monomers for dental adhesive formulations.

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Physicochemical characterization of DMLS dental implants



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Purpose/aim: Direct metal laser sintering (DMLS) is a technology for 3D printing that can allow design and manufacture customized dental implants using a digital model. The aim of this study was to compare experimental DMLS titanium dental implants with seven different conventional dental implants (CDI) available on the market.

Materials and methods: Four experimental DMLS implants and seven different CDI (Straumann, Nobel Biocare, Biomet 3i, Dentsply, 3M Oral care, Titanium Fix, Pi Branemark) were used in this study. DMLS implants were made from additive manufacturing (EOS Laser Systems, Munich, Germany) of Ti-6Al-4V alloy powder (particle size of 3–30 μ m). Processing was carried out in an argon environment using a fiber laser system (ytterbium). All specimens were halved and mounted in epoxy resin, polished and mechanically investigated using a nanoindentation instrument (Hysitron TI 750 Ubi Triboindenter). The tests were performed with a Berkovich indenter tip applying a maximum load of 2000 μ N. A minimum of 6 indentations were carried out on each sample and the results were reported as the average of the tests. In addition, the morphological structures of the specimen were analyzed by scanning electron microscopy (SEM) and the chemical composition verified by energy dispersive spectroscopy (EDS). All the data were statistically analyzed using ANOVA one-way and Tukey test.

Results: Chemical composition analysis demonstrated a small difference between DMLS and CDI implants. Elastic modulus ranged from 72 to 118 GPa. DMLS implants values were significantly lower than most of the CDI. The hardness means for DMLS implants were: 4.28 ± 0.7 GPa while the values for CDI ranged from 4.31 to 5.24 GPa with significant scatter among some of them.

Conclusions: With the limitations of this study, we can conclude that DMLS titanium implants satisfy the chemical and mechanical requirements to be used as oral health procedure.

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Repair bond strength of resin composite to various restorative materials



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Purpose/aim: To investigate the repair bond strength (RBS) of a resin composite to six restorative materials either medi-

ated by application of a silane and a bonding agent or by application of a universal adhesive.

Materials and methods: Thirty specimens were produced from each restorative material: an amalgam alloy (ORALLOY MAGICAP S), a direct resin composite (Filtek Z250), two indirect resin composites (Paradigm MZ100 and Lava Ultimate), a hybrid ceramic (VITA ENAMIC), and a feldspar ceramic (VITABLOCS Mark II). The specimens were stored for 3 months in tap water (37 °C) for artificial ageing. After storage, the surfaces of all specimens were sandblasted (aluminum oxide, grain size: 25 µm), water-sprayed, and air-dried. Subsequently, the surfaces of half of the specimens ($n = 15$ /restorative material) were treated with a silane (Monobond Plus) followed by application of a bonding agent (OptiBond FL Adhesive) whereas the other half was treated with a universal adhesive only (Scotchbond Universal). A resin composite (Filtek Z250) was applied as repair material on the treated surfaces and the specimens were stored for 24 h (37 °C, 100% humidity). Then, RBS was measured by means of a shear bond strength test. Due to normally distributed data (Shapiro Wilk's test: $p = 0.216$), RBS-values were analyzed with a parametric ANOVA and two-sample t-tests. The p -values were corrected with Bonferroni-Holm adjustment for multiple testing (significance level: $\alpha = 0.05$).

Results: The RBS-values are shown in Fig. 1. Mean values (standard deviations) (MPa; Monobond Plus and OptiBond FL Adhesive/Scotchbond Universal) were: 18.6 (3.2)/17.2 (3.1) for ORALLOY MAGICAP S, 19.8 (3.9)/17.0 (3.5) for Filtek Z250, 19.9 (3.2)/17.6 (3.7) for Paradigm MZ100, 20.5 (4.2)/18.1 (4.6) for Lava Ultimate, 23.9 (5.0)/17.1 (3.2) for VITA ENAMIC, and 22.3 (4.3)/12.5 (4.9) for VITABLOCS Mark II. For VITA ENAMIC and VITABLOCS Mark II, treatment with Monobond Plus and OptiBond FL Adhesive showed a significantly higher RBS than did treatment with Scotchbond Universal ($p \leq 0.0009$). For the other four restorative materials, RBS did not significantly differ between the two treatments ($p \geq 0.207$).

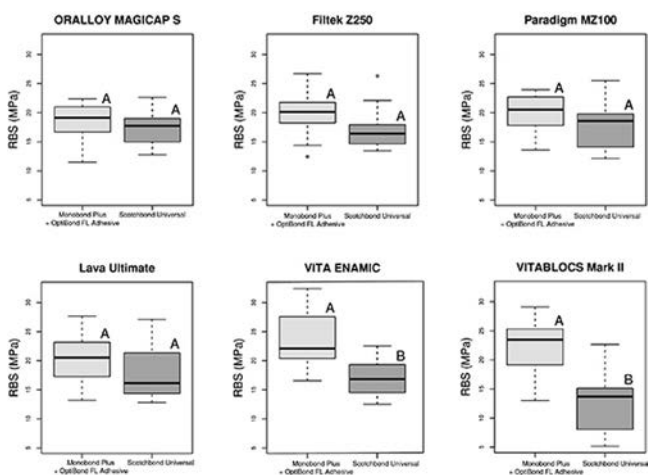


Fig. 1 – Repair bond strength (RBS (MPa); medians, lower and upper quartiles as well as minima and maxima) of the two treatments for the six restorative materials. Different upper case letters show significant differences between the treatments within a restorative material.

Conclusions: Clinically (with the exception of amalgam alloy), the material of a restoration to be repaired may be unknown. Consequently, when repairing restorations with resin composite it seems advisable to use a silane followed by a bonding agent since for two out of the six restorative materials investigated, the use of an universal adhesive showed lower repair bond strength.

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Clinical performance of structurally optimized three-unit fiber-reinforced composite bridge



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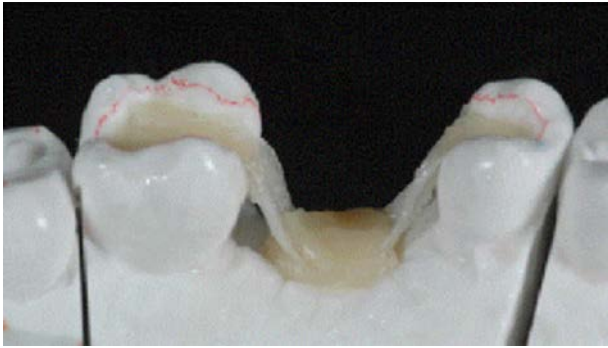
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Purpose/aim: Conventional fiber-reinforced composite (FRC) bridges have unsatisfactory survival rates, with the main failure modes being connector fracture and veneer delamination. Structural optimization based on the finite element method (FEM) has been used to obtain an alternative (U-shape) substructure for the three-unit FRC bridge. Numerical simulation and *in vitro* tests have shown that the optimized design could withstand higher loads and suffered from far less sub-critical cracking. The purpose of this study is to examine the clinical performance of the new FRC bridge design.

Materials and methods: 40 patients, aged between 20 and 60 years, with mono-edentulism received the 3-unit FRC bridge. There were 15 males and 25 females. The teeth replaced included 37 molars or premolars, 2 canines and 1 lateral incisor. Depending on the amount of sound tissues left, the abutment teeth were prepared for inlay, onlay or overlay restoration. Both uni- and multi-directional glass fibers (Dentapreg America Inc., Sarasota, FL, USA) were used to construct the substructure, with a dual-cured laboratory composite resin being used as veneer. The period of observation ranged from 1 to 6 years.

Results: With 9 failures, the survival rate of the shape-optimized FRC bridge was 77.5% over the 6-year observation period. All the failures occurred within approximately 2 years after placement. The failure modes were: 4 cases of delamination, 4 of chipping and 1 of tooth loss due to inadequate bone support. No connector failure was observed. The occlusal patterns played an important role in determining failure. Those failed with chipping were repaired chairside with direct composite resin.

Conclusions: Compared to the conventional design, the new FRC bridge has a higher survival rate and, in case of failure, a less destructive mode of failure which can be easily repaired without any loss of function or mechanical strength.



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Phase characterization of Li-Si systems using X-ray photoelectron spectroscopy



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Purpose/aim: Lithium silicate-based glass ceramics (LSGC) have gained much popularity in recent years due to its enhanced strength, durability, aesthetics and versatility. Lithium metasilicate (Li_2SiO_3) and lithium disilicate ($\text{Li}_2\text{Si}_2\text{O}_5$) are two major phases of LSGC systems. Li_2SiO_3 is considered an intermediary phase that will contribute to the transformation of a stable crystalline phase of $\text{Li}_2\text{Si}_2\text{O}_5$. The aim of this study was to quantify the amount of Li_2SiO_3 and $\text{Li}_2\text{Si}_2\text{O}_5$ present in four different LSGCs used to fabricate dental restorations, using X-ray photoelectron spectroscopy (XPS) physicochemical characterization.

Materials and methods: Four kinds of LSGCs were used in this experiment: IPS e.max[®] CAD (Ivoclar-Vivadent), Celtra Duo[®] (Dentsply), Vita Suprinity[®] (Vita Zahnfabrik) and Nice[®] (Straumann). Each LSGC ingot was sectioned into blocks ($n=6$) measuring 2 mm of thickness using a Buehler Isomet low speed saw. IPS e.max[®] CAD and Vita Suprinity[®] were crystallized according to manufacturer's instructions. Celtra Duo[®] and Nice[®] were tested as received. Physicochemical analyses were performed using XPS, the parameters were: X-ray gun emission set to 15 mA and an X-ray gun anode HT set to 15 kV with power setting 225 W and base pressure of 2×10^{-9} Torr. Etching was performed using an argon (Ar) gun and performed in 10 nm, 50 nm or 100 nm depth. The deconvolution of high resolution Li 1s and Si 2p peaks were performed in each depth.

Results: XPS results reveal presence of Li_2SiO_3 in all LSGCs tested. After crystallization process IPS e.max[®] CAD and Vita Suprinity[®] displayed 8.9% (± 0.3) and 16.9% (± 0.6) of Li_2SiO_3 phase, respectively. Pre-crystallized blocks like Celtra Duo[®] showed 18.2% (± 0.2) of Li_2SiO_3 phase.

Conclusions: With the limitations of this study, it is possible to conclude that lithium metasilicate phase (Li_2SiO_3) can be detected after final crystallization process.

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Effect of doxycycline-containing 35% phosphoric acid on dentin bond strength



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Purpose/aim: This study evaluated the effect of etching using 2%, 5% and 10% doxycycline-containing 35% phosphoric acid on resin-dentin micro-tensile bond strength.

Materials and methods: The dentin surface of eighty non-carious human third molars were exposed and then etched using 2%, 5% and 10% doxycycline-containing 35% phosphoric acid for 15 s. A 35% phosphoric acid with no doxycycline was used as a control group. After rinsing with water, the dentin was bonded with Single Bond Plus (3M ESPE) and composite build-up was constructed, followed by polymerization. The teeth were sectioned and the bonds were tested for microtensile bond strength (μTBS) at 24 h and 1 year.

Results: The groups did not show statistical difference among them at 24 h of water storage. However, acid-etching using the 10% doxycycline/35% phosphoric acid did not lower the μTBS after 1 year and had statistically higher values compared to the control and 2% doxycycline/35% phosphoric acid groups.

Conclusions: Ten percent doxycycline-containing 35% phosphoric acid can produce stable resin-dentin without requiring additional steps in the bonding procedure.

Table 1 – Means and standard deviations of the resin-dentin micro-tensile bond strength of different doxycycline-containing 35% phosphoric acid.

Etchant	μTBS (MPa)	
	24 hours	1 year
35% H_3PO_4	35,10 \pm 4,89 Aa	25,97 \pm 5,63 Bb
2% doxycycline-containing 35% H_3PO_4	33,71 \pm 4,75 Aa	26,28 \pm 4,44 Bb
5% doxycycline-containing 35% H_3PO_4	38,09 \pm 6,77 Aa	34,50 \pm 6,11 ABa
10% doxycycline-containing 35% H_3PO_4	42,20 \pm 5,69 Aa	39,37 \pm 4,44 Aa

Identical capital letters in a column indicate the absence of any statistically significant difference. Identical lower cased in a row within the same etchant between 24 h and 1 year indicate the absence of any statistically significant difference.

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Cells and biomaterial for bone repair under osteoporotic conditions



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Purpose/aim: The objective of this study was to evaluate the association of mesenchymal stem cells derived from bone marrow (BM-MSCs) or mesenchymal stem cells derived from adipose tissue (AT-MSCs) associated with membrane of poly(vinylidene-trifluoroethylene)/barium titanate (PVDF-TrFE/BT) in the repair of calvarial defects created in osteoporotic rats.

Materials and methods: Female Wistar rats were submitted to bilateral ovariectomy (OVX) to induce osteoporosis. After 150 days, 5-mm unilateral calvarial defect was created and immediately implanted with PVDF-TrFE/BT membrane. Fourteen days after that, BM-MSCs, AT-MSCs (5×10^6 cells/50 μ l of PBS) or PBS only (control) were injected into the defects on the membrane and after 28 days the histological and micro-Ct evaluations were performed. The data of morphometric analysis ($n = 6$) were compared by one-way ANOVA followed by Tukey test ($p \leq 0.050$).

Results: All defects presented some bone formation but in histological sections and 3D reconstructions it was more noticeably in cell-treated defects. The bone volume (mm^3) was significantly increased ($p = 0.039$) in PVDF-TrFE/BT with BM-MSCs (1.61 ± 0.77) compared to PVDF-TrFE/BT with AT-MSCs (0.68 ± 0.40), but without difference ($p = 0.094$) with control group (0.85 ± 0.47). The percentage of bone volume was significantly increased ($p = 0.031$) in PVDF-TrFE/BT with BM-MSCs (13.46 ± 6.47) compared to PVDF-TrFE/BT with AT-MSCs (5.70 ± 3.38) and control group (5.65 ± 4.60). The bone surface (mm^2) was not significantly different ($p = 0.118$) in PVDF-TrFE/BT with BM-MSCs (75.68 ± 43.37) compared to PVDF-TrFE/BT with AT-MSCs (29.95 ± 18.31) and control group (45.94 ± 37.52).

Conclusions: It seems that BM-MSCs acted synergistically with PVDF-TrFE/BT membrane to increase bone formation in the presence of osteoporosis but it did not happen with AT-MSCs. Maybe it means that the source is relevant when selecting cells to be used in therapies to promote bone repair.

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Ceramic occlusal veneers – Influence of the thickness in fatigue resistance



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Purpose/aim: The aim of this study was to evaluate the influence of the thickness of ceramic occlusal veneer in fatigue resistance, adhesively cemented in enamel substrate.

Materials and methods: Forty healthy third molars were divided into four groups ($n = 10$): GC – without restoration (control group); G05 – 0.5 mm thickness veneer; G10 – 1.0 mm thickness veneer; G15 – 1.5 mm thickness veneer. The corresponding restorations were made by CAD/CAM technology (system CEREC SW4) in ceramic blocks of lithium disilicate IPS e.max CAD, cemented adhesively in enamel substrate and stored in distilled water in a stove at 37°C until the test. The specimens were submitted to mechanical testing simulating cyclic and isometric chewing motion (5 Hz) to evaluate the fatigue resistance. A preload of 200 N was established by 5000 cycles, followed by increasing loads of 400, 600, 800, 1000, 1200 and 1400 N, by 30,000 cycles each. The specimens were loaded until fracture or up to a maximum of 185,000 cycles. Afterwards, cracks and/or fractures of samples were evaluated from photography assistance, with macro lens 105 mm (D3000; Nikon, Japan).

Results: After the statistical analysis by Kaplan Meier and Chi-square tests, it was observed that all specimens supported the maximum cycles, obtaining 100% of survival rate, suggesting that different thickness would not differentiate in fatigue resistance ($p > 0.05$). However, all groups presented failure mode at different levels. The control group had 40% presence of cracks/fractures, while the groups with occlusal veneer of 0.5 mm and 1.0 mm presented the highest values for fracture restoration, 50 and 60%, respectively ($p > 0.05$). As for the group with 1.5 mm occlusal veneer, it had distribution of significant failure mode ($p < 0.05$), presenting 80% of cracks.

Conclusions: The ceramic occlusal veneers present high fatigue resistance. Nevertheless, when observed the failure mode, it still has problems that need to be better investigated.

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Long-term bond strengths of novel methacrylamide-based adhesives



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Purpose/aim: Methacrylamide monomers have been proposed as a hydrolytically stable alternative for the formulation of dental adhesives. The objective of this study was to eval-

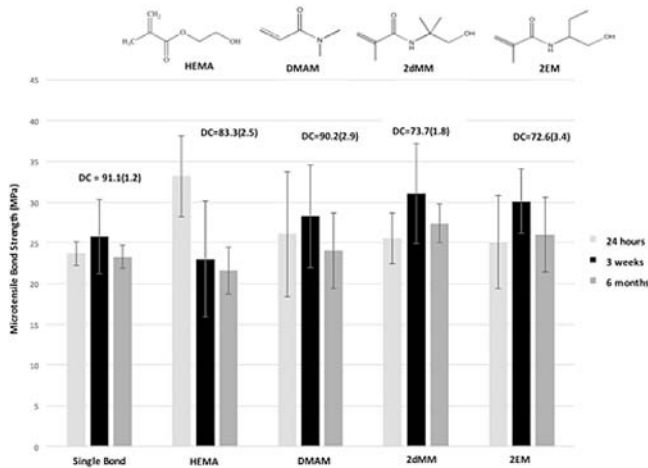


Fig. 1 – Microtensile bond strength (in MPa) for all materials tested at 24h, 3 weeks and 6 months. The degree of conversion (%) and standard deviation are shown in the text boxes for the non-solvated adhesives.

uate polymerization kinetics and microtensile bond strength stability of adhesives formulated with novel methacrylamides after storage in water.

Materials and methods: Newly synthesized mono-functional secondary methacrylamides 2dMM (1-hydroxy-2 methyl, 2-propanyl methacrylamide) or 2EM (1-hydroxy-2-butanyl methacrylamide) synthesized, and commercially available HEMA (2-hydroxyethyl methacrylate) or DMAM (2-hydroxypropyl methacrylamide), were mixed with BisGMA at 40/60 mass ratio. Materials were made polymerizable by the addition of 0.2 wt% DMPA and 0.8 wt% DPI-PF6. Vinyl conversion (DC) was followed in real-time in near-IR (6165 cm^{-1}) during polymerization at 800 mW/cm^2 (320–500 nm). Solvated adhesives (40 vol% ethanol) were used to bond a commercial composite (Filtek Supreme) to the flat surface of human dentin and Adper Single Bond (SB) was used as the commercial control. Microtensile bond strength (MTBS) was measured in $1 \times 1\text{ mm}$ dentin/composite sticks after 24 h, 3 weeks and 6 months storage. Results were analyzed with one-way ANOVA/Tukey's test for each testing time (95%).

Results: Microtensile bond strength (MPa) and degree of conversion (%), in text boxes are shown in Fig. 1. DC (%) was higher for SB and DMAM and decreased as follows: methacrylate (HEMA) > secondary methacrylamides (2dMM = 2EM). This was expected based on the lower reactivity of methacrylamides. However, all materials presented conversion values above 70%. Overall, all experimental materials were able to maintain the MTBS results after 6 months storage, except for the group containing HEMA. For that group, the MTBS was higher at 24 h, but it significantly decreased after 6 months. Among the experimental groups, secondary methacrylamides presented greater MTBS compared to HEMA (the methacrylate control), though not statistically significant. It is important to note that those experimental groups containing methacrylamides behaved as well or better than SB. Even after 6 months

2dMM and 2EM results were higher than the initial values for SB.

Conclusions: DC values did not show correlation with MTBS performance. Experimental adhesives formulated with secondary methacrylamides monomers were able to resist bond degradation over 6 months.

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Evaluation of zirconia reinforced mica glass ceramics for veneering zirconia



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Purpose/aim: Veneer fractures are one of the most common failures in zirconia fixed dental prosthesis. Considerable efforts have been attempted to reduce their chipping rates in zirconia restorations. Processing techniques such as Press on and CAD on techniques with low fusing glass ceramic to zirconia cores and monolithic zirconia structures, are some of the methods explored to reduce the incidence of veneer fractures (Table 1). We propose for a possible application of zirconia glass ceramic composite as a potential veneer material for zirconia restorations. With preliminary studies on mechanical and cytocompatibility properties of mica glass ceramic reinforced with zirconia, other relevant properties such as wear resistance, coefficient of thermal expansion, transmittance and finite element model simulation for stress analysis will be presented in the proposed paper.

Table 1 – Properties of commercially available veneering ceramics.

Veneering ceramics	Flexural strength	COTE	Vickers hardness	Glass transition temperature (°C)
Layered ceramics				
IPS emax Ceram	90 MPa (Biaxial)	9.5/°C	5.4	490
IPS Eris Veneer	85 N/mm ² (3 point flexural strength)	9.7/°C	5.5	490
Vitadur Alpha		6.2/°C	4.7	
Press on veneers				
IPS emax Zirpress	110 MPa	9.7/°C	5.4	530
CAD on veneers				
IPS emax CAD on	360 MPa	–	–	–
Lava DVS	95 MPa	–	–	–
Vita RLT	150 MPa	–	–	–

Materials and methods: Rod shaped specimens of 10 mm × 3 mm dimensions ($n=3$) measured with a digital micrometer with quartz as the reference will be placed in a thermo dilatometer from 250 °C to 900 °C at a heating rate of 50 °C/min followed by cooling to room temperature. Wear of the zirconia reinforced mica glass ceramic composites will be evaluated with a dual axis chewing simulator (SD Mechanotrik, GmbH) under a load of 50 N, 120,000 cycles, 1.5 Hz against antagonist steatite ball in an artificial saliva medium and quantified with surface profilometry and electron microscopy. Specimens of 12 mm × 1 mm thickness were polished in 600 grit and measured using a spectrophotometer. Total transmittance of veneering ceramics at a thickness of 1 mm falls between 18 and 41%. Total transmittance will be calculated based on the following equation. % Total transmittance = (Sum of the intensity at each wavelength)/(Total number of wavelength) = $(\sum I(\lambda)d\lambda)/(\sum d\lambda)$. Finite element model simulation for shear stress distribution at the core veneer interface will be investigated with the proposed ceramic veneer with different core materials. 4 rectangular models of core of 12 mm × 11 mm × 0.9 mm and veneer of 2.5 mm × 11 mm × 0.9 mm will be constructed subject to a load of 150 N at the core veneer interface and further analysed.

Results: Stress distribution at the core veneer interface demonstrate 253 MPa (emax Ceram/Zirconia) against 131 MPa (mica glass zirconia/Zirconia). Experiments on coefficient of thermal expansion, wear and optical properties are in progress.

Conclusions: A possible application of zirconia mica glass ceramic as veneer ceramic for zirconia prosthesis have been explored by studying relevant properties such as wear resistance, coefficient of thermal expansion, transmittance and finite element model simulation.

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Physical tests and characterization for experimental-material to use in stereolithography

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Purpose/aim: Stereolithography is a technique used as an auxiliary in dental treatments such as maxillofacial prostheses, pathology, surgery, etc. It has been used since the 1980s with great success for the elaboration of restorative prostheses and reproduction of defects for its elimination. Previously, this type of prosthesis was performed through the use of X-ray and magnetic resonance imaging. Preliminary studies showed that the powder was a compound made up of sulphur, calcium and oxygen, liquid contained carbon, oxygen and hydrogen with a basic pH. This suggests that dental gypsum can be a substitute for the powder and a water-soluble polymer can be a

substitute to the liquid. The aim of this study is to evaluate the oxide types on the setting time and physical properties in a commercial plaster to be used on a 3D-printer.

Materials and methods: We use zinc oxide (50%, w/w), silicon oxide (5%, w/w), glass ionomer (10%, w/w) and sodium alginate (10%, w/w). Water-soluble polymer was polyacrylic acid (PAA) in different concentrations (0.25, 0.50, 2% (w/w)). Commercial gypsum was used. The control group was a mixture of commercial stereolithograph powder (ZP151) and commercial binder solution (ZB63) in 1:3 ratio. Sample preparation methods indicated by ADA were used. Samples were prepared for sorption and solubility (ADA27), film thickness (ADA96), setting time (ADA96) and setting expansion (ADA25). Scanning electron microscopy and infrared spectroscopy were used to obtain structure.

Results: Control group: sorption: 406 $\mu\text{g}/\text{mm}^3$; solubility: 62 $\mu\text{g}/\text{mm}^3$; film thickness: 224 μm ; setting time: 636 s; setting expansion: 0.91%. Silicon oxide-PAA (0.5%): setting time: 435 s. Zinc oxide-PAA (2%): 540 s. Glass ionomer and sodium alginate showed higher values than 1100 s. Micrographs and patterns FTIR of the control group were obtained.

Conclusions: The settling time was modified using different oxides.

Best mixtures times	
Control group (PE + LE)	00:10:36 (636 s)
Gypsum (95%) + SiO ₂ (5%) + PAA (0.5%)	00:07:23 (443 s)
Gypsum (50%) + ZnO (50%) + PAA (2%)	00:09:12 (552 s)



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Differences in spectral absorbance of esthetic restorative materials

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Purpose/aim: To measure and compare spectral attenuation with restoration thickness of a variety of esthetic restorative materials.

Materials and methods: Five specimens (14 mm width; 14 mm length; 0.5, 1.0, 1.5, 2.0 mm thick) each of resin composites (Cerasmart, A2HT, GC Corp.; Epricord, DA2, Kuraray Noritake; Enamic, 2M2HT, Vita and Lava Ultimate, A2HT, 3M ESPE) and dental ceramics (Celtra Duo, A1HT, Dentsply Sirona; eMax, A1HT, Ivoclar Vivadent; Rosetta, A1HT, Hass; Suprinity, A1HT, Vita and Vita Real Life, 1M1C, Vita) were polished to 600 μm . A 5-mm diameter opening was constructed over the aperture of a 6 in. integrating sphere (Labsphere, Sutton, NH). A spectral radiometer (USB2000+, Ocean Optics) was connected to the sphere, from which the spectra were collected using software (Spectrasuite, Ocean Optics). The system was calibrated using a NIST-traceable light source. The emitting tip of a plasma arc (PAC) curing light (ARCIIM, Air Techniques) was placed over the 5-mm opening, and the spectral profile of the light was recorded from 350 to 550 nm. Individual discs of restorative materials were then placed over the opening, and the same PAC light tip was placed directly against the flat specimen surface, and activated. Following spectra collection, data were exported into a spreadsheet program (EXCEL, Microsoft), where the percent transmission at each recorded wavelength from 390 to 510 nm was determined, from which absorption values were calculated. For each material, plots of the absorption at 400, 450, and 500 nm were made as a function of material thickness. Linear regression was applied to each plot correlating the thickness of the specimen with its absorbance value, for each of the three measured wavelengths. The slopes of the lines were determined, and the 95% confidence value of the slope was calculated. Differences in slopes were compared among the three wavelength values. Significant differences were determined by observing if the 95% confidence interval (CI) of each slope overlapped, indicating no significant difference.

Results: Findings presented in Table 1. All composites, except Enamic, indicated a significantly higher slope of the

400 nm absorbance profile with respect to restoration thickness. Only two of the five ceramics (eMax and Suprinity) indicated no preferential loss of violet light (400 nm) with respect to blue (450 and 500 nm).

Conclusions: Most esthetic restorative materials tested demonstrated significantly higher violet absorbance than blue, indicating potential for lessening of photoactivation of resin cements containing short-wavelength-activated photoinitiators.

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Manufacturing process influence on Co-Cr base-alloy mechanical properties



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Purpose/aim: Currently, there are three different manufacturing processes such as casting (CAS), milling (MIL) and selective laser melting (SLM) available for Co-Cr alloy. To prolong the clinical use of porcelain-fused-to-metal (PFM) restorations, it is necessary to achieve the mechanical properties required in ISO 9693. Therefore, the aim of this study was to explore the differences in mechanical properties of a Co-Cr alloy which was produced by different manufacturing processes (CAS, MIL, and SLM).

Materials and methods: Eighteen Co-Cr alloy samples (Remanium Star, Dentaureum, Germany) were produced by the CAS, MIL and SLM processes ($n=6$ per each group). Each conical shoulder specimen (the diameter in the central of $3\text{ mm} \pm 0.1\text{ mm}$) was used for mechanical properties test. The tensile tests were performed using a universal testing machine (Z200, Zwick, Ulm, Germany) at a crosshead speed of 2 mm/min according to ISO 9693. Vickers hardness device (HV 10, Wolpert, Germany) was used for hardness testing. The data were analyzed by one-way ANOVA and Tukey's multiple comparison tests ($\alpha=0.05$).

Results: The results of Co-Cr mechanical properties by three manufacturing processes are presented in Table. The 0.2% yield strength ($R_{p0.2}$) values in the SLM group were higher than those in the CAS and MIL groups while the CAS group showed the lowest values ($p < 0.05$). The same trend was held for the ultimate tensile stress (R_m) and Vickers hardness. For the elongation, the SLM group exhibited significantly higher values than the MIL group ($p < 0.05$) while no significant difference was observed between the SLM and CAS groups. Moreover, the MIL group exhibited the highest Young's modulus values than the CAS and SLM groups ($p < 0.05$) while no statistically significant difference was observed between the SLM and CAS groups.

Table 1 – Slope (95% CI) and statistical grouping of absorbance values as a function of material thickness at 400, 450, and 500 nm. N = 5 specimens per test condition. Within a material (column), values depicted by similar upper case letters are not significantly different.

Wavelength (mm)	Composites				
	Cerasmart	Enamic	Epricord	Lava Ultimate	
400	0.50 (0.05) B	0.42 (0.11) A	1.44 (0.46) C	0.57 (0.10) B	
450	0.30 (0.07) AB	0.36 (0.10) A	0.59 (0.05) B	0.37 (0.10) A	
500	0.36 (0.06) A	0.32 (0.00) A	0.47 (0.05) A	0.34 (0.11) A	
Ceramics					
	Celtra Duo	eMax	Rosetta	Suprinity	Vita Real Life
400	0.50 (0.11) B	0.50 (0.11) A	0.75 (0.15) B	0.38 (0.07) A	0.48 (0.04) C
450	0.37 (0.03) A	0.34 (0.12) A	0.46 (0.06) A	0.39 (0.09) A	0.41 (0.01) B
500	0.34 (0.00) A	0.30 (0.12) A	0.38 (0.03) A	0.28 (0.09) A	0.34 (0.04) A

Group	0.2% yield strength, $R_{p0.2}$ (MPa)	Ultimate tensile stress, R_m (MPa)	Elongation (%)	Young's modulus (GPa)	Hardness (HV 10)
CAS	581 ± 15.6^a	783 ± 32^a	11.6 ± 1.5^{ab}	187.8 ± 18.5^a	303 ± 15^a
MIL	672 ± 4.4^b	1060 ± 10^b	10.1 ± 0.8^a	235.3 ± 13.6^b	353 ± 6^b
SLM	783 ± 14.5^c	1158 ± 10^c	13.2 ± 1.1^b	195.1 ± 15.2^a	399 ± 24^c

Different lowercase letters in the same column indicate that the groups are with statistically significant differences ($p < 0.05$).

Conclusions: The mechanical properties of the Co–Cr alloys used in this study are influenced by different manufacturing processes. Based on the alloy used in this study, the SLM has improved or comparable mechanical properties compared to the CAS and MIL. Despite the observed differences, all groups fulfilled the requirements of ISO 9693.

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Fatigue resistance of CAD/CAM all-ceramic molar crowns of reduced thickness



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Purpose/aim: To test the fatigue resistance of two all-ceramic materials for molar crowns of 1-mm thickness. Less invasive tooth preparation reduces the risk of post-operative hypersensitivity, pulp exposure and pulp necrosis, with the latter being up to 3.7% after 5 years for all-ceramic crowns.

Materials and methods: Two CAD/CAM all-ceramic materials were tested on lower first molar crowns: Celtra Duo (Dentsply Sirona) and e.max CAD (Ivoclar Vivadent). The crowns with an occlusal thickness of 1 mm were milled with the Zenotec Select milling machine (Wieland) and glazed (e.max CAD with Ivocolor glaze; Celtra Duo with Celtra glaze) or polished (Celtra Duo). The crowns were adhesively luted to standardized CAM milled composite dies (LAVA Ultimate) with a composite resin (Multilink Automix). The inner surface of the crowns was etched with hydrofluoric acid and silanized with Monobond Plus. Cyclic loading was carried out under water with a Willytec chewing simulator (SD Mechatronik). In this test, a steel antagonist (\varnothing 4 mm) hits the disto-buccal cusp of the reduced crown on the lower molar with reduced impulse and then slides for a distance of 0.7 mm. Four crowns per group and load were subjected to four decreasing load levels for 200,000 cycles at 0.8 Hz in water at room temperature until all four crowns survived without showing cracks or fractures. The fatigue resistance was calculated by linear regression analysis (SPSS), relating each failure per load to the log-transformed number of cycles. In vivo measurements have revealed chewing forces in the posterior region of dentate subjects to be between 110 N and 140 N (Fontijn Tekamp et al., 2000). Therefore, 150 N has been defined as an acceptable level for fatigue resistance.

Results: As some glazed Celtra Duo crowns already showed cracks after glazing, only the polished Celtra Duo crowns were subjected to cyclic loading. Crowns of both materials invariably showed small or large cracks, but no bulk fractures. The fatigue resistance of e.max CAD crowns was 204 N and that of Celtra crowns 117 N; statistically, the difference of fatigue resistance was highly significant (univariate linear model; $p < 0.001$).

Conclusions: The lithium-disilicate material e.max CAD, in contrast to Celtra Duo, is suitable for molar crowns of reduced thickness.

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How to optimize curing parameters for resin-based composites?



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Purpose/aim: Many resin-based materials are commercially available, with different compositions and chemistries, making it difficult for practitioners to select the optimal curing parameters leading to optimal materials properties. In fact, the optimum for a given property may be different for another one. Hence, the present work had two objectives: first to determine the optimal curing parameters for three different commercial resin-based composites (RBCs), and second to study how various materials properties correlate as the polymerization evolves.

Materials and methods: Three different commercial RBCs were chosen for their different characteristics (Grandio and GrandioFlow, VOCO; SDR, Dentsply). Samples ($n = 3$) were photopolymerized in a 2 mm \times 2 mm \times 25 mm Teflon mold using a halogen light (Swiss Master Light, EMS) with three irradiances (339, 563, 1235 mW/cm²) and five exposure times (2, 4, 8, 16, 32 s); the same sample was submitted subsequently to all analyses. Five minutes after photopolymerization, trapped free radical concentration (FR) was measured by electron paramagnetic resonance. Samples were then stored for 7 days (water, 37 °C) before measuring elastic modulus (E) and flexural strength (FS) by three-points bending. Vickers microhardness (VH) was measured 10 days later (water, 37 °C), and

once again after an extra day storage in ethanol. Multivariate correlation analyses were performed using JMP software.

Results: Overall, the considered properties were much more influenced by curing time increase than by irradiance. While certain properties reached a plateau after a certain curing time (for E and FS at 8 s for Grandio and at 16 s for SDR; for FR at 16 s for SDR), others kept increasing up to the maximum investigated curing time – 32 s (E for GrandioFlow; FR for Grandio and GrandioFlow; VH values for all three materials).

High correlation coefficients were globally observed between materials properties (ranging from 0.55 to 0.99), particularly between E-FS (>0.9 for Grandio and SDR), E-VH (0.99 for GrandioFlow), and VHwater-VHethanol (0.99 for GrandioFlow). A high correlation (>0.90) common to all three materials was observed between FR-VH.

Conclusions: The present work confirms that: (1) curing time has much more impact on the considered properties than irradiance, which seems to be a secondary aspect for the investigated materials; (2) materials properties do not build up simultaneously as the polymer network grows. It is therefore difficult to determine a specific “optimal” curing time. Since dentists have the tendency to use a single curing time as universal rule, a database should be made available for each material to guide practitioners for the best light-curing protocol.

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Curing quality in peripheral zones of large bulk-fill resin-composite fillings



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Purpose/aim: Bulk-fill restorations with resin-composites are increasing in popularity, but sufficiency of curing in depth and in peripheral zones of large fillings is still questioned. Modern curing units displaying more homogeneous light beam profiles claim enhancing homogeneity of curing also in large fillings.

Materials and methods: The variation in micro-hardness within simulated large cavities (10 mm × 6 mm) filled in one increment with three bulk-fill resin-based composites (Filtek Bulk-Fill, FBF, Tetric Evo Ceram Bulk Fill, TEVOBF and SonicFill, SF) was assessed by means of a universal hardness device. Modern blue and violet-blue light curing units (LCUs: Elipar™ DeepCure, Demi Ultra and Bluephase Style) were applied at an exposure distance of 3-mm at three different positions resulted by rotating the LCU in 120° steps. The exposure time was 10 s for TEVOBF and 20 s for FBF and SF. One central and two peripheral (4-mm apart from the centre) line profiles were measured at 24 h post-polymerisation in 0.5 mm steps, allowing calculating the depth of cure (DOC). Incident light, irradiance and spectral distribution were recorded.

Results: The incident irradiance was identified as $1786.0 \pm 56.9 \text{ mW/cm}^2$ for Elipar™ DeepCure, $1550.8 \pm 50.3 \text{ mW/cm}^2$ for Demi Ultra and $1184.6 \pm 3.9 \text{ mW/cm}^2$ for Bluephase Style. The effect of LCU-rotation was not significant ($p=0.109$). DOC varied among 3.46 mm (SF, peripheral, LCU Bluephase Style) and 5.50 mm (FBF, central, all LCUs) and was strongly influenced by the BF-RBC ($p<0.001$, $\eta_p^2 = .774$), followed by the width of specimen ($p<0.001$, $\eta_p^2 = .554$), while the influence of the LCU was extremely low ($p<0.06$, $\eta_p^2 = .070$). The DOC measured peripheral or central was similar in FBF. DOC measured peripheral was at $1.12 \pm 0.11 \text{ mm}$ lower in TEVOBF and at $1.04 \pm 0.11 \text{ mm}$ lower in SF compared to the DOC measured central. FBF reached the significant highest DOC ($5.4 \pm 0.2 \text{ mm}$), while DOC in TEVOBF ($4.1 \pm 0.7 \text{ mm}$) and SF ($3.9 \pm 0.6 \text{ mm}$) was statistically similar.

Conclusions: Whether a BF-RBC filling is cured peripheral as good as central depends more on the material than on the used curing unit.

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Effects of pre-silanized lithium-disilicate ceramic contamination on resin bond strength



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Purpose/aim: The aim of this study was to evaluate the effect of different contaminants on the microshear bond strength of a pre-silanized lithium disilicate reinforced glass ceramic (IPS e.max Press, Ivoclar Vivadent AG, Schaan, Liechtenstein).

Materials and methods: Fifty ceramic disks were etched with 10% hydrofluoric acid during 20 s and were silanized (Monobond Plus, Ivoclar Vivadent AG). Samples were randomly distributed in 5 groups according to different contaminants: no silane contamination (control); rinsing with distilled water; contamination by try-in paste; contamination by saliva; and contamination by gypsum. Afterwards, they were divided into 2 subgroups, according to 24 h of storage or thermocycling regimen (500 cycles of 5 and 55 °C) ($n=5$). Tygon tubes of 1-mm diameter and 3-mm height were used for application of a low-viscosity composite resin. Four resin composite cylinders were made on each ceramic disk and were light-cured by LED for 40 s. Microshear bond strength test (SBS) was carried out on a universal testing machine (1 mm/min). Results were statistically analyzed by 2-way ANOVA and Tukey test ($p<0.05$).

Results: After 24 h of storage in distilled water, saliva contamination produced the lowest bond strength values ($p<0.05$). Thermocycling significantly reduced SBS values for all groups. After thermocycling, control groups and saliva contamination presented SBS values significantly lower than groups that contacted water, try-in paste and gypsum.

Conclusions: After 24 h of storage or after thermocycling, the silane-treated ceramic surface cleaning with water did not present significantly lower values in relation to the other groups. Groups that were contaminated by saliva presented significantly lower bond strength values.

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Differences in glossiness of ceramics with differing polishing methods



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Purpose/aim: All-ceramics are increasing due to patients' esthetic-related requests. 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 (e.max) (Ivoclar Vivadent Co.), Initial LiSi Press (LiSi) (GC Co.) and CEREC Blocs (CER) (Dentsply Sirona). VITA and CER were cut to a thickness of 3 mm as measurement specimens. For IPS and LiSi, wax was used to fill a silicon mold of 13 mm × 10 mm × 3 mm, and a wax cast was produced. Specimen rods were softened and pressure forming was applied to produce measurement specimens. These specimens were sequentially polished using #150, 400, and 600 water-resistant polishing papers. Polishing was performed using a Porcelain Ceramic Polisher (PCP) (Kerr Co.), Meisinger LiSi Twist (Lisi-C) (GC Co.), and CERASHAIN (CES) (GC Co.). At each polishing stage, glossiness was measured using a glossmeter (GV-2000, NIPPON DENSYOKU Co.). For 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: In LiSi and e.max, although increases in the glossiness using PCP were slight at each polishing stage, it rapidly increased using Lisi-C and CES at each polishing stage. In VITA and CER, the increase in glossiness with each polishing system was limited, showing no significant differences. In LiSi and e.max, the glossiness was significantly lower with the polishing system of PCP and CER than with Lisi-C and CES, and polishing using Lisi-C and CES led to no significant differences in the glossiness. The glossiness of ceramics on final polishing was 36.2 in VITA, 72.9 in e.max, 74.1 in LiSi, and 36.0 in CER. Although a significant difference was noted between VITA and LiSi, e.max, no significant difference was present between e.max and LiSi. Regarding the glossiness at polishing sites, it was 51.4 at PCP, 68.4 at LiSi, and 63.5 at CES. The glossiness was lowest (22.2%) when e.max was polished using PCP, and highest (86.6%) when LiSi was polished using Lisi-C.

Conclusions: Differences in the glossiness were noted among the types of ceramics and polishing systems. For every polishing system, when polishing was sequentially conducted from rough to final polishing, the glossiness increased. Clinical application should be performed on considering the combination of the types of ceramics and polishing systems.

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WITHDRAWN



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Evaluation of gloss retention of indirect composite after toothbrush abrasion



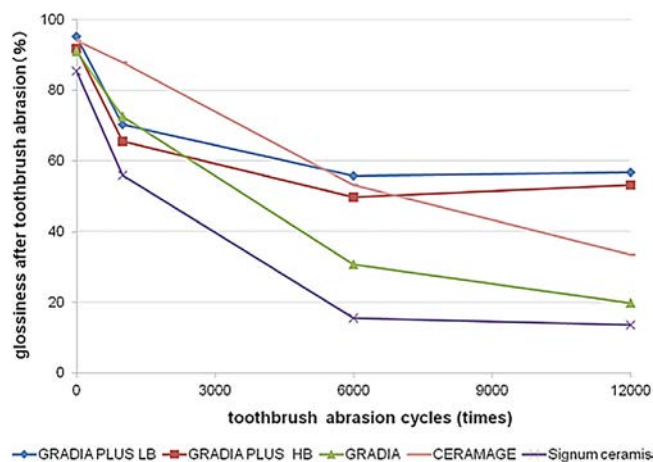
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Purpose/aim: Recently, super engineering plastic materials to use as the frame of dental prosthesis are attracting a lot of attention such as PEEK. Therefore, the properties of indirect composite resin for use in combination with plastic frame influence clinical longevity. Specially, the gloss retention of composite resin is very important for esthetics. We developed a new indirect composite system "GRADIA PLUS". GRADIA PLUS demonstrates higher mechanical properties than conventional indirect composite thanks to adopting nano-filler technology. The purpose of this study is to evaluate the gloss retention of indirect composites after tooth brush abrasion.

Materials and methods: GRADIA PLUS LB (Light Body)/HB (Heavy Body), GRADIA (GC), CERAMAGE (Shofu), Signum ceramis (Heraeus Kulzer) were examined in this study. The surface of each specimen was polished with buff and GRADIA DIAPOLISHER (GC). All specimens were stored in 37 °C water for 24 h after light curing according to the manufacturers' instructions for use. Tooth brush abrasion was performed with abrasion test machine for 12,000 cycles (load 200 g). Tooth brush was PROSPEC TOOTH BRUSH ADULT HARD (GC). Slurry was a mixture of WHITE & WHITE (toothpowder, LION Corp.) and water with mixture ratio 1:2. Glossiness was measured with glossmeter VG2000 (Nippon Denshoku Industries Co. Ltd) after toothbrush 1000, 6000 and 12,000 cycles.

Results: GRADIA PLUS LB/HB showed higher gloss retention after 12,000 cycles toothbrush abrasion than any other composite resin (Figure). Glossiness is correlated with surface roughness. The included glass filler in each indirect composite resin is GRADIA PLUS LB/HB: 300 nm, GRADIA: 1–2 μm, CERAMAGE: 1–6 μm and Signum ceramis: 0.6–1 μm. These results suggested that glass filler became smaller and gloss retention became higher.



Conclusions: New indirect composite, GRADIA PLUS LB and HB, showed higher gloss retention than any other indirect composite after toothbrush abrasion. GRADIA PLUS should lead to clinical longevity.

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In-vitro evaluation of mechanical quality of casted/laser-sintered clasps for removable dentures



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Purpose/aim: Recently, the additive production of metal clasps for removable dentures has been possible by laser sintering process. However, little is known about the structural quality and the mechanical properties of the resulting objects. The aim of this pilot study was to evaluate and compare the mechanical quality of casted clasps with that of laser-sintered clasps.

Materials and methods: On 12 identical metal models were constructed identical clasps of the teeth 35 and 36 each after digitalization and measure (Dental Designer RPD Modul 2014, 3Shape, Copenhagen). Each 6 clasps were printed in wax and then casted (Remanium GM 800, Dentaaurum, Isbringen), the other 6 clasps were laser-sintered directly (SP2, EOS, Krailling). All clasps were then standardized and examined radiographically using a high-resolution micro-CT, in order to determine the void volume and the number of luncker in the clasps. Furthermore, the clasps withdrawal values were initially tested (Universalprüfmaschine 1445, Zwick/Roell, Ulm) and after artificial aging in the chewing simulator (CS-4, SD-Mechatronik, Feldkirchen). Subsequently, the data were imported into the software SPSS 23 (IBM, Ehningen) and statistically evaluated.

Results: The luncker analysis showed a significantly lower total luncker volume per clasp in the laser-sintered clasps (median/IQR, 0.0001614 mm³/0.0002373 mm³) versus the cast (median/IQR, 0.0014926 mm³/0.002756 mm³) (MWU test $p \leq 0.000$). Retention strength showed a similar course. After

the initial non-differentiation (laser sintering: median/IQR, 10.45 N/3.24 N, cast: median/IQR, 11.68 N/3.04 N) the pull-out strength increased significantly in comparison to the initial value after 5000 cycles (lasers: MWU $p \leq 0.002$, cast: MWU $p \leq 0.009$). The groups did not differ from each other after 5000 cycles (MWU $p = 1.000$). The laser sintered clasps showed an increase in the pull-out force of 46.76%, the cast clasps of 56.57%. After 10,000 cycles, the trigger values were again reduced to the level of the initial values (laser sintering: MWU $p \leq 0.180$, casting: MWU $p \leq 0.699$). In both groups, however, the spread of the values against the initial values increased.

Conclusions: Laser-sintered clasps for removable dentures have lower luncker volumes and thus a more homogeneous structure than cast clasps. Regard to their retention strength, there are no differences in this pilot test. Presumably, a cold setting or hardening is responsible for the increase in the retention values after 5000 chewing cycles. Between 5000 and 10,000 chewing cycles, fatigue and/or embrittlement processes probably result in a reduction in retention values. This question is to be investigated in further test series with a larger sample number and long-term studies.

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Resin infiltration analysis into carious lesions by optical coherence tomography



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Purpose/aim: The minimally invasive approach claims for the detection and treatment of early caries lesions. Resin infiltrant materials can penetrate into porosities of the lesion body by capillary forces, preventing the progression of white spot lesions, improving esthetic and providing support to enamel. It is suggested that optical coherence tomography (OCT) could assess penetration depth of the resin infiltrant into white spots lesions, which may provide information about the lesion's progression. Therefore, the aim of this study evaluated the efficiency of the penetration of the resin infiltrant into porosities of artificial white spot lesions by OCT and micro-CT.

Materials and methods: From fifteen bovine incisors, 6 vs. 4 mm fragments were obtained and attached at the bottom of well in a 24 tissue culture plate. Non-cavitated enamel lesions were produced by microbiological method with *Streptococcus mutans* UA 159. To obtain the artificial white spot lesions cariogenic challenge was carried out by adding the fragment to 1 ml of 1% sucrose TSB *S. mutans* culture medium for 14 days. The medium was replaced every 24 h. The average depth of obtained lesions was measured by OCT and micro-CT. The resin infiltrant was applied according to the manufacturer's instructions, without scrubbing the ICON etch on enamel surface of the lesion. Then, another OCT reading was performed to detect the degree of infiltration of the resin. Micro-CT and OCT techniques were used to measure lesion depth. The

images obtained after resin infiltration were measured by OCT. Then, they were compared and qualitatively described.

Results: OCT and micro-CT were able to measure lesion's depth ranged around 450 μm . When OCT images were compared before and after resin infiltrant application, they showed an inhomogeneous penetration into the lesions, but differences in the gray gradients of the images were observed, indicating the technique's ability to detect the material presence into enamel lesions porosities and the total depth reached by the resin infiltrant.

Conclusions: Based on the obtained results, we suggest that OCT may be a useful tool to monitor the resin infiltration into deep enamel lesions, contributing to the minimally invasive approach to treat non-cavitated carious lesions.

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Salivary esterases modulate biofilm structures on adhesive and composite resins



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USA

Purpose/aim: Salivary esterases have been shown to degrade the bonded resin restoration interface, but little is known about their effect on the structures of biofilms grown on resin restorations. The objective of this study was to compare the effect of 30-day immersions in various salivary esterases on selected cellular and extracellular components within biofilms grown on selected adhesive and composite resins.

Materials and methods: Unpolished specimens of adhesive resin ASB (Adper Scotchbond Multi-Purpose, 3M ESPE) and composite resins PTF (Point 4, Kerr Corp.) and TPH (TPH Spectra HV, Dentsply Caulk) were fabricated and then UV-sterilized (8 kJ/cm²) before immersion in 400 μl of one of the following solutions for 30 days: D-PBS (Control; CT), 0.1 U/ml pseudocholinesterase (PC), 0.1 U/ml cholesterol esterase (CE), and 0.1 U/ml PC+CE (CM). Solutions were stored at 37 °C, and replenished every 48 h. *Streptococcus mutans* (strain UA159) biofilms were grown microaerophilically on specimens (batch culture, 0.5 \times Tryptone-Yeast extract medium with 10 mM sucrose, 37 °C, 100 rpm). After 24 h of growth, the biofilms were

stained [Syto 9 (SY; nucleic-acids), Sypro Red (SR; proteins), Concanavalin A-Alexa Fluor 647 conjugate (AF; extracellular polymeric-substances/EPS); Invitrogen], then imaged using a confocal laser scanning microscope (CLSM; Leica TCS SP2-MP) at three locations/specimen. A separate group of specimens that was not immersed in solution also had biofilms grown and imaged. Biofilm structural parameters calculated from CLSM images ($n=9/\text{group}$) using ISA3D software were: biovolume (BV), fractal dimension (FD), homogeneity (HM), mean biofilm thickness (MT) and mean biofilm roughness (BR). Data were analyzed using one-factor ANOVA for comparisons of each parameter before and after immersion in the various solutions, categorized by biofilm component.

Results: The results of the 3-D biofilm structural parameters for product ASB are shown in Table 1, but do not include results for the other products due to space limitations. Statistically significant differences were observed in the parameters among the solutions and biofilm components tested ($p < 0.01$), except parameter BR for proteins ($p = 0.15$).

Conclusions: Immersion in pseudocholinesterase for 30-days resulted in larger biovolumes and more homogeneous distributions of nucleic acids within biofilms on adhesive resin ASB. Immersion in D-PBS (CT) produced the lowest biovolumes and least homogeneous distributions in all biofilm components. The cellular and extracellular components within the 3-D structures of biofilms grown on composite resins PTF and TPH were variably altered by immersion for 30 days in the different esterase solutions tested.

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Synthesis and characterization of novel in-situ grafted bioactive dental fillers



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Purpose/aim: Nowadays dental fillers are required to have bioactive and reliable bonding properties. Bioactive

Table 1

Component	Solution	BV (μm^3)	FD	HM	MT (μm)	BR (μm)
Nucleic acids	Before immersion	117,592 \pm 24,117 B,C	2.13 \pm 0.07 B	0.89 \pm 0.04 B	6.71 \pm 1.18 B	1.34 \pm 0.09 B
	CT	45,444 \pm 17,543 D	1.88 \pm 0.06 D	0.87 \pm 0.04 A	2.75 \pm 1.28 B	1.64 \pm 0.05 B
	PC	269,048 \pm 67,994 A	2.46 \pm 0.06 A	0.96 \pm 0.01 C	23.51 \pm 14.79 A	0.85 \pm 0.19 A
	CE	148,648 \pm 39,784 B	2.17 \pm 0.06 B	0.97 \pm 0.01 B	8.6 \pm 84.07 B	1.35 \pm 0.06 B
	CM	102,885 \pm 22,910 C	2.06 \pm 0.05 C	0.98 \pm 0.01 B	7.28 \pm 2.00 B	1.42 \pm 0.07 B
Proteins	Before immersion	141,223 \pm 17,186 A	2.24 \pm 0.05 A	0.98 \pm 0.01 B	8.96 \pm 3.10 A	1.00 \pm 0.21 A
	CT	17,797 \pm 6884 B	1.90 \pm 0.11 B	0.67 \pm 0.03 A	2.10 \pm 1.05 B	1.61 \pm 0.15 A
	PC	131,516 \pm 42,870 A	2.21 \pm 0.15 A	0.87 \pm 0.02 B	7.67 \pm 2.70 A	1.21 \pm 0.22 A
	CE	151,928 \pm 40,854 A	2.18 \pm 0.06 A	0.97 \pm 0.01 B	9.49 \pm 4.42 A	1.22 \pm 0.19 A
	CM	140,073 \pm 54,048 A	2.14 \pm 0.12 A	0.90 \pm 0.02 B	8.87 \pm 3.43 A	1.22 \pm 0.36 A
EPS	Before immersion	58,664 \pm 8949 A	2.01 \pm 0.09 A	0.90 \pm 0.02 B	6.09 \pm 1.01 A	1.42 \pm 0.07 B,C
	CT	22,466 \pm 4884 B	1.81 \pm 0.08 C	0.98 \pm 0.01 A	2.11 \pm 0.89 B	1.71 \pm 0.04 A
	PC	44,116 \pm 14,317 A	1.89 \pm 0.07 B,C	0.91 \pm 0.01 A	4.86 \pm 1.82 A	1.59 \pm 0.08 C
	CE	53,195 \pm 20,786 A	1.92 \pm 0.08 B	0.86 \pm 0.03 A	6.29 \pm 3.63 A	1.57 \pm 0.11 A,B
	CM	44,878 \pm 14,432 A	1.89 \pm 0.07 B,C	0.98 \pm 0.00 A	5.38 \pm 1.86 A	1.59 \pm 0.08 A,B

fillers have regenerating capability and bonding properties, however, they are prone to water sorption due to hydrophilic nature. Therefore the aim of this study is to develop in-situ surface grafted bioactive dental filler with less water sorption properties

Materials and methods: Nano-apatite particles were synthesized by using microwave irradiation technique. Calcium and phosphorous ratio was adjusted at 1.66. Urethane-based monomer was added in calcium precursor and phosphorous precursor was added drop wise, later irradiated with microwave at 1000 W for 3 min. The obtained material was freeze-dried and ball milled to get fine powder. To prepare control materials, silanized (using conventional 3-methacryloxypropyltrimethoxysilane) and non-silanized nano-hydroxyapatite were synthesized by same technique. Both resulting powders were characterized by XRD, FTIR, SEM, BET, and TGA/DSC. Additionally, water sorption, ion release and mechanical properties were also analyzed.

Results: XRD pattern showed characteristic peaks of apatite and resin. The FTIR of grafted apatite showed the characteristic peaks of PO_4 ($1000\text{--}1150\text{ cm}^{-1}$), O–H/N–H bands ($3200\text{--}3600\text{ cm}^{-1}$), C=O ($1700\text{--}1715\text{ cm}^{-1}$), and amide I and II peak ($1550\text{--}1640\text{ cm}^{-1}$), whereas non-grafted apatite showed characteristic peaks of hydroxyapatite. SEM images confirmed the presence of resin on filler particles and non-grafted apatite showed the nano-structure. BET also confirmed nano-particle size of 20–150 nm with a surface area of $71.77\text{ m}^2/\text{g}$ of in situ grafted apatite. TGA/DSC thermogram showed thermally stable apatite particle and on heating loss of organic components were observed. In-situ grafted apatite showed less water sorption and exhibited comparable calcium ion release compared to control materials on immersion in deionized water for 21 days. UTM studies showed low compressive strength after modification of apatite particle by urethane-modified monomer compared to non-grafted nano-hydroxyapatite

Conclusions: The experimental bioactive grafted filler has shown promising results and has potential to be used clinically in dental adhesives and composites.

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Evaluation of ions release and pH of fluoride-based bioactive glass

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Purpose/aim: The use of fluoride with its anti-cariogenic, anti-microbial nature along with its remineralization potential has led to the evolution of the fluoride containing adhesive dental restorative materials. Calcium ions play a vital role in remineralization of tooth structure. The amount and pattern of fluoride and calcium release is the key factor in calculating

the potency of these restorative materials to control secondary decay. Therefore the aim of this study was to compare fluoride ion release (FR) and calcium ion release (CaR) behavior and its effect on the pH of newly synthesized bioactive glass (BG) powders.

Materials and methods: In the present study non-fluoride based BG and three groups of fluoride (2.5%, 5% and 7.5% by weight) containing BG powders were synthesized by using sol-gel technique. The prepared samples were initially characterized and selected for FR, CaR and pH study. The powdered samples were conditioned in 10 mL deionized water at 37°C and the pH, FR, and CaR were analyzed periodically for 6 months by using Ion Selective Electrode (Hanna HI3222 pH/ISE meter). The mean daily pH values and the cumulative values of FR and CaR were calculated. Statistical analysis was done by repeated measures ANOVA and Post hoc Tukey test using SPSS version 22.

Results: Initially maximum pH (9.42) was exhibited by non-fluoride based BG followed by BG-7.5 (8.28), BG-2.5 (8.07) and BG-5 (8.01). The cumulative FR of BG-7.5, BG-5, and BG-2.5 were 17.07 ppm, 16.99 ppm, and 15.86 ppm respectively. Whereas, maximum CaR was observed from non-fluoride based samples followed by BG-2.5, BG-7.5 and BG-5. Statistically significant difference was detected in the pH, FR and CaR values over the period of observation within each study group ($p \leq 0.005$). The Post hoc Tukey test showed a statistically significant difference in the daily pH values between BG-5 and BG-7.5 only, whereas no statistically significant variance in cumulative FR and CaR was observed between the three fluoride containing study groups ($p = 0.05$).

Conclusions: The fluoride content influenced not only the quantity and pattern of FR, CaR but also the pH in the experimental BG powders upon ageing.

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New methodology in dental ceramic sintering – The decoupled drying process



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Purpose/aim: Heat radiation and heat conduction into the crown's framework is the best energy transfer for ceramic sintering. Deviations in sintering quality are ascribed to insufficient sintering conditions. However, sintering tray's physical data influence directly the sintering conditions and are responsible for deviation in sintering quality. This study is focused on the effects of the decoupled drying phase and was examined in detail regarding the required time for evaporation depending on the used sintering trays.

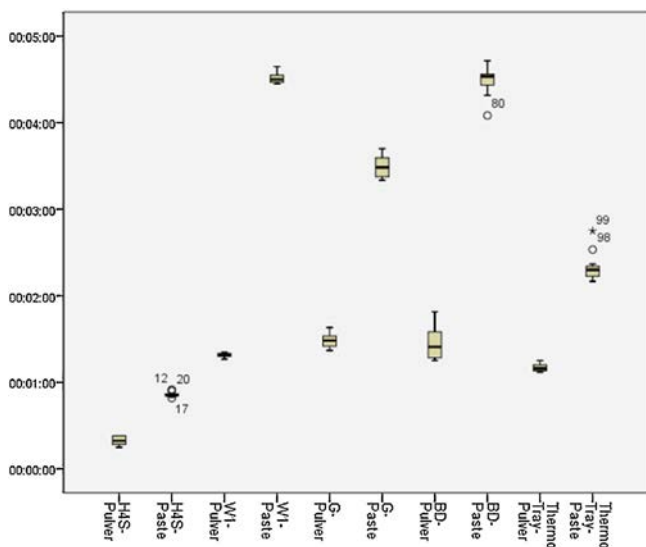
Materials and methods: Casted frameworks ($N = 10$, non-precious alloy: Bär-light, selection GmbH-dental, Hollern, Germany), which were designed for full ceramic veneer, are coated with standard opaquer (pasty opaquer and powder opaquer mixed with modelling liquid). The time from the beginning and the entire time interval up to the complete



drying was recorded. The results were represented by statistical, descriptive methods.

Results: The firing tray W1 (paste/powder) and G (paste/powder) started the evaporation (EVMEAN±SD) after 50.6±0.52s/37.8±1.68s and 62.5±3.48s/44.6±2.5s, respectively, while metal based trays reached the evaporation temperature after 10.3±0.9s/11.0±0.9s (H4S (paste/powder)); ThermoTray (paste/powder) 14.8±1.7s/19.0±1.42s; and BD (paste/powder): 21.3±1.53s/26.3±7.41s (*p*<.001). Paste opaque needs much longer for drying than powder opaque: H4S (powder): 19.6±2.95s, ThermoTray (powder): 70.0±2.53s, BD (powder): 87.4±12.4s, W1 (powder): 68.9±1.66s, G (powder): 89.5±4.97s. All differences were significant (*p*<.001).

Conclusions: Physical properties of firing trays affect significantly the heat transfer. The significantly better heat conduction of the metallic firing tray H4S optimizes heat transfer into the sintered object, and its heat retention has positive effects on long term cooling. If conventional ceramic firing trays and paste opaque are used, an extension of sintering parameters must be considered. The sintering process of fixed PFM-restorations, can be optimized by simply changing the sintering methodology according to physical regularities. The decoupled preheating process leads to better sintering results, greater process reliability of the ceramic sintering process and can guarantee process safeness according to good manufacturing practice requirements.



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Shear bond strength to different types of zirconia restorations

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Purpose/aim: The aim of this study was to investigate the adhesion performance of the self-adhesive resin cement RelyX

Unicem 2 Automix (RXU, 3M Oral Care) to different types of zirconia restorations.

Materials and methods: Materials tested were Lava Plus High Translucency Zirconia (LP) and Lava Esthetic Fluorescent Full-Contour Zirconia (LE, both products from 3M Oral Care).

For shear bond strength (SBS) testing specimens (dimensions: *l* = 14 mm, *w* = 12 mm, *h* = 4 mm) of LP and LE were sandblasted with alumina (grain size ≤50µm at 2 bar). Pre-treated samples (*n* = 12) were cleaned with alcohol and dried with oil-free air. Stainless steel rods (diameter: 4 mm) were cemented with RXU under pressure (20 g/mm²) onto zirconia specimens. After light curing, (Elipar S10, 3M Oral Care) of RXU (10s each side; in total: 40s), specimens were stored for 24 h at 36 °C and 100% relative humidity. In addition half of the specimens were artificially aged by thermal cycling (TC) between 5 and 55 °C (dwell time: 30 s). SBS was measured using a universal testing machine (Zwick Z010, crosshead speed: 0.75 mm/min). Data obtained were analyzed using Multiple Range Test (Fisher's LSD; *p* < 0.05).

Results: Mean values for bond strength including standard deviations are summarized in the following table. Values marked with the same characters (a) are not statistically different.

	SBS [MPa]
LP: 24 h	38.8 ± 4.5 a
LE: 24h	37.3 ± 4.9 a
LP: 24 h + 5000 TC	36.3 ± 5.9 a
LE: 24 h + 5000 TC	36.8 ± 6.5 a

Conclusions: Consistently high adhesion performance was achieved with RelyX Unicem 2 Automix after sandblasting on both Lava Plus and Lava Esthetic after 24 h and after artificial aging without using an additional zirconia primer.

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High temperature silicatization of zirconia-surface to improve veneering strength

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Purpose/aim: It is a challenge that the strength for initiating de-bonding of ceramic veneering materials to zirconia-based crown- and bridges is low. Thus, the requirement in ISO 9693-2 has been reduced compared to metal-ceramic bond characterization in ISO 9693-1 from 25 MPa to 20 MPa. It has not been easy to make chemical, interfacial bonds between veneering materials and the zirconia surface since zirconia-based materials are chemically quite stable. The purpose of this study was to find a way to improve the bond strength with silicatization of the zirconia surface at high temperature with different surface treatments.



Materials and methods: Zirconia strips of ICE Zirkon Translucent (Zirkonzahn), with a cross section of 3.0 mm × 0.5 mm, dry prepared from presintered blanks, were sprayed with a solution of tetraethyl orthosilicate (TEOS), ethanol and HCl, mixed with water at one surface in three different conditions, G1: in green state, G2: sintered and etched with KHF₂ and G3: as-sintered. Thereafter they were sintered a second time at 1500 °C. As-sintered samples without spray-treatment served as a control group, GC. Six specimens in all groups were veneered with Vita VM9, a feldspar porcelain, according to manufacturer's instructions (Vita Zahnfabrik).

Results: All silicized groups were covered with a silicate-layer having an even thickness of 0.5–0.9 nm measured by XPS-analysis. Also the non-silicized control group was covered with a layer, though thinner and containing silicate (0.1 nm), alumina, as well as carbon. All groups revealed equal bond strength (27–31 MPa). The modulus of elasticity for G1 was reduced compared to the other groups.

Conclusions: High temperature silicization revealed an even zirconiumsilicate layer at the surface. However, the material seemed to be contaminated from constituents in the air, which may be the cause why bond values were not improved by any of the surface treatments which were investigated in this project. Surface contaminations may have been decisive for the bond strength since all groups revealed equal bond strength despite quite different surface treatments.

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Effect of PWM-controlled light on the polymerization kinetics of composite



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Purpose/aim: To investigate the effect of pulse width modulation (PWM)-controlled LED curing light on the polymerization shrinkage (stress) kinetics of composite.

Materials and methods: A pulse width modulation (PWM) controlled LED curing light system was made, which consisted of a high power LED (2000 mW/cm²) and a transistor switched by a microcontroller and software. The duty ratio of the PWM light and total cure time were varied as follows: 10% (100 s), 50% (20 s), 100% (10 s), increasing ramp mode from 0% to 100% (20 s), and decreasing ramp mode from 100% to 0% (20 s). The switching frequency of the PWM light was set at 50 Hz and the total radiant energy was identical for all groups. A universal composite (Z250, 3M ESPE) was used, and the kinetics of polymerization shrinkage (stress) was measured using an LVDT probe and a stress analyzer with feedback mechanism. The polymerization shrinkage (stress), maximum shrinkage (stress) rate, and the time to reach peak shrinkage (stress) rate were determined.

Results: The polymerization shrinkage stress, maximum shrinkage stress rate, and the time to reach peak shrinkage stress rate were shown in Table 1. The change in duty ratio could not influence the polymerization shrink-

Table 1

Pulse width modulation (duty ratio/time)	Stress (MPa)	Maximum stress rate (MPa/s)	Time to reach peak stress rate (s)
10%/100 s	3.27 (0.26)	0.08 (0.01)	16.18 (1.74)
50%/20 s	3.41 (0.20)	0.22 (0.02)	5.19 (0.77)
100%/10 s	3.73 (0.21)	0.30 (0.02)	4.68 (0.96)
Increasing ramp mode (0%–100%)/20 s	3.39 (0.31)	0.19 (0.02)	12.70 (1.60)
Decreasing ramp mode (100%–0%)/20 s	3.59 (0.21)	0.27 (0.03)	4.99 (0.37)

age of composite; however the maximum shrinkage rate increased with increasing the duty ratio while the time to peak shrinkage rate decreased with increasing the duty ratio. The increasing ramp mode showed much lower maximum shrinkage rate and delayed peak time compared to the decreasing ramp mode. The change in duty ratio influenced the polymerization shrinkage stress kinetics of composite; the polymerization shrinkage stress and maximum shrinkage stress rate increased with increasing the duty ratio while the time to reach peak shrinkage stress rate decreased with increasing the duty ratio. The increasing ramp mode showed lower shrinkage stress and maximum shrinkage rate, and delayed peak time compared to the decreasing ramp mode.

Conclusions: The light irradiance controlled by PWM greatly influences the polymerization shrinkage (stress) kinetics of composite. With identical total radiant energy, the reduced light intensity or increasing ramp mode can reduce the polymerization shrinkage stress compared to the high light intensity or decreasing ramp mode.

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Effect of chitosan solution as irrigant on dentin surface



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Purpose/aim: To evaluate, in vitro, the effect of 0.2% chitosan (CH), 1% sodium hypochlorite (NaOCl) and 17% EDTA as irrigant, on dentin surface and the bonding interface of the filling material/dentin by means of confocal laser microscopy (CLM).

Materials and methods: Twenty-four human maxillary canines, divided into 4 groups ($n=6$) were submitted to a crown cut, and roots prepared with K3 rotary files up to #60.04. During the preparation, the roots were irrigated with 1% NaOCl and 0.2% CH, and the final irrigation was performed by 17% EDTA and 0.2% CH irrigation: G1 – NaOCl + EDTA + NaOCl, G2 – NaOCl + CH + NaOCl, G3 – CH + CH + CH, G4 – CH + EDTA + CH. The samples were cut longitudinally to analyze the number, perimeter of exposed tubules at different times, the surface roughness before and after each treatment set besides the endodontic sealer penetration and the evaluation of the filling

Table 1 – Means ± standard deviations of the perimeter, tubule counting, roughness and the extension of tags formed at the filling material/dentin interface for the groups of irrigating solutions used during the endodontic treatment.

Groups of irrigating solutions	Perimeter	Tubule counting	Roughness	Extension of tags
N+E+N	21.47 ± 9.17 B	152.18 ± 201.77 B	2.253 ± 1.918 A	20.85 ± 1.52 A
N+C+N	21.22 ± 5.38 AB	135.78 ± 181.34 B	1.680 ± 1.628 A	18.13 ± 2.52 A
C+C+C	22.78 ± 5.08 A	264.35 ± 194.84 A	1.666 ± 1.267 A	23.61 ± 8.68 A
C+E+C	22.21 ± 5.73 AB	300.81 ± 212.30 A	1.403 ± 0.962 A	18.18 ± 5.32 A

N = 1% sodium hypochlorite; E = 17% EDTA; C = 0.2% chitosan. Different letters indicate a statistically significant difference between the columns ($p < 0.05$).

material/dentin interface after obturation (Time 3), by CLM. Data were analyzed statistically by ANOVA and Tukey's test ($\alpha = 5\%$).

Results: Data showed that only G3 presented higher values of tubule perimeter when compared to G1 ($p < 0.05$) and without difference between the root thirds. In the dentinal tubule count analysis, it was observed that G4 presented higher values similar to G3 ($p > 0.05$). The T2 presented the highest values and T0 the lowest means ($p < 0.05$). In addition, the cervical third had higher values ($p < 0.05$). In roughness analysis, no difference was observed between the groups and root thirds ($p > 0.05$), with T0 presenting higher values, different when compared to T1 and T2 ($p < 0.05$). With regard to filling material/dentin interface analysis, no difference was observed between the groups, and the apical third presented a smaller extension of tags formation ($p < 0.05$). Only G3 presented higher values of tubule perimeter with difference in G1 ($p < 0.05$), that T2 presented similar values to T1 ($p > 0.05$), without difference between root thirds. In the analysis of the dentinal tubule count, it was observed that G4 presented higher values, similar to G3 ($p > 0.05$). The T2 presented the highest values when compared to T0 that showed the lowest means ($p < 0.05$) with higher values for cervical third ($p < 0.05$). In the filling material/dentin interface analysis, no difference was observed between the groups, and the apical third had a smaller extension of tags formation ($p < 0.05$) (Table 1).

Conclusions: The chitosan solution as irrigant showed favorable effects on root dentin without affecting the interaction of the substrate with endodontic sealer.

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Effects of camphorquinone concentrations on resins containing diphenyliodonium hexafluorophosphate



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Purpose/aim: The aim of this study was to evaluate the influence of different concentrations of camphorquinone (CQ) on model resins containing diphenyliodonium hexafluorophosphate (DPI).

Materials and methods: To the Bis-GMA/TEGDMA comonomer blend (1:1 in weight) was added 60 wt% of inorganic sillonated particles of Ba-Al-Si glass. Groups were established according to CQ amount (0.125; 0.25; 0.5; 0.75 and 1 mol%) and DPI concentration (0 and 0.5 mol%). EDAB was used as co-initiator (1:2 ratio initiator/co-initiator). Properties evaluated were degree and rate of polymerization (FTIR), real-time shrinkage strain, and light transmittance through the resin. The statistical analysis was performed at a significance level of 5%.

Results: Addition of DPI increased rate of polymerization for all CQ concentrations. Degree of conversion at 10 s and 20 s increases as higher the CQ concentration. The shrinkage strain was higher for the resins containing DPI, as well as the resins with high concentration of CQ. Similar results were observed for the maximum rate of shrinkage. The light transmission through resin is initially higher for the resins with low amount of CQ, however, after 5 s of polymerization, the resins with higher CQ concentration presented better light transmission.

Conclusions: High concentration of CQ promotes better conversion. Addition of DPI can increase the rate and degree of conversion of the system, however increasing the shrinkage strain. Resins with 0.5 and 0.75 mol% of CQ have a better light transmittance than the other concentrations tested.

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Borosilicate phase-separated glasses for GICs: Ion-release under acid condition



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Purpose/aim: Glass-ionomer cements (GICs) were designed nearly five decades ago by Wilson and Kent in 1969. Currently,

they are used in a variety of clinical dental situations as restorative, lining, luting and sealing materials. The self-hardening setting reaction takes place between a glass powder and a poly(acrylic acid) and involves the formation of ionically cross-linked acidic polymer chains featuring multivalent counter ions leached from the glass. The novel glass powder composition reported here, based on $\text{SiO}_2\text{-B}_2\text{O}_3\text{-K}_2\text{O-CaO-Al}_2\text{O}_3$, is produced with the melt-quenching technique. The borosilicate system exhibits a strong tendency to phase separate after a thermal heat treatment; one of the phases created is more reactive and susceptible to acid attack and will be leached out from the glass earlier. The GIC setting time is thus related to the acid susceptibility of the glass and it is proposed that a controlled phase separated glass can improve the workability and final properties of the cement thanks to the controlled formation of the acid susceptible phase. The other phase in the glass can remain in the cement improving the mechanical properties of the dental restorative material.

Materials and methods: Factorial Experimental Design (FED) approach sets up a series of samples covering an interesting compositional range for the final purpose of the research. The heat-treated borosilicate powders are dissolved in an acid solution (HNO_3 , pH 2.5) and the ions leaching is checked using ICP analysis at different time points. SEM analyses before and after an acid leaching (HNO_3 , 1 M) are directed to study the surface microstructure and phase separation on the bulk glasses. Glass powders were selected and mixed with poly(acrylic acid) to study the influence on the mechanical properties.

Results: The glass composition influences the colour appearance of the samples, probably due to a different mechanism of phase-separation. A complete characterization of the glass dissolution kinetics reveals the effect of the composition on the ions leaching. Al_2O_3 increases the network connectivity and durability stabilizing the glass structure. The $\text{B}_2\text{O}_3/\text{CaO}$ ratio influences the calcium and potassium leaching. SEM studies show different surface microstructures. The glass composition influences flexural strength and hardness of the final material.

Conclusions: The results show the connection between the compositional feature of the glasses and their leaching behaviours. This is a useful tool for designing an ideal glass system with the tailored characteristic in order to improve the properties of the glass ionomer cements and enhance the understanding of their setting mechanism.

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Bulk fill vs incremental layering in posterior restorations: Systematic review

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Purpose/aim: To systematically review the risk and intensity of postoperative sensitivity, risk of fractures, marginal adaptation and marginal discoloration in posterior composite resin restorations placed with bulk or incremental filling.

Materials and methods: A comprehensive search was performed in the MEDLINE via PubMed, Scopus, Web of Science, LILACS, BBO and Cochrane Library. The abstracts of IADR (1990–2016), unpublished and ongoing trials registries were also searched, as well as, dissertations and theses. Study selection: We included randomized clinical trials that compared the bulk and incremental filling of composite resins for restoration of posterior cavities in adult patients. The risk of bias tool of the Cochrane Collaboration was used to assess the risk of bias of the included studies. Random effects model was used for the meta-analyses.

Results: After duplicates removal and non-eligible articles, 8 studies remained for qualitative synthesis. Two studies were judged to be “low” risk of bias, and six at “unclear” risk of bias. No evidence of difference between techniques was observed for postoperative sensitivity, risk of fractures, marginal adaptation and marginal discoloration in any of the study follow-ups ($p > 0.05$).

Conclusions: Both restoration techniques do not influence the postoperative sensitivity up to 1 month in posterior restorations, as well as, fracture and marginal discrepancies until 6 years of clinical evaluation.

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Development of a hoop-strength test for a crown-like model geometry



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Purpose/aim: To develop a test using a standardized spherocylindrical geometry as an analogue for dental crowns, where an opening hoop stress is induced to the margins to simulate different clinical scenarios.

Materials and methods: Metallic abutments having a spherocylindrical shape with 10 mm in diameter and 7 mm in height were fabricated with a 0.5 mm inner radius between the axial and marginal walls and two marginal thicknesses: 1 and 2 mm. These abutments were sputtered and scanned to generate a CAD model, upon which a spherocylinder “crown” was modelled having a final thickness of 0.7 and 1.6 mm throughout and a rounded inner margin. A finite element model of the crown geometry was built simulating the loading of a conical (7°) piston from the crown opening by touching the rounded inner margin circumferentially to induce hoop-stresses. Experimental tests imitating this set-up were conducted in a universal testing machine for a lithium disilicate (e.max CAD, Ivoclar-Vivadent) and a feldspar ceramic (Vitablocs Mark II, Vita Zahnfabrik) in the two aforementioned thicknesses. The forces at fracture were used as input in the finite element simulation to obtain the maximum principal

stress at failure and volume/area at maximum stress. A Weibull statistical model was used to compute the hoop-strength for the loaded volume and area and compared to the relation previously obtained for biaxial and uniaxial bending.

Results: The loading of a conical piston from the intaglio of sphero-cylindrical crowns lead to the generation of homogeneously distributed tensile hoop-stresses at the inner rounded margin. Fracture initiation sites in the crowns matched this location experimentally. Hoop-strength values were higher for thicker crowns and for the lithium disilicate material. The volume and surface area effect on strength was confirmed using the Weibull theory.

Conclusions: The stress distributions in the crowns were validated *in-vitro*, showing that the hoop-strength test is feasible to investigate marginal hoop-stress scenarios of clinical relevance.

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Participation of ITGAV on osteoblast induction by titanium with nanotopography



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Purpose/aim: The osteogenic potential of titanium with nanotopography (Ti-Nano) is mediate by integrins, including integrin $\alpha 1\beta 1$. As integrin Alpha V (ITGAV) is involved in the process of osteoblast differentiation, the aim of this study was to investigate the participation of ITGAV on the osteogenic potential of Ti-Nano compared with machined Ti (Ti-Machined).

Materials and methods: Mesenchymal stem cells (MSCs) from rat bone marrow were obtained under the approval of the Committee of Ethics in Animal Research (#2014.1.796.58.7) and cultured on Ti-Nano and Ti-Machined, under non-osteogenic conditions. At day 5, the gene expression of ITGAV, RUNX2, osterix (OSX), osteocalcin (OC), bone sialoprotein (BSP) and alkaline phosphatase (ALP) was evaluated by real-time PCR and the protein expression of ITGAV and RUNX2 was evaluated by Western blot. Additionally, MC3T3-E1 cells were transduced with lentiviral shITGAV (ITGAV silencing vector) or pLKO.1 (scrambled/empty vector) and cultured on Ti-Nano and Ti-Machined, under the same conditions. At day 5, the same assays previously described were performed. All experiments were done in triplicate ($n=3$) and the data were compared by t-test ($p \leq 0.05$).

Results: The osteogenic potential of Ti-Nano was confirmed by higher gene expression of RUNX2, OSX, OC, BSP and ALP ($p < 0.05$), and higher protein expression of RUNX2 compared with Ti-Machined. The gene and protein expressions of ITGAV were higher on Ti-Nano compared with

Ti-Machined ($p < 0.05$). After silencing, the protein expression of ITGAV decreased 20% on Ti-Machined and 60% on Ti-Nano. The ITGAV silencing decreased the gene expression on Ti-Machined and Ti-Nano of RUNX2 (54% and 40%, respectively), OSX (62% and 71%, respectively), OC (75% and 77%, respectively) and BSP (51% and 70%, respectively), and increased the gene expression of ALP on Ti-Machined (41%) compared with non-silenced cells. The ITGAV silencing reduced 88% the protein expression of RUNX2 on Ti-Nano but it was not measurable on Ti-Machined.

Conclusions: Our data indicates that Ti-Nano induced osteoblast differentiation and increased ITGAV expression. In addition, the ITGAV silencing negatively regulated the osteoblast differentiation induced by both surfaces, with a more pronounced effect of Ti-Nano. Thus, the higher osteogenic potential of Ti-Nano may be, at least in part, associated with the modulation of ITGAV induced by this surface.

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Shrinkage stress control in dental composite by polymerizable stable radical



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Purpose/aim: Rapidly developed shrinkage stress could challenge the tooth-composite bonding interphase, leading to compromised marginal integrity and even recurrent caries. This study aims to evaluate the effect of polymerizable stable radical, based on methacrylate functionalized nitroxide radical, to the material property, real-time modulus development, and shrinkage stress build-up of dental composite.

Materials and methods: The polymerizable stable radical N,N-Bis-(3-oxa-4-oxo-6-methacryloyloxyhexyl)-4-amino-2,2,6,6-tetramethylpiperdin-1-oxyl radical (EATMPO) was incorporated in conventional dimethacrylate based experimental composites at various concentrations (0.016–0.06 wt%). Flexural strength and modulus were tested per ISO4049. Shrinkage stress was measured using ADAF's cantilever-beam based tensometer. Densities of cured and uncured composites, from helium pycnometer, were used to calculate volumetric shrinkage. Photo-rheology was studied on TA DHR-2 rheometer coupled with an OmniCure lamp (with 400–500 nm filter) using oscillatory fast sampling mode. Real-time shear storage modulus (G') and loss modulus (G'') evolution of the composites were recorded. Three-body attrition wear was evaluated using UAB Leinfelder type wear machine, at 400,000 cycles and 7.8 kgf loads. Data were analyzed with one-way ANOVA/Tukey's test ($\alpha = 0.05$).

Results: As shown in Table 1, when steadily increasing the EATMPO concentration in the experimental composite, continuous reduction of shrinkage stress was observed when comparing to control composite in which no polymerizable stable radical was present. Not only the final shrinkage stress value but decreased shrinkage stress buildup rate was also observed. No significant differences for polymerization volume shrinkage were observed indicating similar level of curing was achieved. Moreover, within the range of concentrations

Table 1

Experimental composite	Control	EXP-A	EXP-B	EXP-C
EATMPO wt% in composite	0	0.016	0.03	0.06
Filler loading (wt%)	80.0	80.0	80.0	80.0
Flexural strength (MPa) (S.D.)	151 (5) ^a	166 (3) ^b	155 (3) ^a	154 (6) ^a
Flexural modulus (MPa) (S.D.)	11,047 (449) ^{a,b}	11295 (379) ^a	10554 (456) ^{b,c}	10299 (331) ^c
Barcol hardness	79	80	81	81
3-Body wear volume loss (mm ³) (S.D.)	0.0307 (0.0086) ^a	0.0274 (0.0044) ^a	0.0297 (0.0097) ^a	0.0259 (0.0045) ^a
Volumetric shrinkage (%) (S.D.)	2.22 (0.01) ^a	2.12 (0.15) ^a	2.14 (0.24) ^a	2.32 (0.25) ^a
Gel point (<i>G'</i> / <i>G''</i> crossover), S	1.3	2.2	3.9	10.4
Shrinkage stress (MPa) (S.D.)	2.6 (0.2) ^a	2.3 (0.1) ^{a,b}	2.2 (0.2) ^b	1.8 (0.1) ^c
Shrinkage stress reduction (%)	–	11.5%	15.4%	30.8%

Within each row, results not connected by same letter are significantly different ($\alpha = 0.05$).

of stable radical studied, no noteworthy compromise to flexural strength, flexural modulus, hardness, or 3-body wear resistance was observed. Through real time photo-rheology investigations, steadily delayed gelation (crossover point of *G'* and *G''*) as a function of EATMPO concentration was found. Also observed were reduced modulus build-up rate, however, the final (plateaued) storage moduli are all highly comparable to the control sample's modulus. The delayed gelation and network build-up, as a result of nitroxide radical mediation, contributed to the observed decrease of shrinkage stress build-up rate and final stress.

Conclusions: In these highly filled experimental composites studied, the EATMPO demonstrated distinctively effective shrinkage stress control, without compromising the overall mechanical properties and wear resistance. The substantial reduction of the composite's polymerization stress while still attaining excellent strength and modulus provided a desirable combination that could benefit the overall performance of the restoration.

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How TiO₂ nanotubes addition affects Y-TZP and resin-based materials biocompatibility



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Purpose/aim: The aim of this *in vitro* study was to evaluate the biocompatibility of yttrium-stabilized tetragonal zirconia polycrystal (Y-TZP), a resin-based cement (RelyXTM Ultimate) and a 10-MDP-based adhesive (Single Bond Universal) modified or not by titanium nanotubes (TiO₂), by means of the MTT cell viability test and Crystal Violet.

Materials and methods: For this purpose, disks of 13 mm in diameter per 2 mm in thickness of pre-sintered Y-TZP zirconia (IPS e.max ZirCAD) were obtained. The resin-cement and 10-MDP adhesive disks were obtained through a metal mold with the same dimensions. For Y-TZP, the incorporation of TiO₂ nanotubes occurred before sinterization, while for the resin-based materials 0.3 wt% of nanotubes were added to the uncured materials. The specimens were divided into 8 groups

(*n* = 8). The *in vitro* evaluation was carried out by means of tests in which fibroblast line NIH 3T3 cells were placed into indirect contact with these materials. For cell viability were made MTT assay tests and Crystal Violet in duplicate and after 24, 48 and 72 h the absorbance levels were analyzed by spectrophotometry ELISA reader. The data obtained were submitted to two-way ANOVA, followed by Tukey test ($\alpha = 0.05$).

Results: In the period of 72 h the highest increases of absorbance happened for the groups Y-TZP without TiO₂ nanotubes and adhesive with TiO₂ nanotubes when compared to the other groups.

Conclusions: According to the results of MTT and Crystal Violet assays of this study, the addition of TiO₂ nanotubes in the tested materials did not affect the cell viability.

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Combination of surface treatments for cementation of zirconia restorations



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Purpose/aim: Following objectives were pursued: (1) impact of plasma treatment or air-abrasion of zirconia on bonding properties to resin composite cement, (2) impact of universal adhesives on bonding properties between zirconia and resin composite cement, and (3) the combination between pretreatments and the use of new universal adhesives on bonding properties between zirconia and resin composite cement.

Materials and methods: For surface roughness (Ra) and surface free energy (SFE) 24 zirconia specimens were fabricated, divided and pretreated as follows (*n* = 6): plasma treatment, air-abrasion, air-abrasion and plasma treatment, no treatment. Ra was measured using a tactile profilometer and SFE by contact angle measurement. For tensile bond strength (TBS), 720 zirconia specimens were prepared, divided into the 4 pretreatment groups (*n* = 180). Groups were further divided (*n* = 18) into 10 conditioning subgroups: All-Bond Universal (ABU), Adhese Universal (AU), Clearfil Universal Bond (CUB), G-Premio Bond (GPB), Futurabond U (FBU), iBond Universal (IBU), One Coat 7 Universal (OCU), Scotchbond Universal (SBU),

no adhesive (NCG), and conditioned and luted using Duo-Cem. The positive control group (PCG) used Clearfil Ceramic Primer combined with Panavia F2.0. All specimens were stored in distilled water for 24 h (37 °C) and thermal cycled (5000×; 5 °C/55 °C). TBS was measured (5 mm/min) and fracture types were determined. Data were analyzed using univariate ANOVA with partial eta squared (η_p^2), Kruskal–Wallis *H*, Mann–Whitney *U* and Chi² test ($p < 0.05$).

Results: Plasma treatment showed highest increase of SFE ($p < 0.001$), but no impact on Ra. Air-abrasion resulted in highest Ra and higher TBS values compared to plasma and no treatment within different pretreatment methods. SBU and AU obtained higher TBS compared to PCG. OCU, FBU, ABU, IBU and GPB showed comparable TBS to PCG. CUB revealed lowest TBS within all universal adhesives, while all specimens of NCG debonded within thermocycling procedure.

Conclusions: Plasma treatment is not possible as a substitute of air-abrasion for cementation of zirconia restorations, while MDP-based adhesives are necessary to achieve long-term clinical success.

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Clinical effectiveness of dentin roughness in non-carious cervical lesions



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Purpose/aim: The objective of this double-blind randomized clinical trial was to evaluate the influence of dentin roughening on the clinical behavior of a new universal multi-mode adhesive (Tetric N-Bond Universal; Ivoclar Vivadent) applied as self-etch and as etch-and-rinse in non-carious cervical lesions (NCCLs).

Materials and methods: A total of 192 restorations were randomly placed in 48 patients according to the following groups: ER – etch-and-rinse (no preparation); SE – self-etch (no preparation); ER + RO – ER with dentin roughening; and SE + RO – SE with dentin roughening. The resin composite Empress Direct (Ivoclar Vivadent) was placed incrementally. The restorations were evaluated after 1 week (baseline), 6 and 18 months, using the FDI and USPHS criteria. Statistical analyses were performed using appropriate tests ($\alpha = 0.05$).

Results: Fifteen restorations were lost at 18 months (3 for SE, 2 for ER, 5 for SE + RO and 5 for ER + RO) ($p > 0.05$ between groups). Post-operative sensitivity was not observed in any of the recall periods. Eighty-four restorations were considered to have minor discrepancies in marginal adaptation at the 18-month recall using the FDI criteria (24 for SE, 18 for ER, 22 for SE + RO and 20 for ER + RO; $p > 0.05$ between groups). Nineteen restorations were considered to have minor discrepancies in marginal discoloration at the 18-month recall (10 for SE, 3 for ER, 5 for SE + RO and 1 for ER + RO; $p > 0.05$ between groups).

Conclusions: The dentin roughening before application of Tetric N-Bond Universal as self-etch and etch-and-rinse did not affect the clinical behavior of composite restorations placed in NCCLs.

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Silica-coating of Y-TZP before final sintering: Monoclinic content



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Purpose/aim: To quantify the phase transformation on yttrium stabilized zirconia poly-crystals (Y-TZP) after different silica-coating (SC) protocols.

Materials and methods: Bar-shaped specimens (20.0 mm × 4.0 mm × 1.2 mm) were obtained by slicing partially sintered Y-TZP blocks (Vita Zanhfabrik, Germany) with a diamond disc in a precision cutting machine (1000 Isomet, Buehler, USA). These bars were sintered in a Sintramat high-temperature furnace (Ivoclar Vivadent, Liechtenstein) and divided into 5 groups according to the moment at which silica coating was performed. SC using either 30 or 110 μm silica-coated aluminum oxide particles was performed perpendicular to surface, at a distance of 10 mm for 15 s and pressure of 2.8 bar. On the partially sintered Y-TZP specimens, SC was performed at a distance of 20 mm and the other parameters were kept the same. The new strategy proposed in this study (SC before final sintering) is to be applied to multilayered zirconia-based restorations; therefore, it is important to consider that this type of prostheses needs to be submitted the equivalent veneering layer. Hence, two firing cycles of the dentin shade veneer porcelain were simulated.

Representative specimens ($n = 3$) of each group were selected for X-ray diffraction (XRD) analysis. The percentage of zirconia phase transformation (tetragonal to monoclinic) induced before and after surface treatment and sintering was determined. Grazing incidence XRD was performed using a diffractometer (XDS 2000, USA). Data was collected from 26° to 60° (2θ) with a step size of 0.02° and dwell time of 1 s per step. The monoclinic phase volumetric content was calculated using the Toraya's equation.

Results: When SC with 30 μm silica-coated aluminum oxide particles was applied to Y-TZP in the partially sintered state, XRD peaks for the monoclinic phase (21%) were observed, however, after final sintering, the monoclinic phase decreased to 0%. When 110 μm silica-coated aluminum oxide particles were used, the monoclinic content was similar to those found for 30 μm particles. None of the two firing cycles of the dentine veneer porcelain induced phase transformation. When SC was performed after final sintering, a significant amount of monoclinic phase was detected. The monoclinic phase found for groups “30 μm and 110 μm/after final sintering” was 5% and 9%, respectively.

Conclusions: SC before final sintering seems to be a better surface treatment as it results in a material without mono-clinic content.

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Effect of a chlorhexidine-based adhesive on dentin hybrid layer stability

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Purpose/aim: It has been shown that dentinal endogenous enzymes could accelerate the aging process of the hybrid layer by degrading the collagen fibrils exposed after bonding to dentin. Chlorhexidine (CHX) has the ability to inhibit MMP-2, -8 and -9 in very low concentrations. In order to shorten chair-time, there has been a tendency to incorporate CHX into one of the components of the adhesive system. The aim of this study was to investigate, by the means of micro tensile strength test, nanoleakage, zymographic and in situ zymographic assays, the influence of 0.2% CHX incorporated within a commercially available adhesive on long-term bond strength.

Materials and methods: Non-cariou teeth ($N=15$ for each group) were assigned to 4 groups and treated according to the manufacturers' instructions: G1: dentin bonded with Scotchbond Universal (SBU) in the etch-and-rinse (E&R) mode (control group); G2: dentin bonded with Peak Universal (PU, 0.2% CHX) in the etch-and-rinse (E&R) mode; G3: dentin bonded with SBU in the self-etch (SE) mode (control group); G4: PU (0.2% CHX) in the SE mode. Composite buildups were made using Filtek Z250. Specimens were further subjected to microtensile bond test (?TBS) and stressed until failure. Another 12 teeth ($N=3$ for each group) were prepared for nanoleakage analysis. ?TBS test and nanoleakage were evaluated immediately as well as after 12-month storage in artificial saliva at 37 °C. Zymographic analysis was performed to assess the influence of 0.2% CHX blended within the adhesive on MMPs activity. Further, in situ zymographic assay was performed on sections of dentin of the same groups.

Results: The bond strength was significantly higher in the experimental group compared to the control group, immediately, as well as after aging. There were no differences in the immediate nanoleakage expression between the tested groups, while aging increased nanoleakage expression in all groups. The results of the zymography and in situ zymography showed that the enzymatic activity was less pronounced in the experimental groups, being related to the bonding strategy.

Conclusions: CHX blended within the Peak Universal adhesive monomer seems to efficiently inhibit the endogenous enzymatic activity in dentin. Further, it does not influence negatively immediate bond strength, but seems to preserve bond strength over time. Hence, blending the CHX in low

concentrations within the adhesive could be recommended as an efficient technique in every-day clinical practice.

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Effect of the resin impregnation technique for enamel micro-crack

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Purpose/aim: Recently, enamel micro-cracks have been often observed at many elderly aged patients' teeth. Many researchers described that teeth with micro-cracks may cause critical dental disease, such as dental carious, dental pulp disease and tooth fracture. However, treatment method for teeth with micro-cracks was not established in routine clinical situation. Meanwhile, the resin impregnation technique has been used for occurred contraction gap and white margin at the enamel surface after resin composite restoration. The purpose of this study was to examine the effect of the resin impregnation technique for micro-crack using near-infrared light trans-illumination device.

Materials and methods: Extracted human upper incisors with typical enamel micro-crack were selected in this study. The labial surface of all tooth specimens were polished with a low-speed rotated polishing-brush and the width of micro-crack of each tooth was measured by a light microscope (MM-1200, Nikon). Every tooth specimens were observed by near-infrared light trans-illumination device (DIAGNOcam, KaVo), as control. Then, tooth specimen surfaces were cleaned with 6% NaOCl solution at 30 s and were observed by DIAGNOcam (NaOCl). And also two adhesive materials were selected: anti-cariou coating material, Icon (Icon, DMG) and one-step dental adhesive system, Scotchbond Universal (SBU, 3M ESPE). The cleaned tooth specimens were treated with Icon and SBU, and then were observed by DIAGNOcam. The digital images of all tooth specimens ($n=8$) were compared with background enamel surface. The difference of gray value was measured using image analysis software (Image J, v1.60, NIH, USA) and obtained data were analyzed using one-way ANOVA and Tukey's q -test (Microsoft Excel 2010, Microsoft, USA).

Results: The mean value of enamel micro-crack width (S.D.) was 15.9 (3.1) μm . The mean gray values (S.D.) measured by four conditions were Control: 68.9 (13.5), NaOCl: 42.8 (7.3), Icon: 43.1 (5.21) and SBU: 42.3 (5.5). The difference of gray value was influenced significantly by the four conditions at $p < 0.01$. The value of Control was statistically bigger than those of NaOCl, Icon and SBU at $p < 0.01$. And also there was no significant difference among NaOCl, Icon and SBU.

Conclusions: Cleaning with NaOCl solution was effective in bleaching the organic debris in the enamel micro-crack. And the resin impregnation technique using Icon and SBU was effective in maintaining the translucency of the cleaned enamel micro-crack.

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3D abrasion of zirconia posterior bridge after 10 years



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Purpose/aim: In recent years the demand for all-ceramic restorations increased due to their high biocompatibility and enhanced esthetics. Meanwhile, zirconia-based all-ceramic posterior fixed partial dentures (FPDs) are well established and commonly used. Nevertheless, long-term scientific evidence is still needed. Long-term studies in current literature concerning the abrasion in particular are difficult to find. The aim of this prospective clinical trial was to evaluate the abrasion of zirconia-based all-ceramic posterior fixed partial dentures (FPDs) after 10 years of clinical use.

Materials and methods: This prospective study was conducted at Dental Clinic 2–Prosthodontics, Friedrich-Alexander University, Erlangen-Nuremberg, Germany. 15 patients who needed a 3- or 4-unit posterior FPD were randomly selected and provided with 17 all-ceramic FPDs with zirconia frameworks made using Lava system (3M ESPE). A dentist examined the patients at baseline, 3-, 5- and 10-years-follow-up for material (especially abrasion) and biological failures. To digitally constitute the abrasion in all dimensions, an impression was taken from the FPDs with a single-step, two-phase impression technique, using an A-Silicon (Affinis heavy and light body) and plaster models were produced. Subsequently, the models were scanned using a high-resolution industrial scanner. The models from every follow-up examination were superposed with the base line models. The occlusal surface was selected as a region of interest and represented in false colours. The fields of abrasion were selected using the GOM Inspect Professional Software afterwards and data was analyzed by descriptive statistics. The Wilcoxon Signed Rank Test, which was corrected by the Benjamini-Hochberg correction, was applied.

Results: During the observation period of 10 years clinical use, with 3-, 5- and 10-years follow-ups, the abrasion significantly increased. The *p*-value varied in the different periods between 0.001 and 0.004. 3.458 mm³, was the mean value of the abrasion at the 36-months follow-up examination. After 10 years in clinical use the mean-value of the abrasion was -9.055 mm³. The mean value of the deepest measured point was -0.69 mm.

Conclusions: Within the limitations of this in vivo study these main conclusions can be drawn: With the method used in this study, the abrasion of zirconia based all ceramic posterior fixed partial dentures can be composed very well. All in all, the abrasion is clinically acceptable. That is why zirconia frameworks for three- and four-unit posterior FPDs seem to have sufficient mechanical requirements for use in the stress-bearing posterior region and stands a chance to get even more established in modern and esthetic dentistry.

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Influence of conservative endodontic access on dental color stability



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Purpose/aim: The aim of this study was to assess, longitudinally, the influence of conservative endodontic access on the color stability of the dental crown of maxillary central incisors after endodontic treatment.

Materials and methods: Twenty human maxillary central incisors were randomly divided according to the type of the access cavity to the pulp chamber (*n* = 10): conventional endodontics cavities (CEC) and conservative access cavities (CAC). After the access, the root canals were prepared with reciprocating system (Reciproc R50[®]) and constant irrigation using 2.5% NaOCl. Subsequently, the canals were filled with gutta-percha cone R50 (Reciproc R50[®]) and AH Plus endodontic sealer. The access cavities were cleaned using 70% alcohol and then was performed the temporarily sealing with glass ionomer cement (GIC). Teeth were submitted to thermocycling, and posteriorly the final restoration was performed using adhesive system (Single Bond 2, 3M[®]) and composite resin (Filtek Z350 XT, 3M[®]). After that, the teeth were again submitted to thermocycling. The colorimetric evaluation (CIE L*a*b system) were performed in different times, after:

Table 1 – Mean and SD of ΔL and ΔE in different periods.

Groups	ΔL	ΔE
T1 – after biomechanical preparation		
CEC	3.64 ± 5.77aB	5.98 ± 3.43aB
CAC	5.47 ± 4.11aC	6.13 ± 3.17aCD
T2 – after obturation		
CEC	7.51 ± 5.20aC	8.11 ± 4.74aB
CAC	11.97 ± 8.01aB	13.83 ± 6.28bB
T3 – cleaning of the cavity		
CEC	5.82 ± 9.48aBC	10.21 ± 5.88aB
CAC	11.01 ± 7.18aBC	12.72 ± 5.69aB
T4 – after temporary sealing		
CEC	7.24 ± 9.32aBC	10.73 ± 6.14aB
CAC	11.07 ± 5.68aBC	11.39 ± 5.45aBC
T5 – after thermocycling		
CEC	4.79 ± 5.49aBC	6.16 ± 4.19aB
CAC	6.29 ± 2.98aBC	7.40 ± 2.94aCD
T6 – after cervical plug		
CEC	-0.89 ± 8.7aA	7.87 ± 4.60aB
CAC	-1.67 ± 4.42aD	5.40 ± 2.23aD
T7 – after final restoration		
CEC	0.88 ± 7.77aA	7.14 ± 3.99aB
CAC	-1.38 ± 5.11aD	5.64 ± 2.84aD
T8 – after thermocycling		
CEC	42.09 ± 4.92aD	42.37 ± 4.88aA
CAC	41.20 ± 4.05aA	41.7 ± 3.81aA

Lowercase letters indicate comparison between groups within the same time (*t*-test, *p* < 0.05). Uppercase letters indicate comparison between the same group at the different times (ANOVA, *p* < 0.05).

biomechanical preparation (T1), root canal filling (T2), cleaning cavity (T3), GIC temporary sealing (T4), initial thermocycling (T5), cervical plug (T6), final restoration (T7) and final thermocycling (T8). The data were analyzed using two-way ANOVA and Tukey's test ($\alpha = 5\%$). As a complementary analysis, the teeth were qualitatively evaluated by microcomputed tomography (μ CT) and confocal laser scanning microscope (CLSM).

Results: Changes in color parameters (Δa and Δb) were observed in both groups ($p < 0.05$). After T2, the CAC group (1383 ± 628) presented a significant color change (ΔE) when compared to the CEC group (8.11 ± 4.74) ($p < 0.05$). In a longitudinal evaluation, the time increased the luminosity (ΔL) mean values. The μ CT and CLSM qualitative analysis showed the inadequate cut of the gutta-percha cone for CAC group, as well as the presence of endodontic sealer and adhesive system. Also, after the final restoration, it was possible to observe the presence of voids in the CAC, mainly in the vestibular surface (Table 1).

Conclusions: The CAC in human anterior teeth may influence the color stability of the dental crown during each step of the endodontic treatment.

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Endogenous enzymatic activity on deciduous and permanent dentin



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Purpose/aim: Endogenous dentin matrix-metalloproteinases (MMPs) are claimed to be responsible for the degradation of resin–dentin interface over time. The hydrolysis leads to loss of bond strength, forming gaps between the resin and the tooth structure. The age of the patient and the kind of dentinal substrate, deciduous or permanent dentin, could influence the amount of enzymatic activity, which could affect the results of the studies on dentin and the longevity of the adhesive interface over time. The aim of the study was to investigate whether there are differences in the age-related activity of dentinal gelatinases using zymographic assay and *in situ* zymographic assay.

Materials and methods: For the zymographic assay analysis, separate pools of dentin powder were obtained from sound teeth of: (1) deciduous teeth and (2) permanent molars. Each pool was divided in two, with 1a and 2a left mineralized (as control), while 1b and 2b demineralized with 10% phosphoric acid. Different pools of dentin powder were submitted to the zymographic analysis. Further, *in situ* zymographic assay was performed on sections of dentin of the same groups.

Results: Deciduous dentin powder groups showed phantom expressions in the area of the bands for MMP-2 and MMP-9. As for the permanent dentin, demineralized groups showed higher gelatinolytic activity with respect to the mineralized ones. The signal of the MMPs was stronger and more

clearly delineated in the permanent dentin as compared to the deciduous one. *In situ* zymography also displayed distinctive differences in the activity of MMPs in the different groups.

Conclusions: The discrepancies in the enzymatic activity detected could be related to the differences in the amount of mineralized tissue of the deciduous teeth; however, additional studies are needed to further investigate MMPs expression in deciduous teeth.

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Effect of etching time on MMPs activity and radicular bond-strength



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Purpose/aim: The aim of this *in vitro* study was to evaluate the effect of different etching time with or without the application of ethanol pretreatment of a novel hydrophilic multi-mode universal adhesive (Clearfil Universal Quick, Kuraray) on immediate push-out bond strength and MMPs gelatinolytic activity on radicular dentin.

Materials and methods: 48 single root teeth were selected, endodontically treated and obturated. 7 days after obturation, an 8-mm post space was prepared with dedicated drills. Samples were randomly divided into 4 groups according to the adhesive protocol applied: G1 – 15s H₃PO₄ application + Universal Quick; G2 – 60s H₃PO₄ application + Universal Quick; G3 – 15s H₃PO₄ application + Ethanol-wet bond + Universal Quick; G4 – 60s H₃PO₄ + Ethanol-wet bond application + Universal Quick. All adhesives were applied following manufacturer's instructions, and fiber posts were luted into the post space with the same cement (DC Core, Kuraray). Specimens of each group were further cured for 40s. After 24 h of storage in artificial saliva specimens were prepared to perform micropush-out test and nanoleakage analysis of the coronal and apical region. Additionally, *in situ* zymographic assay was performed to investigate endogenous MMPs activity within the hybrid layer. Results were statistically analyzed with ANOVA and Tukey's post-hoc tests. Statistical significance was set for $p < 0.05$.

Results: Three-way ANOVA analysis showed a statistically significant difference in push-out bond strength values for the variable area ($p = 0.01$) and etching time ($p = 0.01$), but not for the ethanol pretreatment variable ($p = 0.50$). In particular, coronal samples showed immediate bond strength significantly higher than the apical samples. Furthermore, when dentin was etched for 60s, push-out results are significantly higher than 15s etched teeth. *In situ* zymography quantification analysis revealed that all tested groups independently from activate MMPs gelatinolytic activity.

Conclusions: In radicular dentin, a prolonged etching time seems to improve immediate bond strength, regardless the application of an ethanol pretreatment. However, *in situ* zymography assay revealed an increased MMPs activation

when H₃PO₄ is applied for 60 s, thus creating the possibility of a faster degradation of the hybrid layer over time. Longer observation times are needed to validate these *in vitro* results and better clarify the role of extended etching time on radicular dentin.

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Mechanical properties of Y:TZP/TiO₂ coated with hydroxyapatite for dental implants



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Purpose/aim: (1) To investigate the effect of titania content in mol% (0, 10 and 30) in the specific surface area (SBET), the size of the agglomerates and the intensity of the peaks corresponding to crystalline phase present in the ceramic powder of Y:TZP/TiO₂; (2) to investigate the effect of titania addition (0, 10 and 30 mol%) on the microstructure, relative density (RD), Young's modulus (E), Poisson's ratio (PR), flexural strength (σ_f) and Weibull modulus (*m*) of a Y:TZP/TiO₂ composite; and (3) to investigate the effect of the presence of a biomimetic coating on the microstructure and mechanical properties (σ_f and *m*) of Y:TZP/TiO₂ composite.

Materials and methods: Y:TZP (3 mol% of yttria) and Y:TZP/TiO₂ composite (10 or 30 mol% of titania) were synthesized using a co-precipitation route. The powders were pressed and sintered at 1400 °C/2 h. Half of the discs were subjected to biomimetic coating. The powders were characterized by X-ray diffraction (XRD), laser scattering, gas adsorption and scanning electron microscopy (SEM). The surfaces, with and without biomimetic coating, were characterized by SEM and XRD. The RD was measured by the Archimedes' principle. E and PR were measured by ultrasonic pulse-echo method. For the mechanical properties the specimens (*n* = 30 for each group) were tested in a universal testing machine. Weibull modulus was estimated by the maximum likelihood method and ANOVA with Tukey test (α = 5%) was used to evaluate σ_f , E and RD.

Results: All powders had a SBET greater than 42 m²/g and the titania addition favored the formation of larger agglomerates. Titania addition increased the grain size of the composite and caused a significant decrease in the σ_f in MPa (control:

815.4a; T10: 455.7b and T30: 336.0c), E in GPa (control: 213.4a; T10: 155.8b and T30: 134.0c) and relative density in % (control: 99.0a; T10: 94.4c and T30: 96.3b) of the Y:TZP/TiO₂ composite. The presence of 30% titania caused substantial increase in *m* and PR. Biomimetic coating resulted in the formation of apatite globules heterogeneously distributed on the surface of the material and this treatment did not significantly alter the σ_f and *m* of the composite (Table 1).

Conclusions: The Y:TZP/TiO₂ composite coated with a layer of CaP has great potential to be used as implant material. Properties of the powder were affected by titania addition. Addition of titania to Y:TZP caused an increase in grain size, a significant decrease in σ_f , E and RD. The presence of biomimetic coating did not jeopardize the reliability of Y:TZP/TiO₂ composite.

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Antibacterial activity and flexural strength for experimental composites with graphene



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Purpose/aim: The aim of this study was to develop composite materials with antibacterial activity using nanopowders of graphene oxide (GO-SiO₂ and GO-ZrO₂ synthesized in INCD-TIM laboratory) in difference concentration. In this study was to evaluate the antibacterial activity, elastic modulus (E) and flexural strength (FS).

Materials and methods: Five experimental composites were made with organic matrix of BisGMA (synthesized in our laboratory)/TEGDMA (Aldrich) and inorganic phase: (HA-SiO₂, barium glass, GO-SiO₂: 1%, 0.8% – for GS1, GS2; and HA-Zr, barium glass, GO-ZrO₂: 1%, 0.8% for GZ1, GZ2) and GC (HA-Zr, HA-SiO₂, colloidal silica, barium glass) composite without graphene, in 20/80 proportions of weight. Specimens for flexural properties (25 mm × 2 mm × 2 mm) were half immediate tested (24 h) and half storage (1 month). Elastic modulus (E) and flexural strength (FS) was measured using the three point bending test (*n* = 10), in accordance with ISO 4029/2000 (Lloyd Tools- LR5k Plus). The antimicrobial activity materials were evaluated using the agar diffusion method. The bacterial

Table 1 – Mean ± standard deviation (coefficient of variation) of flexural strength (σ_f) and Weibull modulus (95% confidence interval) (*m*). Values followed by the same letter are statistically similar (*p* > 0.05).

Titania content (mol%)	Flexural strength (σ_f) (MPa)		Weibull modulus (<i>m</i>)	
	Biomimetic coating		Biomimetic coating	
	No	Yes	No	Yes
0	815.4 ± 145.1 ^a (18%)	763.6 ± 144.2 ^a (19%)	6.4 ^{b,c} (4.7–8.6)	5.4 ^c (3.9–7.4)
10	455.7 ± 48.4 ^b (11%)	439.4 ± 65.4 ^b (15%)	10.5 ^{a,b} (7.7–14.1)	8.7 ^{a,b,c} (6.3–11.7)
30	336.0 ± 38.7 ^c (11%)	334.2 ± 43.6 ^c (13%)	11.7 ^a (8.6–15.8)	9.9 ^{a,b,c} (7.3–13.4)

strains were from *Escherichia coli* ATCC 25922 (Gram negative) and *Staphylococcus aureus* ATCC 25923 (Gram positive) used the paper disc method and the wells method. The reading (24 h and 48 h) was done by measuring the diameter of the inhibition zone: the larger the inhibition zone diameter, the greater the susceptibility of bacteria to antimicrobial substance.

Results: Values for elastic modulus (E) and flexural strength (FS) at 24 h of the 0.8% concentration GO-ZrO₂ presented the higher values, but after 1 month of storage this concentration showed the lower values of all. For the two bacteria tested the composites with graphene loaded presented inhibition of growth for all concentration. Also, by the wells method it may notice a higher antibacterial activity and especially for the GZ2 against *E. coli* (12 mm) and GS2 against *S. aureus* (13 mm). The largest diameter of bacterial inhibition zone (14 mm) was obtained by the paper disc method for GS1, GS2 against *S. aureus* and GZ2 against *E. coli*.

Conclusions: The bacterial inhibition assay revealed that exist an antibacterial activity for all samples, but most good activity is against *S. aureus* bacteria for composites with GO-SiO₂ graphene. Values flexural strength after 1 month of storage was lower.

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NaOCl pretreatment and 3-year retention of cervical composite restorations



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Purpose/aim: This split-mouth, randomized controlled clinical trial evaluated the 3-year clinical performance of composite resin restorations in non-carious cervical lesions (NCCLs) performed with or without a deproteinization pretreatment with 10% NaOCl solution on etched dentin (experimental). The control group used a placebo solution (water).

Materials and methods: In total, 30 patients with 100 cervical restorations were included in the study. The NCCLs were evaluated according to lesion shape ("U" or "V"), lesion length and height (in mm), relation to the gingival margin (supragingival, gingival level, or subgingival), presence of wear facets, dentin sensitivity, and pulp vitality. Randomization considered the tooth group. A two-step, etch-and-rinse adhesive system and a nanofilled composite were applied according to the manufacturer's directions. The placebo or NaOCl solutions were applied for 60 s after acid etching and rinsed with water. Clinical evaluations were carried out after 1 week, 6, 12, 24, and 36 months using the FDI criteria. Differences between frequencies were assessed by the Exact Fisher test. Survival analysis was performed using the Kaplan-Meier method. The log-rank test was used to evaluate differences between the survival curves. Unadjusted Cox-regression models with

shared frailty were used to verify the association between treatment and the risk of failure over time ($\alpha = 0.05$).

Results: The average lifetime of the restorations was 2.86 years. At 36 months, the annual failure rate was 9% for the control and 17.8% for the experimental group. Most lesions had a V wedge shape (60%), 48% had a depth below 1 mm, and 49% had a height between 1 and 3 mm. Most NCCLs were present in premolars (58%). In the survival analysis, no significant differences were observed between the control and experimental groups ($p = 0.077$) or for the number of teeth in the mouth ($p = 0.320$), whereas mandibular restorations ($p = 0.039$) and restorations in premolars ($p = 0.013$) had significantly lower clinical survival. The experimental group failed 40% more often compared to the control group, but the association was not significant ($p = 0.075$). From the sample, 37.5% of patients never had tooth sensitivity, 56.3% had improvement in sensitivity after restoration, and 6.3% reported the restored teeth remained sensitive (all from the control group).

Conclusions: In conclusion, the deproteinization technique did not improve the retention of class V restorations in NCCLs or the failure rates during 36 months of clinical follow up.

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Resin composite restoration survival: Preliminary results on systematic review



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Purpose/aim: This study determined the clinical evidence of the most suitable treatment/material for resin composite restoration survival in primary and permanent teeth.

Materials and methods: The PRISMA guidelines were followed. Studies were searched on PubMed, Embase and Scielo databases without language restrictions, from August 1977 to January 2017. The MeSH headings used were "adhesive" and "restoration" and "composite". The analysis was limited to clinical trials that compared adhesives and/or resin composites related to restoration survival in primary and permanent teeth and had at least 12 months of follow-up. The primary outcome evaluated was retention, followed by recurrent caries and marginal discoloration. After title, abstract and full versions reading, the data were extracted and the studies were subjected to the evaluation of risk of bias according to predetermined criteria of Cochrane Collaboration's tool. Narrative synthesis of those included studies was performed.

Results: Among the 905 papers identified in the search, 117 fulfilled the inclusion criteria. Fifteen studies were of low risk of bias. No statistical difference was found in the retention of different adhesives and resin composites in 12 studies. However, two studies showed worst performance of one-step self-etch adhesive, for retention, recurrent caries and marginal discoloration, in comparison to two-step self-etch, two and three step etch-and-rinse adhesives. One study showed better results on marginal discoloration when selective etching of the enamel for self-etch adhesives was used.

Conclusions: There was no significant difference in the restoration survival rates regardless the adhesive and resin composite type. However, concerning one-step self-etch adhesive systems, it is necessary to be conducted more studies with high evidence level.

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Characterization of lithium-disilicate ceramic surface-treatments via contact-angle analysis



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Purpose/aim: The aim of this study was to determine the effect of different ceramic primers and silanization protocols upon surface hydrophobicity of lithium disilicate glass ceramic.

Materials and methods: One hundred and fifty plates (6 mm × 10 mm × 2 mm) were milled from lithium disilicate CAD/CAM blocks (IPS emax CAD, Ivoclar Vivadent) and polished with 600-grit sandpaper. Specimens were divided into three groups according to the ceramic primer employed: 1. Rely X Ceramic Primer (RLX) (3M ESPE), 2. Clearfil Ceramic Primer (CCP) (Kuraray), and 3. Monobond Etch and Prime (MBEP) (Ivoclar Vivadent). Specimens from groups RLX and CCP were etched using 5% hydrofluoric acid (Condac Porcelana, FGM) for 20s (as recommended by each primer manufacturer). Specimens from each group were then distributed into 5 sub-groups according to additional protocols after silane primer application ($n=10$): 1. Treated as recommended by manufacturer (no additional step: positive control group-MR), 2. MR silanization plus additional drying with hot air for 30s (HA), 3. MR silanization plus additional drying with air at room temperature for 30s (RTA), 4. MR silanization plus additional surface rinsing with water for 10s and drying with air at room temperature for 30s (WA), and 5. Specimens were not silanized at all (negative control group-CG). A 5- μ L drop of deionized water was placed on each ceramic surface. Static contact angles were measured on treated ceramic surfaces using a goniometer and specialized software (Digidrop Contact Angle Meter; GBX, Bourg de Peage, France). Two measurements, one on each side of the drop, were recorded and an average was obtained. Statistical analysis was performed using two-way ANOVA and Tukey's test ($\alpha=0.05$).

Results: Two-way ANOVA showed that factors "silanization protocol" and "ceramic-primer" were statistically significant for contact angle ($p<0.001$). MBEP presented higher contact angles independent of silanization protocol. CCP demonstrated greater values than RLX. WA protocol significantly increased contact angle on specimens treated with CCP and RLX. For the later primer, MR and RTA silanization protocols did not differ from the control group ($p>0.05$).

Conclusions: Ceramic water rinsing after application of RLX and CCP silane-primers, increased ceramics' hydrophobicity, whereas MBEP presented the highest contact angles independent of silanization protocol employed.

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Properties of experimental adhesive containing copper oxides and copper-zinc nanocomposites



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Purpose/aim: Evaluation polymer properties (SEM, IR vibrational spectroscopy, surface microhardness), and immediate adhesive behavior of microtensile bond strengths (μ TBS) on dentine of six hema-free experimental adhesive blends with copper oxides [Cu(0), Cu(I), Cu(II)] and nanocomposites of copper oxide with zinc (nZn-CuO).

Materials and methods: Nanoparticles samples of Cu(0), Cu(I), Cu(II) and Zn were analyzed by SEM to determined morphology and size distribution. The size distribution of the particles was estimated from the average of 200 particles approximately. Through IR vibrational spectroscopy, the composition of the synthesized nanoparticles and the polymer, before and after mixing was identified. Three specimens for each group were made to the surface Vickers microhardness (VHN) evaluation (100g/20s). Five measures were carried out (50 μ m distance). To μ TBS, thirty caries-free extracted third molars were divided into six groups corresponding to hema-free experimental adhesive blends with: Cu(0), Cu(I), Cu(II), nZn-CuO(I), nZn-CuO(II) and Control (without nanoparticles). After restorations constructed on dentin surface, specimens were stored in water (37°C/24h). Resin-dentin beams (0.8mm³) were tested at 0.5 mm/min (μ TBS). Data from μ TBS and VHN were analyzed using one-way ANOVA and Tukey's test ($\alpha=0.05$).

Results: The distribution showed that the particles were able to maintain the dispersion inside the polymer formed. The addition of copper [Cu(I) and Cu(II)] and zinc oxides nanoparticles do not affect the immediate adhesive bond strength when compared to the control group. The best VHN values were observed when adhesive systems have Cu(II) and nZn-CuO(II).

Conclusions: Copper oxides nanoparticles and nanocomposites of copper oxide with zinc addition do not affect the immediate adhesive properties on dentin and may provide additional intrinsic resistance of the polymer formed. However, longevity challenges could be performing with this experimental adhesive to analyse its stability, antimicrobial activity and capability to keep entire against degradation.

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Effect of acid-etching protocols on 3D microstructure of ceramic materials

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Purpose/aim: To evaluate the effect of different acid etching protocols on microstructural characteristics of ceramic-containing CAD/CAM materials.

Materials and methods: Three materials were used: IPS/Empress-LEU, IPS/e.max-LDC (Ivoclar Vivadent) and Enamic-PIC (VITA). Sixty blocks (3 mm × 3 mm × 2 mm) were cut from each material and polished (SiC sand paper #600). Lateral surfaces from each block were isolated with petroleum jelly/Teflon tape, letting only the superior surface uncovered (only treated surface). Specimens were distributed into 6 groups ($n=10$) and treated employing different etching protocols: 1. No treatment (C); 2. Hydrofluoric acid (HF) 5%, 20s (HF5%20s); 3. HF5%60s; 4. HF10%20s; 5. HF10%60s; 6. Monobond Etch & Prime (MBEP). Surface roughness (Ra) was analyzed using a confocal-laser optical microscope at ×216 magnification (LEXT OLS 4000, Olympus); also a surface 3D profile representative was taken from each experimental group at ×1000 magnification. Energy dispersive spectroscopy (EDS) analysis was performed, to obtain silicon (etchable phase representative)/potassium (non-etchable phase representative) (Si/K) (LEU and LDC) and silicon (etchable phase representative)/carbon (non-etchable phase representative) (Si/C) (PIC) element ratios for each group. Finally, superior (treated) and lateral (non-treated) surfaces were analyzed using scanning electron microscopy (SEM) (JSM 5600 LV, JEOL) obtaining SEM images from each experimental group. In the case of lateral surfaces, etching deepness was also measured. All variables were submitted to ANOVA-One-Way and Tukey's test ($\alpha=0.05$).

Results: For LEU, only HF10% treatments produced statistically different roughness values (20s: $0.55 \pm 0.04 \mu\text{m}$; 60s: $0.65 \pm 0.11 \mu\text{m}$) and Si/K ratios (only HF10%60s: 2.23 ± 0.13) compared to C group (Ra: $0.44 \pm 0.02 \mu\text{m}$ /Si/K: 2.53 ± 0.09). Regarding LDC and PIC, groups HF5%60s (LDC: $0.55 \pm 0.04 \mu\text{m}$ /PIC: $0.64 \pm 0.03 \mu\text{m}$) and HF10% (both: LDC-20s: $0.62 \pm 0.06 \mu\text{m}$; LDC-60s: $0.68 \pm 0.02 \mu\text{m}$ /PIC-20s: $0.71 \pm 0.09 \mu\text{m}$; PIC-60s: $0.80 \pm 0.22 \mu\text{m}$) showed higher roughness values than C group (LDC: $0.35 \pm 0.08 \mu\text{m}$ /PIC: $0.54 \pm 0.05 \mu\text{m}$). In the case of PIC, all treatments (except MBEP) produced higher Si/C ratios than C group. All treatments (except MBEP) produced higher etching deepness values than C group for the three materials tested, being HF10%60s the highest (LEU: $403.2 \pm 11.4 \mu\text{m}$; LDC: 617.4 ± 75.7 ; PIC: $291.6 \pm 6.5 \mu\text{m}$). HF10% produced more aggressive etching morphology patterns on superior and lateral surfaces (SEM).



Treatments MBEP and HF5%20s, produced the least aggressive structural alterations.

Conclusions: Acid etching produces in general tri-dimensional (surface/deepness) alterations on ceramics' structural configuration, which depends on acid type, concentration and application time. HF5%20s and MBEP demonstrated to be the best options to etch glass ceramic materials in terms of microstructure integrity.

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Effect of concentration of p-TSNa on dentin bond strength

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Purpose/aim: The aim of this study was to evaluate the bonding performance of two dentin adhesive systems with various concentration of sodium p-toluene sulfinate (p-TSNa) activator on dentin.

Materials and methods: Twenty-five extracted caries free human third molars were abraded to obtain a flat dentin surface. Teeth were randomly assigned to 5 groups ($n=5$) according to the dentin adhesive and the concentration of activator as follows: Group AQ0: AQ bond plus (Sun medical) only, Group AQ30: AQ bond plus with 30% p-TSNa activator, Group AQ50: AQ bond plus with 50% p-TSNa activator, Group AB0: All-bond Universal (Bisco Inc.) only, Group AB50: All-bond Universal with 50% p-TSNa activator. The dentin adhesives were applied on prepared occlusal surfaces, and 4-mm resin composite (Filtek Z350, 3M ESPE) was incrementally built-up. A micro-tensile bond strength (μTBS) test and the fracture failure mode analysis were performed. Fractured interface was analyzed with scanning electron microscopy (SEM).

Results: Two-way ANOVA results indicated that there was significant differences according to the concentration of p-TSNa and type of dentin adhesive ($p<0.05$). There were no significant interaction between differences concentration of p-TSNa and type of dentin adhesive ($p>0.05$). Failure mode test presented commonly adhesive failure in the dentin. Adhesive failure mode was over 90% in all experimental groups.

Conclusions: p-TSNa enhances the bonding strength of the two different dentin adhesives, but the concentration of p-TSNa does not significantly affect the bonding strength.

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Bond strength of ceramic to resin composite for core build-up



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Purpose/aim: This study examined the shear bond strength of self-adhesive resin cement between ceramic for CAD/CAM and resin composite for core build up.

Materials and methods: A commercially available CAD/CAM ceramic block [GN-I CERAMIC BLOCK A3M, GC], a dual cured composite resin for core build up material [UniFil Core EM, GC], a self-adhesive resin cement [G-CEM ONE, GC] and a primer [G-Multi PRIMER, GC] containing MDP, MDTP and γ -MPTS were used. The ceramic blocks were embedded into the epoxy resin, and were polished using abrasive papers from SiC#600 to SiC#1200 under water. Disc specimens (6 mm diameter and 4 mm thick) of dual cured composite resin for core build up were prepared using Teflon molds according to manufacturer's instruction. Then the surface of the disc specimens was sandblasted (0.4 MPa) by alumina particles. In order to evaluate the factors affecting shear bond strength, three different experimental groups were compared as shown in Table 1. Prior to the cementation, each material was cleaned by ultrasonic bath using deionized water for 10 min. The resin cement mixture was placed on the ceramic surface and the disc specimen of resin composite were cemented and fixed by finger pressure. And the cement was cured using curing lamp for 40 s. The specimens were kept in the $95 \pm 5\%$ relative humidity at $37 \pm 2^\circ\text{C}$ for 24 h after the start of cement mixing. Then the shear bond strength of self-adhesive resin cement, between the ceramic and the resin composite, was determined using a universal testing machine (Instron 3366). Five specimens were fabricated and tested for each experimental condition. Shear bond strength was calculated by dividing the maximum failure loads (N) by the adhesive area of the disc specimens (0.283 cm^2). The results were analyzed using ANOVA/Scheffe's test ($\alpha = 0.05$).

Results: The shear bond strength values of each group tested were as follows (MPa, mean \pm SD); 12.3 ± 4.0 for Group 1, 8.0 ± 4.3 for Group 2 and 5.0 ± 1.0 for Group 3. Group 1 had significantly greater shear bond strength than Group 3 ($p < 0.05$). Although no statistical differences in shear bond strength were observed between Groups 1 and 2, and Groups 3 and 2, the results indicated a trend that sandblasting (Group 1 vs 2)

or priming (Group 2 vs 3) to ceramic surfaces increased the bond strength.

Conclusions: Under the present experimental condition, both the sandblasting and the application of primer to the adhesive surface may improve their surface affinity to the resin cement resulting in increasing adhesive strength between ceramics and core build up composite resin.

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Effect of home whitening on green tea-stained composite resin



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Purpose/aim: We applied a home whitening material to composite resin stained with green tea and investigated color changes.

Materials and methods: Composite resins: GC MI GRACE-FIL (MIG; GC Corp.), GC MI FIL (FIL; GC Corp.), and ESTELITE Σ QUICK (EST; Tokuyama Dental Corp.), were irradiated with light on the upper and lower surfaces for 40 s each using G-Light Prima (GC Corp.), and 1-cm diameter \times 2-mm height cylinders were prepared. The smooth surface of the cylinders was polished for 10 s each with waterproof abrasive papers #600, #800, and #1000 in the order of decreasing roughness. The composite resins were immersed in green tea (GIT: IEMON TOKUTYA; Suntory Holdings Ltd.) and distilled water (DW) at 37°C for 3 months. TION HOME (GC Corp.) was applied for 2 h per treatment 14 times to the smooth surface of the stained composite resins. The color of the composite resins was evaluated before and after treatment using Shade Eye NCC (SHOFU Inc.). L^* , a^* , and b^* were measured, the color difference between before and after treatment was determined, and the results were subjected to 2-way layout analysis of variance.

Results: The mean color difference, ΔE^*ab , after each of the 14 treatments was 6.18 in GIT and 6.00 in DW, that of CR was 5.32 in MIG, 6.06 in FIL, and 6.89 in EST, and those with and without whitening were 5.67 and 6.51, respectively, showing no significant difference. After the 14 treatments, ΔE^*ab of the beverages was 9.43 in GIT and 10.13 in DW, showing no significant difference. In CR, it was 8.51, 9.90, and 10.92 in MIG, FIL, and EST, respectively, being significantly different between MIG and EST. Those with and without whitening were 11.27 and 9.29, respectively, being significantly different. Regarding time-course changes, ΔE^*ab once decreased and then increased in the presence of whitening.

Conclusions: When the whitening material was applied to the green tea-stained composite resins, no significant difference was noted in the mean of changes after each of the 14 treatments under any condition, but the color difference after the 14 treatments increased in the order of EST > FIL > MIG, and it significantly increased in the presence of whitening, suggesting that the whitening material caused some changes in the surface properties of the composite resins. It was suggested that after the removal of the stain by whitening, the

Table 1

	Ceramics Sandblasted	Ceramics Priming	Core build up resin composite Priming
Group 1	+	+	+
Group 2	-	+	+
Group 3	-	-	-

color of composite resin changes due to alterations in the surface properties.

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Synthesis of phosphate based bioactive glasses



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Purpose/aim: The aim of this study was to synthesize the novel phosphate based bioactive glass at ambient temperature with better solubility and quick resorption rate.

Materials and methods: Sol-gel method was used to synthesize the phosphate based bioactive glass material at ambient temperature (25 °C) and after aging in vacuum dessicator the obtained material was calcined at 600 °C for 6 h with the heating ramp of 1 °C min⁻¹ in a furnace. The solubility of these glasses was tailored by changing the glass composition. The phase purity, structural, physical and thermal analysis of obtained powder was carried out by X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM) and thermogravimetric analysis/differential scanning calorimetry (TGA/DSC) respectively. The resulting bioactive glass were compressed to disc form (5 mm × 2 mm) and the solubility of the glasses was assessed after immersion in Tris buffer HCl solution (pH ~ 7) at 37 °C and periodically analyzed at 1, 3, 5, 7, 14 and 21 days and afterward they were removed carefully and washed. Weight measurement analysis was conducted before and after immersion and after washing the discs were analyzed with XRD, FTIR and SEM. The phosphate, calcium and sodium ion release behavior was also analyzed.

Results: FTIR spectra of phosphate based bioactive glass confirmed the crystallinity and exhibited asymmetrical and symmetrical stretching peaks of phosphate at 910 cm⁻¹ and 1125 cm⁻¹ respectively and after calcination the OH peak disappeared. The XRD pattern of phosphate based bioactive glass before and after heat treatment demonstrated intense peaks at 2θ values, the peak appeared at 24° corresponded to the P-O; SEM images showed the fine dense nanoparticles size range from 350 to 450 nm. In solubility study the concentration of calcium, phosphorous and sodium released into the solution and significant difference was found in weight analysis. XRD, FTIR and SEM showed the formation of an amorphous apatite layer on disc surface and the dissolution of superficial layer ascribed to the solubility of the glass.

Conclusions: The ease of synthesis and ability to optimize the solubility of these phosphate glasses made them clinically useful for promoting the regeneration. Furthermore, phosphate glasses can be produced at relatively low temperatures, thus allowing the incorporation of drugs and bioactive macromolecules, which could have potent modulating effects.

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Differential dentin bond strength of bulk-fill composites in class I cavities



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Purpose/aim: To evaluate the bond strength of two bulk-fill resin composites and to compare with a conventional hybrid resin composite in standard class I cavities.

Materials and methods: Fifteen third molars were prepared with diamond burs in high-speed handpiece to obtain standardized class I cavities with 4 mm × 4 mm × 4 mm dimensions. Teeth were randomly divided in three groups (n = 5) according to the resin composite used: a control conventional hybrid composite Filtek Z100 (3M), Filtek Bulk Fill (3M) and SonicFill (Kerr). All cavities were bonded with Singlebond 2 adhesive (3M) before application of composites. Z100 was applied in four 1 mm thick vertical increments individually light-cured for 40 s whilst bulk-fill composites were applied in bulk and light-cured for 40 s. After 24 h, specimens were longitudinally cut into 1 mm² resin-dentin sticks for microtensile bond strength test, which was undertaken in a universal testing machine. Failure pattern was surveyed in a stereomicroscope and divided in adhesive, cohesive or mixed. Outcomes of bond strength were statistically analyzed by one-way ANOVA and Tukey's test (p < 0.05).

Results: Filtek Bulk Fill achieved lower bond strength (p = 0.038) than Z100, and SonicFill provided intermediate result without statistical difference (p > 0.05) from further composites. Most fractures were adhesive in all groups.

Conclusions: In conclusion, bulk-fill composites attain different bond strengths when applied in class I cavities in comparison to Filtek Z100 applied in incremental technique. Between bulk-fill composites studies, Filtek Bulk Fill provided lowest dentin adhesion.

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Effect of prolonged-storage on tensile bond strength of adhesive systems



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Purpose/aim: The purpose of this study was to evaluate the tensile bond strength of the universal adhesive systems to repair ceramic restorations before and after their expiry dates.

Materials and methods: Three types of the universal adhesive systems (SU, Scotchbond Universal Adhesive, 3M; CP, G-Premio bond/Ceramic Primer, GC; UP, Bond Force II/Universal Primer, Tokuyama Dental) were tested in this study. All bonding systems were tested before or after 2 months of each expiry date. Surfaces of the ceramic blocks (Ceram Block, GC) were grinded with #600 SiC paper and ultrasonicated for 10 min. Each adhesive system was applied on the surface according to the manufacturer's instructions. Then a cylindrical stainless mold (3.0 mm height, 4.0 mm diameter) was put on the surface and resin composite was filled (MI LOW FLOW, GC). Tensile bond strength, TBS, was measured by universal testing machine, cross head speed at 0.5 mm/min, after the specimens were stored in distilled water at 37 °C for 24 h. The data were statistically analyzed by two-way ANOVA and Tukey-HSD ($p < 0.05$, $n = 12$). The components of adhesive systems tested in this study were analyzed to compare between before and after their expiry dates by HPLC.

Results: Whereas TBS before the expiry dates showed 13.2 ± 6.2 MPa for SU, 15.4 ± 3.2 MPa for CP, and 17.5 ± 5.9 MPa for UP, TBS after expired were significantly decreased in all products, 8.1 ± 2.4 MPa for SU, 10.3 ± 3.0 MPa for CP, and 13.1 ± 3.0 MPa for UP. There was no intersection between expiry date and products. For HPLC analysis, some shifted peaks which seemed to be hydrolyzates of γ -MPTS appeared in the expired bonding systems tested.

Conclusions: The results in this study suggested that the component for Si-coupling, γ -MPTS, of adhesive systems might be hydrolyzed during storage and the tensile bond strength would be affected.

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Fractographic analyses of dentin



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Purpose/aim: Cracked teeth often cause pain and discomfort. Although a common clinical problem, there are no rules for prevention or intervention. It is of tremendous importance to understand the principal causes of fractures in teeth, which can help in developing guidelines for prevention and treatment. The aim of this study was to characterize

the fractographic features of dentin resulting from static and cyclic loading to failure.

Materials and methods: Twenty rectangular beam specimens of radicular dentin were obtained from young and old donors and subjected to static ($n = 14$) or cyclic ($n = 6$) four-point flexure to failure. Each was inspected by SEM and analyzed using standard fractographic methods.

Results: The fracture origin and direction of crack propagation was identified in all specimens. The fractographic features included initial crack, compression curls and arrest lines. There were differences between specimens that failed by static or cyclic loading, although not very distinct. Multiple arrest lines were present in specimens that failed by fatigue, whereas most specimens fractured during static loading did not exhibit distinct arrest lines beyond the initial crack. The tortuosity of the surface created by the dentin tubules complicated interpretation since the features were often partial or non-continuous.

Conclusions: The findings show that fractography can be used for identifying fracture origins and direction of crack propagation in dentin. Furthermore, it can be used to understand the conditions of loading that facilitated the fracture of teeth in vivo.

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Preparation of nanocomposite resin block using the FPMI method



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Purpose/aim: We have developed a new technique of preparing dental CAD/CAM composite resin blocks (CRBs): the filler press and monomer infiltration (FPMI) method. The purpose of this study was to prepare the nanocomposite resin block in which the nanofiller is uniformly dispersed and extra-high densely packed using the FPMI method.

Materials and methods: A fine silica powder (Aerosil OX-50, average particle size: 40 nm) was surface-treated using 3-methacryloxypropyltrimethoxysilane and used as the inorganic filler. The monomer mixture was comprised of 49.48 wt% UDMA, 49.48 wt% TEGDEMA, 0.99 wt% benzoyl peroxide and 0.05 wt% acylphosphine oxide (Lucirin TPO). A stainless die with an internal capacity of 33 mm × 24 mm and two punches were used for uni-axial press. 5.5 g of inorganic filler was placed in the die, which is compressed from both the top and bottom using two punches at 60 kN (76 MPa) for 60 s. After pressing, the block-shaped green body of nanosilica filler was taken out of the die. The blocks pressed were sealed in a vinyl bag and subjected to cold isostatic pressing (CIP) at 170 MPa and 950 MPa for 60 s respectively. The resulted nanosilica green bodies were immersed in the monomer mixture for 5 days. The translucent monomer-infiltrated green bodies were obtained, followed by the polymerization with the

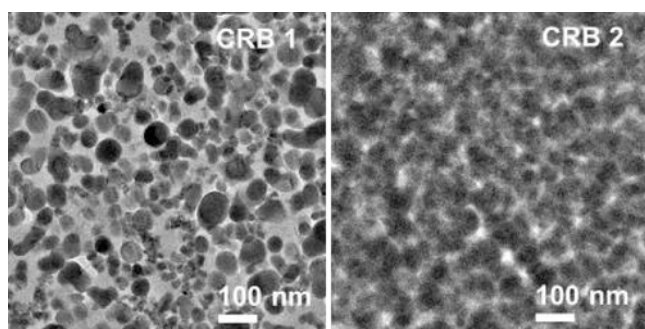


Fig. 1

light-curing for 3 min and then heated at 120 °C for 2 h, resulting in the hard nanocomposite resin blocks, CRB1 (170 MPa) and CRB2 (950 MPa). The inorganic filler content was measured by ignition residue at 600 °C and the volume content was calculated by the gravity of nanosilica and matrix polymer. TEM observations were carried with the 50 nm thickness sectioned specimen. The flexural strengths were measured according to ISO4049, the specimens, 2 mm × 2 mm × 25 mm, were cut from the CRB using a diamond saw.

Results: The inorganic filler contents were 70.1 wt% (56 vol%) for CRB1 and 76.0 wt% (64 vol%) for CRB2. The TEM images of the CRB (Fig. 1) reveal that the nanofiller are uniformly and densely distributed. The flexural strengths were 201 MPa for CRB1 and 208 MPa for CRB2, the flexural modulus were 10.1 GPa for CRB1 and 15.2 GPa for CRB2.

Conclusions: The greater the pressure of the nanofiller molding in the FPMI method, the more nanofiller in the CRB resulting in a high elastic modulus CRB. The nanocomposite material in this study will be useful for the fabrication of permanent resin crown.

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Can glass ionomer cements inhibit cariogenic species? In vitro study



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Purpose/aim: The objective of this in vitro study was to determine whether glass ionomer cements (GICs) can inhibit bacteria involved in caries lesion process. For this, three strains were selected: *Streptococcus mutans* (ATCC 25175), *Lactobacillus casei* (ATCC 334) and *Bifidobacterium dentium* (ATCC 27534).

Materials and methods: Three GICs were tested, two conventional GICs (Fuji IX Extra and IonZ – a new GIC available in Brazil, that present in its composition zinc oxide particles) and one resin modified GIC (Fuji II LC) using two methodology: agar diffusion test and direct contact test. The GICs were tested immediately after manipulation (I) and after 10 min (M). For the agar diffusion test the mean inhibition zones in millime-

ters were measured and for direct contact test the number of colony forming units was evaluated by scores. The tests were done in triplicate.

Results: For *S. mutans*, just Fuji IX Extra (I) and Ion-Z (I) presented inhibition zones of 3.00 (±5.19) and 10.66 (±4.61) mm respectively in agar diffusion test, and, a score of 3 (dense bacterial growth) for direct contact test. *L. casei* was inhibited in agar diffusion test by Fuji IX Extra (I) and (M), Ion-Z (I) and (M), and the major inhibition zone was for Fuji IX Extra (M) with 14.00 (±1.73) mm. In direct contact test, *L. casei* presented a score 2, a moderate bacterial growth against the cements. In agar diffusion test, *B. dentium* was inhibited by Fuji IX Extra (M) with 9.33 (±8.14) mm, Ion-Z (M) 7.33 (±1.52) mm and Ion-Z (I) 6.33 (±5.68) mm of inhibition zones. In direct contact test, Fuji II LC (I) allowed a higher *B. dentium* growth (score 3), and the others GICs I or M presented a slight bacterial growth (score between 1.66 and 2.22).

Conclusions: The conventional GICs (Fuji IX Extra and Ion-Z) could inhibit the growth of cariogenic species, varying among bacteria. *B. dentium* demonstrated lower resistance against the conventional GICs tested. The resin modified GIC (Fuji II LC) could not present inhibition zones for the bacteria tested in this in vitro study.

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Adhesion of resin–resin and resin–lithium–disilicate ceramic: A methodological assessment



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Purpose/aim: Dental literature contains overwhelming amount of work on adhesion to dental ceramics but several test methods have not been studied in one investigation. This study compared the adhesion of resin composite to resin and lithium–disilicate ceramic using four common adhesion test methods.

Materials and methods: Resin composite specimens (N = 180, Quadrant Universal LC) were obtained and randomly assigned to test the adhesion to resin composite (Quadrant Universal LC) and lithium disilicate ceramic (IPS e.max CAD) using one of the following test methods: (a) macroshear test (SBT) (n = 30), (b) macrotensile test (TBT) (n = 30), (c) microshear test (μSBT) (n = 30) and (d) microtensile test (μTBT) (n = 6, n_{composite}: 216, n_{ceramic}: 216). Bonded specimens were stored for 24 h at 23 °C. Adhesion tests were performed in a Universal Testing Machine (1 mm/min) and failure types were analyzed after debonding. Data were analyzed using Univariate and Tukey's, Bonferroni post-hoc test (alpha = 0.05). Two-parameter Weibull modulus, scale (m) and shape (0) were calculated.

Results: Both the test method (p < 0.05) and adherend–substrate type (p < 0.05) significantly affected the adhesion results. Interaction terms were also significant (p < 0.05). When testing adhesion of resin to resin, SBT (24.4 ± 5)a, TBT (16.1 ± 4.4)b and μSBT (20.6 ± 7.4)a,b test methods showed

significantly lower mean bond values compared to μ TBT (36.7 ± 8.9)c ($p < 0.05$). However, for resin composite-glass ceramic adhesion, μ SBT (6.6 ± 1)B showed the lowest and μ TBT (24.8 ± 7)C,D the highest values ($p < 0.05$). Only SBT and μ TBT presented significant difference in adhesion results for resin-resin (24.4 ± 5 ; 36.7 ± 9) and resin-ceramic adhesion (14.6 ± 5 ; 25 ± 7), respectively ($p < 0.05$). Weibull distribution presented the highest shape values for resin-ceramic (7.6) and resin-resin (5.7) among all substrate-test combinations when μ TBT was employed. Incidence of cohesive failures (%) were most frequent in resin-resin combination (SBT: 87; TBT: 50; μ SBT: 50), while mixed failures were more common in resin-ceramic specimens (SBT: 100; TBT: 90; μ SBT: 90).

Conclusions: Considering bond strength values, Weibull modulus and the failure types, resin-resin adhesion was more reliable than resin-ceramic. μ TBT tests could be considered more suitable for testing adhesion of resin to resin, and μ TBT and μ SBT for resin to lithium disilicate materials as these tests showed significant distinction to other test methods in one study.

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Hybrid manufacturing of metal framework for full arch dental restoration



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Purpose/aim: Selective Laser Melting (SLM) technology used for the production of a full-arch prosthetic restoration on implants generates geometry inaccuracies and surface roughness, which do not fulfill clinical requirements, with biological consequences on the osteointegration of implants. Modern approach to Additive Manufacturing (AM) for precision production integrates SLM and milling techniques in the so-called hybrid manufacturing process to produce a more accurate interface to implant.

Materials and methods: The virtual (CAD) model of the framework was designed as for a full-arch prosthetic rehabilitation and served as the control of the experiment. Directly from the framework CAD model, eighteen specimens were produced by two different manufacturing centers using hybrid technology, (lab #1 and lab #2). This is a recently introduced productive process, which integrates the SLM, for the production of a semi-finished framework, and the milling technique, for the finishing operation at the interface to implant. Measurements of the frameworks were made in vitro according to a metrological approach that uses an opto-mechanical coordinate measuring machine (OCMM), a CAD-based reconstruction of actual interface, and a geometric error analysis to describe manufacturing inaccuracies. Each implant platform of framework was reduced to its center for the calculation of the relative (between implants) and absolute distances (between manufactured framework and its CAD model).

Results: The relative 3D distances between implant platforms showed a mean error varying from 0 to 25 μ m for lab #1 and 0 to 38 μ m for lab #2; the 3D mean position error of the implant platforms with respect to the CAD model was 8–16 μ m for lab #1 and 9–22 μ m for lab #2. No statistically significant difference was registered between the two groups. Considering both groups, the absolute values of inaccuracy were between 0.011 mm and 0.019 mm \pm 0.005–0.010 mm (SD).

Conclusions: The hybrid technology used for the manufacturing of the metal framework for an implant-supported full-arch restoration showed acceptable levels of accuracy, regardless the specific hybrid system. Using the hybrid technology, the geometric error generated during the framework production is lower than 22 μ m, which is comparable to errors shown in the literature for direct CAD-CAM manufacturing from metal blanks.

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Effect of radiotherapy on resin cements bond strength



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Purpose/aim: Evaluate the influence of radiotherapy on bond strength (BS) and adhesive interface among different resin cements and root dentin.

Materials and methods: Sixty maxillary canines were selected and distributed into two groups ($n = 30$) according to the irradiation protocol: non-irradiated and irradiated. The irradiated group was submitted to X-ray radiotherapy of 6 MV in fractions of 2 Gy, with 30 cycles, until complete 60 Gy. The teeth were sectioned to obtain 16 mm of root length, followed by biomechanical preparation with R50 reciproc instrument and filling using the lateral condensation technique with epoxy resin-based sealer. Then, each group was subdivided according to the resin cement used for the glass fiber post cementation ($n = 10$): RelyX U200, Panavia F 2.0 and RelyX ARC. The posts were cemented according to the manufacturer instructions. After the posts cementation, the teeth were sectioned transversely into 1 mm thick slices, and 3 slices were obtained from each root third. The most cervical slice of each third was used to evaluate the BS by the push-out test at 0.5 mm/min and the failure pattern was analyzed. Apical slice of each third was selected for SEM analysis, which were prepared and metalized. The dentin/cement interface analysis was performed at the following magnification: 100, 1000, 2000 and 4000 \times . The BS data were submitted to statistical analysis by ANOVA and Tukey's test.

Results: The irradiated specimens had lower BS values ($8.23 + 4.26$) compared to non-irradiated group ($11.88 + 6.42$) ($p < 0.00001$). Regarding the resin cements, the RelyX U200 showed the higher values in BS ($15.17 + 5.89$) compared

Table 1 – Results of bond strength (in MPa) for each experimental group, resin cement and root third.

Resin cement	Radiotherapy						
	Non irradiated Root third			Irradiated Root third			Pooled average
	Cervical	Middle	Apical	Cervical	Middle	Apical	
U200	20.9 ± 6.3	18.3 ± 4.4	15.89 ± 3.8	16.7 ± 3.6	11.35 ± 3.1	7.8 ± 2.2	15.17 ± 5.89 A
ARC	13.9 ± 5.9	7.6 ± 2.4	5.33 ± 1.0	8.5 ± 2.3	6.40 ± 2.2	4.4 ± 1.3	7.68 ± 4.22 B
Panavia	10.3 ± 2.7	8.4 ± 1.9	6.26 ± 2.1	8.2 ± 1.4	6.19 ± 2.1	4.5 ± 1.7	7.32 ± 2.71 B
Pooled average		8.23 ± 4.26 B			11.88 ± 6.42 A		

Different letters indicate statistical differences ($p < 0.05$).

to RelyX ARC (7.68+4.22) and Panavia F 2.0 (7.32+2.71) ($p < 0.0001$). In addition, the cervical third presented higher BS values (13.08+6.10) when compared to the middle (9.72+5.03) and apical (7.38+4.53) thirds ($p < 0.0001$). The failure pattern showed cohesive failures in root dentin of the irradiated specimens. In the SEM qualitative analysis of the irradiated teeth, was possible to observe the presence of fractures and microfractures in the root dentin and a small number of collagen fibers. The resin cements RelyX U200 and Panavia F 2.0 showed a juxtaposed interface of the cement with the root dentin, being that for the RelyX ARC cement the presence of hybrid layer and tags was similar for irradiated and non-irradiated groups.

Conclusions: It was concluded that the radiotherapy promoted reduction of the BS and the self-adhesive resin cement is the best alternative for glass fiber posts cementation in irradiated teeth (Table 1).

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Thiourethane-functionalized fillers as toughening agents in dental composites



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Purpose/aim: Thiourethane additives have been shown to successfully reduce polymerization stress and increase fracture toughness when added to the organic matrix of composites. In this study, we investigate the mechanisms for toughening in materials using inorganic filler particles functionalized with thiourethane oligomers.

Materials and methods: One thiourethane (TU) oligomer was synthesized by combining bis(3-isocyanatocyclohexyl)methane with trimethylol-tris-3-mercaptopropionate and 3-(Triethoxysilyl)propyl isocyanate, at 1:2 isocyanate:thiol, leaving pendant thiol and silyl groups. Barium glass fillers (1 μm average particle size) were functionalized with 2 wt% TU-silane in an acidic ethanol

solution. Commercially available 3-(Trimethoxysilyl)propyl methacrylate (MA-silane) was used as the control. Composites were made with BisGMA-UDMA-TEGDMA (BUT 5:3:2), camphorquinone/Ethyl-4-dimethylaminobenzoate (0.2/0.8 wt%) and di-tert-butyl hydroxytoluene (0.3 wt%) and 50 wt% silanated inorganic fillers. TU was added to the filler only, to the organic matrix only or to organic matrix and filler, or not added at all (control). Polymerization stress (PS) was measured using a cantilever beam apparatus (Bioman). Methacrylate conversion (DC) and rate of polymerization (RP) during photoactivation (800 mW/cm²) were followed in real-time with near-IR. Fracture toughness (K_{1c}) was measured in notched beam specimens. Dynamic mechanical analysis was used to obtain glass transition temperature (T_g), tan delta curves and crosslinking density (from the rubbery plateau). Data were analyzed with one-way ANOVA/Tukey's test ($\alpha = 5\%$).

Results: The silanized particles were characterized by mid-IR and thermogravimetric analysis, which showed 8 wt% mass loss, on average. Therefore, the mass contribution from the TU in the filler was about 4 wt%, whereas the mass contribution from the TU in the matrix was about 10 wt% in this study. Conversion was not affected by the addition of the thiourethane oligomer, independent of the location (filler, matrix or both). The glass transition temperature increased for the TU filler group, but slightly decreased for the others in relation to the control. Fracture toughness increased in the groups containing TU in the filler, and stayed unaltered for the group containing TU in the matrix only, which can be explained by the relatively low T_g of the isolated oligomer, previously determined to be around 20 °C. The polymerization stress showed a monotonic decrease with the increase in TU concentration in the filler, with the lowest value being obtained by the material combining TU in the matrix and on the filler.

Conclusions: The combination of TU in the matrix and on the filler surface contributes to low stress and increased fracture toughness in highly filled materials.

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Direct measurements of intra-canal circumferential strains created along the post



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Purpose/aim: Cast post-and-core and crown are considered as the preferred treatment of choice for anterior teeth with severe destruction. Our aim was to evaluate the effect of ferrule and crown cementation by direct measurement of the circumferential strain in both the intra-canal post and the cervical dentin.

Materials and methods: Twelve extracted central incisors bovine teeth were endodontically treated. The axial surfaces of the tooth were reduced to 5 mm and prepared to receive a full coverage metal crown. Cast Post and cores were constructed in Ni-Cr alloy. The intra-canal buccal and lingual surfaces of the post were reduced by 0.4 mm and four miniature strain gauges (EA-06-031DE-350) were bonded at the same plane; two on the buccal and lingual surfaces of both the post and the external surface of the root. Cementation of the cast post-and-core was done by ZPC. The strain gauges were connected through the apex by three-wire quarter Wheatstone bridge circuit design to data acquisition system. For each tooth 6 Ni-Cr full coverage cast crowns were fabricated covering the 5 mm core and either 5, 4, 3, 2, 1 or 0 mm of ferrule on sound tooth. The epoxy cylinders were inserted to an adjustable loading apparatus and the un-cemented and cemented (ZPC) crown was loaded at angulations of 0°, 15°, 30° and 45° up to 100 N with continuous data acquisition at 10 Hz. After each experiment the crown was removed by gentle cutting and a new crown with a different amount of ferrule was tested. Data were analyzed by two ways ANOVA with repeated measures. The strain at 100 N was taken as a representative value.

Results: The buccal and lingual surfaces of the post and root were characterized by negative (compression) and positive (tension) strains. The strains linearly increased with increasing load ($r > 0.94$, $p < 0.01$). Higher load angulations were characterized by higher absolute values of strain. With increasing amount of ferrule, the absolute values of strain on the post decreased, but those on the root remained relatively constant. The main decrease in strain occurred between 0 and 1 mm (55%) or 2 mm (72%) of ferrule; the remaining 3–5 mm of ferrule contribute to additional decrease of 28%. When comparing cemented and un-cemented crowns having the same ferrule, the strains on the post declined dramatically only upon cementation ($p = 0.001$).

Conclusions: Crown cementation with axial surface ferrule has an important role in reducing the intra canal stresses induced by the post, probably reducing the risk of vertical root fracture.

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Hydroxyapatite ceramic reinforced by ZnO/TiO₂ nanoparticles and TiO₂ nanotubes



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Purpose/aim: Hydroxyapatite (HA) has been a choice for bone grafting materials due to its similar chemical composition to bone natural apatite. It is recognized as one of the most promising biomaterials due to its excellent biocompatibility, bioactivity, and osteoconductivity. However, the poor mechanical properties of HA restrict its clinical applications. To improve the mechanical properties of HA, many reinforcing structures have been used to fabricate dense HA. The aim of this study was to evaluate an bovine dense hydroxyapatite ceramic (HA) compared to HA blends (1%, 2%, and 5%) of zinc oxide nanoparticles (HA/ZnOnp), titanium dioxide nanoparticles (HA/TiO₂np) and TiO₂ nanotubes (HA/TiO₂ nt).

Materials and methods: Discs ($\varnothing = 12.5$ mm; thickness = 1.3 mm) were prepared. Biaxial flexural strength (BFS) ($n = 30$) and Vickers hardness (VH) ($n = 10$) were performed. All data were submitted to the One-way ANOVA and the posthoc Tukey multiple comparisons ($\alpha = 0.05$).

Results: BFS: The higher values were shown to HA and HA/TiO₂np5%, with no difference between them, but they were different to the other groups ($p = 0.067$). HA/ZnOnp5% and HA/TiO₂np2% showed lower values with no difference between them ($p = 1$). All these results were observed, regardless the blends. VH: HA/TiO₂np1% and HA/TiO₂np2% showed the higher values and they were similar between them ($p = 0.102$), differing to the other groups. HA/ZnOnp2%, HA/ZnOnp5% and HA/TiO₂np5% showed higher values with no difference among them, but differing to the HA/TiO₂np1% and to the HA/TiO₂np2%. HA, HA/TiO₂nt1% and HA/TiO₂nt2%, showed intermediated values, with no difference among them ($p = 0.054$). The HA/ZnOnp1% showed lower values, differing to those groups that showed the higher and intermediated values ($p = 1$). HA/TiO₂nt5% showed lower values with no difference to HA/TiO₂nt2% ($p = 0.089$).

Conclusions: This study showed that the blend HA/TiO₂np5% did not affect the BFS and increased the VH, compared to HA.

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One-step surface conditioning of two glass-ceramics: Resin bond durability

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Purpose/aim: This study evaluated the bond strength (μ SBS) and bond durability of two different machined glass ceramics to a resin cement, comparing the classical conditioning method (hydrofluoric acid + silane) Vs an etch&prime one-step method (Monobond Etch & Prime, Ivoclar Vivadent).

Materials and methods: Machined slices of lithium disilicate (LD) (IPS e.Max CAD, Ivoclar Vivadent) and feldspathic (F) (VITA Mark II, VITA Zahnfabrik) ceramics were assigned ($n = 10$) according to surface treatment [Hydrofluoric acid 5% (IPS Ceramic Etching GEL, Ivoclar Vivadent) + silane (Monobond Plus, Ivoclar Vivadent) (HF); Monobond Etch & Prime (EP)] and aging condition (without aging; storage for 90 days + 12,000 cycles of thermocycling). After surface treatment, a resin cement (Multilink Automix, Ivoclar Vivadent) was applied into starch matrices (internal area: 0.72 mm) on the treated ceramic surfaces, and photo-activated. The μ SBS test was carried out (0.5 mm/min), and the failure pattern was evaluated in stereomicroscopy (25 \times). Contact angle and micromorphological analysis were also performed. Data were analyzed by 2-way ANOVA, Student's test ($\alpha = 5\%$).

Results: For both ceramics, the group HF presented higher bond strengths (in MPa) at baseline (DL-HF, $21.2 \pm 2.2 > DL-EP$, 10.4 ± 2.4 ; F-HF, $19.6 \pm 4.3 > F-EP$, 13.5 ± 5.4), and aging conditions (DL-HF $14.64 \pm 2.31 > DL-EP$, 9 ± 3.4 ; F-HF $14.73 \pm 3.33 > F-EP$, 11.1 ± 3.3). The bond strengths for HF groups (DL and F) reduced statistically after aging, while the bond values of EP groups had no reduction significantly after aging (meaning bond stability). The main type of failure was adhesive at ceramic and resin cement interface. Besides, the groups treated with HF presented lower values of contact angle.

Conclusions: Hydrofluoric acid and silane application promoted the highest bond strength for LD and F ceramics, however, Monobond Etch & Prime had stable bond durability after aging.

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S. mutans virulence decreased by a novel antimicrobial monomer-containing composite

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Purpose/aim: In this study the effect of triclosan methacrylate monomer-containing experimental composite resin (MT) on the gene expressions of UA159 *Streptococcus mutans* strain was evaluated.

Materials and methods: Disks (2×6 mm) of three materials were prepared: EC – Ceramics (IPS Empress Esthetic); RSA – TEGDMA/BISEMA + charge; RCA – RSA + MT. Each disc was placed in a well of a culture dish, immersed in 1.5 mL of BHI with 1% sucrose inoculated with *S. mutans* and stored at 37 °C in an environment enriched with 10% CO₂ per 4- and 24 h. After the periods, the disks were removed from the wells, and cells were washed with saline, transferred to microtubes and centrifuged for pellet precipitation ($n = 5$). The pellet RNA was purified and converted to cDNA. Expression analyzes of the studied genes, *gtfC*, *gtfD*, *gpbB*, *vicR* and *covR* were done with the cDNA obtained and specific primers for each gene in the StepOne Real-Time qPCR apparatus and normalized by the 16S gene expression. The *gtfC* gene expression at 24 h was analyzed by Kruskal-Wallis with Student-Newman-Keus for comparison between groups. The other gene expressions at 4 and 24 h were analyzed by ANOVA with Tukey' tests for comparison between groups ($\alpha = 0.05$).

Results: There was a significant reduction in the expression of the *gtfD* and *vicR* genes for RCA in relation to EC and RSA at 4 h. There was a significant reduction in the expression of the *covR* and *gpbB* genes, for RCA, in relation to EC and RSA at 24 h. There was an increase in expression of *gtfC* for RCA in relation to EC and RSA in 24 h. There was no significant difference in gene expression of the analyzed genes between CE and RSA.

Conclusions: The MT-containing experimental resin altered the expression of the *S. mutans* genes studied and became it less virulent.

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Biological, physical and chemical properties of chlorhexidine-adding commercial infiltrant

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Purpose/aim: To evaluate the effect of addition of chlorhexidine diacetate (CHX) to commercial infiltrant on antimicrobial activity, and biological and physical/chemical properties.

Materials and methods: CHX was added as 0.1 and 0.2% (w/w) to Icon[®] and stored at 8° to 10 °C in amber



glass bottles. Groups were set up as follows: Icon[®]-Infiltrant (Icon[®]-DMG), Icon[®]+0.1%CHX (0.1i), Icon[®]+0.2%CHX (0.2i). Biological tests were performed concerning antimicrobial action against *Streptococcus mutans* and *Lactobacillus acidophilus* using agar diffusion test (AD) ($n=3$) and *S. mutans* biofilm degradation, concerning roughness (Ra) ($n=10$), and surface morphology. Physical/chemical properties were evaluated by degree of conversion (DC) ($n=10$), elastic modulus (EM) ($n=12$), Knoop hardness (KH) ($n=10$), softening (S) ($n=10$), sorption (Wsp) ($n=5$)/solubility (Wsl) ($n=5$), contact angle (CA) ($n=10$). Specific specimens concerning dimensions were accomplished for different assays, using the same lightcuring unit (VALO – Broadband LED Curing Light (Ultradent Products Inc., South Jordan, USA) for 60 s, with power density of 1000 mW/cm². Data from Ra and CA were subjected to two-way ANOVA and Tukey tests ($\alpha=5\%$). Data from AD, DC, EM, KH, S, Wsp and Wsl were subjected to one-way ANOVA and Tukey tests (5%).

Results: The Icon[®] group did not show any antimicrobial activity, but 0.1i and 0.2i showed similar antimicrobial effect ($p>0.05$). After biodegradation test 0.1i and 0.2i showed lower Ra than Icon[®] group ($p<0.05$). There was no significant difference on DC, S and CA values for all studied groups. 0.1i and 0.2i groups showed higher EM, KH and Wsp values than Icon[®] ($p<0.05$). However, Icon[®] showed higher values Wsl than 0.1i and 0.2i ($p<0.05$).

Conclusions: CHX-adding Icon[®] showed antimicrobial activity against *S. mutans* and *L. acidophilus* and high resistance to biodegradation and maintained or improved the physics and mechanical properties, except for the sorption.

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Nanohardness of dual-curing resin cement light-cured through nano ceramic



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Purpose/aim: To evaluate nanohardness (GPa) of a dual-cured resin cement (RelyX Ultimate, A1, 3M ESPE) light-cured through different thicknesses of nano ceramic resin (Lava Ultimate, LT A1, 3M ESPE).

Materials and methods: Mixed resin cement was placed in a 1 mm thick cylindrical stainless steel cast. Resin cement was covered by Millar strip and 0 mm, 1 mm, 2 mm or 5 mm nano ceramic resin slice according to the group. Specimens were light-cured for 20 or 40 s using a 1100 mW/cm² light curing unit (Poly Wireless, KaVo). Five specimens per group underwent nanoindentation test by Oliver & Pharr's method (CETR UMT-2, Bruker Nano Surfaces Division). Each specimen was subjected to 9 nanoindentation cycles, arranged in a 3 × 3 matrix at the surface of each specimen at a 180 μm distance. Each cycle consisted of applying a load that was maintained constant for 10 s and then was relieved by 90%, before the

Table 1

		20 s	40 s
Immediately	5 mm	0.0112219 ^A	0.0283807 ^A
	2 mm	0.2138191 ^A	0.2399313 ^A
	1 mm	0.2643541 ^A	0.3559110 ^B
	0 mm	0.3835187 ^A	0.4994975 ^B
	24 h	5 mm	0.0657634 ^A
	2 mm	0.3221497 ^A	0.4791508 ^B
	1 mm	0.2941446 ^A	0.3930581 ^B
	0 mm	0.3942105 ^A	0.5975797 ^B

Different letters indicate statistically significant difference (Tukey; $p<0.05$).

application of the next load. The applied loads were 0.2 mN, 0.4 mN, 0.78 mN, 1.56 mN, 3.13 mN, 6.25 mN, 12.5 mN, 25.0 mN, 50.0 mN, 100.0 mN, 200.0 mN and 400.0 mN. Results were subjected to repeated measure 3-way ANOVA and Sidak's test for multiple comparisons.

Results: Mean nanohardness results are shown in Table 1. There were observed interactions between single factor ($p<0.001$), double-factor ($p<0.001$), and triple-factor comparisons ($p<0.001$).

Conclusions: Resin cements nanohardness increase with longer light-cure time and with thinner nanoceramic resin. After 24 h, resin cement nanohardness increased significantly.

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Moist vs over-dried: FE-SEM/TEM and μTBS evaluation of universal adhesives



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Purpose/aim: The aim of this study was to evaluate the influence of the degree of moisture on dentin interfacial ultra-morphology and bond strength of four universal adhesive systems applied on etch-and-rinse mode.

Materials and methods: Futurabond U (Voco), Scotchbond Universal (3M ESPE), Adhese Universal (Ivoclar Vivadent) and Prime&Bond active (Dentsply Sirona) were used in the present investigation. After cleaning and disinfection, 64 molars were sectioned in order to obtain flat dentin surfaces. Dentin surfaces were wet-polished and etched with 36% phosphoric acid for 15 s and rinsed with water. Two degrees of moisture were tested: moist (as recommended by manufacturers) or over-dried (air-dried for 10 s). Teeth were restored with a thin layer of a low-viscosity composite (SDR) for Electron Microscopy evaluation ($n=3$) and 5 mm-high composite build-ups were made for bond strength evaluation with a conventional composite ($n=5$). Restored specimens were stored in water at 37 °C and sectioned for evaluation 24 h later. Representative FE-SEM and TEM images were recorded to depict the most frequently observed aspect of resin/dentin interfaces. Microtensile bond strength results were statistically analyzed by two-way ANOVA and Tukey test.

Results: For moist dentin, a well-formed hybrid layer was observed for all adhesives. However, when universal adhesives were applied to over-dried dentin, except for Prime&Bond active, remarkable differences were observed in comparison to interfaces produced on moist dentin. Defects, gaps and reduced hybrid layer thickness were observed when Scotchbond Universal, Adhese Universal and Futurabond U were applied to over-dried dentin. When applied to wet dentin, bond strength values were similar for all adhesives, except for Futurabond U, which was significantly lower. When applied to over-dried dentin, Prime&Bond active presented the highest bond strengths, followed by Scotchbond Universal, Adhese Universal and Futurabond U, which presented significantly lower μ TBS. Adhese Universal was the only adhesive that presented significant reduction in μ TBS when applied to over-dried dentin.

Conclusions: Ultramorphological analysis revealed that Prime&Bond active does not seem to be sensitive to the degree of moisture, and presented well-formed hybrid layers when applied to either moist or over-dried dentin. Even though application to over-dried dentin revealed defects, gaps and reduced hybrid layer thickness for Scotchbond Universal, Adhese Universal and Futurabond U, bond strength analysis only revealed a significant reduction in bond strengths for Adhese Universal.

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Randomized clinical trials in bleaching: Compliance with the consort statement



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Purpose/aim: We reviewed the literature to evaluate: (1) The compliance of randomized clinical trials (RCTs) on bleaching with the CONSORT; and (2) the risk of bias of these studies using the Cochrane Collaboration risk of bias tool (CCRT).

Materials and methods: We searched the Cochrane Library, PubMed and other electronic databases, to find RCTs focused on bleaching (or whitening). The articles were evaluated in compliance with CONSORT in a scale: 0=no description, 1=poor description and 2=adequate description. Descriptive analyses of the number of studies by journal, follow-up period, country and quality assessments were performed with CCRT for assessing risk of bias in RCTs.

Results: 185 RCTs were included for assessment. More than 30% of the studies received score 0 or 1. Protocol, flow chart, allocation concealment and sample size were more critical items, as 80% of the studies scored 0. The overall CONSORT score for the included studies was 16.7 ± 5.4 points, which represents 52.2% of the maximum CONSORT score. A significant difference among journal, country and period of time was observed ($p < 0.02$). Only 7.6% of the studies were judged at "low" risk; 62.1% were classified as "unclear"; and 30.3% as "high" risk of bias.

Conclusions: The adherence of RCTs evaluating bleaching materials and techniques to the CONSORT is still low with unclear/high risk of bias.

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Exploring fatigue limits of CAD/CAM ceramic endocrowns



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Purpose/aim: To evaluate the performances in terms of marginal continuity and resistance after fatigue of devitalized premolars restored with CAD/CAM ceramic endocrowns and, in particular, to establish the impact of their endo-core length.

Materials and methods: Forty-eight devitalized premolars were cut at the CEJ. They were restored with standardized CAD-CAM lithium disilicate reinforced ceramic restorations (IPS e.max CAD, Ivoclar-Vivadent) and divided into four Groups ($n = 12$): overlays (Group A, no endo-core, negative control), endocrowns with an endo-core of 2 mm (Group B), endocrowns with an endo-core of 4 mm (Group C) and crowns with post and core (Group D, positive control). All specimens were first submitted to thermo-mechanical cyclic loading (TCML) (1.7 Hz, 49 N, 600,000 cycles, 1500 thermo-cycles). Marginal analysis, before and after the loading, was carried out on epoxy replicas by SEM at 200 \times magnification. Survived specimens were then submitted to cyclic isometric stepwise loading (5 Hz) until completion of 105000 cycles or failure after 5000 cycles at 200 N, followed by 20000 cycles at 400 N, 600 N, 800 N, 1000 N and 1200 N. In case of fracture, fragments were analysed using SEM and failure mode was determined. Results of stepwise loading were statistically analysed by Kaplan-Meier life survival analysis and log rank test ($p = 0.05$).

Results: All the specimens survived the TCML test except four specimens of Group A (early restorations' debonding). No difference in percentages of closed margins was found between endocrowns (Groups B and C) and crowns (Group D). After the stepwise fatigue test, differences in survival within the groups were not statistically significant. Most of restorations experienced non-reparable fracture.

Conclusions: For the full crown restoration of endodontically treated premolars, endocrowns with both 2-mm and 4-mm long endo-cores displayed outcomes after fatigue equivalent to classical crowns. Results of this test discourage the use of flat overlays with only adhesive retention. When restoring extremely destroyed devitalized premolars, adhesive strategies should be coupled to an intra-radicular anchoring.

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Effect of synergism of CQ-amine and TPO on physico-chemical properties of experimental bulk-fill



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Purpose/aim: To evaluate the synergism of diphenyl(2,4,6-trimethylbenzoyl) phosphine oxide (TPO) and camphorquinone (CQ) on the light transmittance (LT), degree of conversion in depth (DC), and polymerization shrinkage stress (PSS) of experimental bulk fill composites.

Materials and methods: Bulk fill composites were produced containing equal molar concentrations of either CQ-amine (CQ) or CQ-amine and TPO (CQ+TPO). The LT inside 380–420 nm and 420–495 nm wavelength ranges of a multi-wave LED through each bulk fill composite of different thicknesses was recorded using a spectrometer. The depth of cure was evaluated using the ISO:4049 test and the cylinders sectioned for the DC evaluation using FT-NIR spectroscopy. The volumetric shrinkage (VS) and the PSS was measured in a mercury dilatometer and the Bioman, respectively. The flexural strength (FS) and flexural modulus (FM) were measured using a three-point bend test. Data were analyzed according to the different experimental designs ($\alpha = 0.05$ and 0.2).

Results: In the 380–420 nm, CQ transmitted more light than CQ+TPO up to 2 mm in thickness, but no differences were found starting at 3 mm. In the 420–495 nm, LT was the same for CQ and CQ+TPO. Up to 1 mm in depth, CQ+TPO had a higher DC, but beyond 1 mm no differences were found. Although there was no statistical difference between CQ and CQ+TPO for VS and FS, CQ+TPO had a higher PSS and E than CQ.

Conclusions: The synergism of CQ-amine and TPO photoinitiators in bulk fill composites increased E and DC only on the top of the restoration; however, it also increased the PSS.

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Clinical evaluation of restorations with ormocer or methacrylate based materials



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Purpose/aim: The aim of this study was to evaluate the clinical performance of class II restorations in posterior teeth using pure ormocer or methacrylate based nanohybrid restorative materials.

Materials and methods: This study had a randomized split mouth design. Thirty patients were selected according to the inclusion criteria and signed a term of informed consent. Each

patient received two medium/large size class II restorations, one made with a pure ormocer based material (Admira Fusion – Voco) and the other with methacrylate based composite (GrandioSO – Voco). The preparations were restricted to the removal of carious tissue with a round diamond bur. The restorations were performed using a sectional matrix and incremental oblique technique, using 2 mm increments, each one light cured for 20 s. All preparations received the application of the universal self-etching adhesive Futurabond U (Voco), according to manufacturer's instructions. The restorations were evaluated for 2 years using the FDI criteria described by Hickel. The evaluations were conducted by two calibrated examiners at baseline, six months, one year and two years after the restorative procedures. The data were analyzed using Kruskal–Wallis' test.

Results: All patients attended the 6 months, 26 the one year and 23 the two years recall. After two years, the restorations performed with both materials showed 100% of acceptable scores for esthetic properties. In relation to functional properties, 95.7% of the scores for Admira Fusion and 91.3% for GrandioSO were acceptable. In relation to biological properties, 100% of the scores for Admira Fusion and 95.7% for GrandioSO were acceptable. Non-significant differences were observed between the two materials ($p > 0.05$) for all properties. After 24 months, just one restoration made with Admira Fusion and two made with GrandioSO presented small fractures.

Conclusions: It can be concluded that after 24 months of intraoral service, the restorations made with both materials presented good clinical performance for all parameters analyzed.

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Reliability and failure modes of anterior monolithic CAD/CAM veneers



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Purpose/aim: To evaluate the probability of survival and failure modes of lithium disilicate, feldspathic ceramic, and resin nano ceramic anterior veneers cemented on G10 substrates after step-stress accelerated life testing (SSALT). Research hypothesis: The probability of survival and failure modes will not differ between materials used as monolithic anterior veneers.

Materials and methods: A natural incisor tooth preparation was produced with a reduction of 1.5 mm at the incisal edge and of 0.7 mm buccally. An .stl file of the preparation was generated and CAD/CAM based G10 (an epoxy filled with woven glass fibers; NEMA grade as compared with a potential dentin analog material) was used as a master veneer die for fabrication and testing. Laminate veneers were produced in three different materials: lithium disilicate (LDS, E.max

CAD, Ivoclar Vivadent), resin nanoceramic (RN, Lava Ultimate, 3 M Oral-Care), and feldspathic (FELDS, Vitablocs Mark II (Vita). Sliding fatigue was employed using SSALT in water. Reliability calculation was performed for a mission of 50,000 cycles at 120 and 200 N (90% confidence bounds) using Reliasoft (Tucson, AZ). Qualitative fractography was used to characterize failure modes.

Results: The probability of survival for a mission of 50,000 cycles at 120 N was 58% for LDS, 43% for FELDS, and 72% for RN with no differences between groups. At 200 N, the probability of survival was significantly lower for FELDS (10%) compared to RN veneers (41%), whereas LDS presented intermediate values (22%). The characteristic strength of RN (247 N) was significantly higher than LDS (149 N), whereas intermediate values were observed for FELDS (151 N).

Conclusions: The postulated hypothesis that the reliability and failure modes would not differ between the materials was partially accepted, since no differences in probability of survival were observed at 120 N, but at 200 N it did vary between groups. Failure modes were similar with veneer fracture down to the tooth-replica substrate.

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Graphene induces spontaneous osteogenic differentiation in vitro and in vivo



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Purpose/aim: To evaluate the potential of graphene substrate (2DGp) and scaffold (3DGp) to promote the osteogenic differentiation of mesenchymal stem cells in vitro and in vivo and to investigate the role of the integrin-FAK axis in the graphene-induced osteogenic differentiation.

Materials and methods: 2DGp (22 × 22 mm) and DGp were produced by chemical vapour deposition. 2DGp was deposited on PDMS substrates with tuneable elastic moduli. To evaluate the osteogenic potential in vivo, cells were seeded on 3DGp were kept in basal culture media for 10 days. Thereafter, the scaffolds were transplanted into subcutaneous pockets of SCID mice. After 28 days, the tissues formed were harvested and characterized by H&E and immunohistochemistry. To check the role of the integrin-FAK axis in the osteogenic differentiation, cells were cultured with basal culture medium on PDMS and 2DGp-coated PDMS with or without the presence of inhibitors (echistatin: 10 nM, Y27632: 50 μM or DMH1: 50 μM). After ten days, the expression of FAK-p397, F-actin, SMAD p1/5, ROCK1, RUNX2, OCN and OPN were evaluated by Western blot.

Results: The histological analysis showed the formation of bony-like structures resembling primary bone within the 3DGp. Immunohistochemical characterization showed that the tissue presented positive expression for bone markers (RUNX2 and OCN) and antibody specific for human

mitochondria. After 10 days, cells on 2DGp-coated PDMS presented higher expression of all proteins analyzed compared to those seeded on PDMS alone. The decrease in the expression of the proteins with the presence of the inhibitors, confirm that the integrin-FAK axis was activated during the graphene-mediated osteogenic differentiation.

Conclusions: 3DGp induced the spontaneous formation of bony-like structures in vivo. 2DGp increased the expression of the proteins expressed in the integrin-FAK axis regardless the stiffness of the PDMS substrate used. This suggests that the physical properties of graphene induce the spontaneous osteogenic differentiation upon the activation of the integrin-FAK axis.

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Quantitative assessment of misfits of dental restorations via strain measurement



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Purpose/aim: Dental restorations can differ from their virtual design in geometry and dimension. Assessing these deviations with optical methods is limited by scanning and alignment inaccuracies. To circumvent this problem, a metal model equipped with strain gauges was developed, enabling a sensitive measurement of minimal deviations.

Materials and methods: To a stainless steel base plate, eight posts with quadratic cross section (4 mm × 4 mm) manufactured from a hardened stainless steel alloy ($\sigma_y > 600$ MPa) were welded in positions of teeth 17, 15, 13, 11, 21, 23, 25, and 27 of a dental arch. Before welding, strain gauges (1-LY13-0.6/120, HBM, Darmstadt, Germany) were applied on all four faces at the lower end of each post. Strain gauges of opposing faces were connected thus that their signals were subtracted from each other in the formed half bridges. This set-up was sensitive with respect to bending strains caused by lateral forces. At the top of each post, a fixture enabled the positioning (and exact repositioning) of abutment teeth. For calibration, a cylindrical abutment with a notch for force application was used. The notch was located at a height of 34 mm (post + abutment), corresponding with the height level of the prepared surfaces of the abutments that were later on used in experiments. On each post, horizontal forces up to 50 N were applied in anterior/posterior and lateral direction with a universal testing device (Zwick/Roell 2005; Zwick AG, Ulm, Germany) and respective signals of the half bridges were recorded (Spider-8/Catman easy, HBM). Resembling a lateral stiffness of a natural tooth, a lateral force of 50 N led to a deflection of the abutment of 0.15 mm (calculated by beam theory and FE analyses).

Results: All sensors showed a very good linear correlation between applied force and measured voltage (mean deviation from the linear behavior: $0.17 \pm 1.25\%$). Crosstalk between the two half-bridges on each post or a vertical load applied to the posts was less than 2%.

Conclusions: The presented model can be used to measure lateral forces on the abutment teeth occurring during the fitting process of removable partial dentures. These forces directly correlate with the deflections of the abutment teeth needed to compensate deviations of the restoration from the CAD construction.

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Conversion of endodontic sealer modified with nanoparticles carrying antibacterial drugs



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Purpose/aim: The aim of this study was to evaluate the polymeric conversion of a commercial endodontic sealer modified with montmorillonite nanoparticles carrying to different antibacterial drugs: clorhexidine (CHX) and metronidazole (MET).

Materials and methods: The sealer used was AH Plus sealer, and 5% in weight was added of the nanoparticles carrying one of the drugs CHX or MET. Cylindrical specimens were made with 5 mm diameter and 1 mm thick ($n=5$). The degree of conversion (DC) was determined using near FTIR. DC was evaluated using the absorption peak at 4529 cm^{-1} that decrease during polymerization, and the absorption peak at 4623 cm^{-1} which is unaltered as normalization. The measurements were obtained for each sample immediately, 4 h and 24 h after mixing the two pastes of the sealer. A group with no modification by the nanoparticle was added as a control. The data was analyzed using one-way ANOVA/Tukey ($\alpha=5\%$).

Results: Results are presented in Table 1.

Table 1 – Means (SD) for degree of conversion (%) at 4 and 24 h. No statistical difference was presented among groups for neither periods of evaluation.

Drug	DC (%)	
	4 h	24 h
Control	35 (11) A	68 (8) A
CHX	31 (11) A	81 (11) A
MET	38 (6) A	77 (14) A

Conclusions: Within the limitations of this study it can be concluded that addition of the nanoparticle carrying both drug did not influence the polymerization of the sealer.

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Biaxial flexural strength of bilayered commercial porcelain/Ce-TZP/A disks



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Purpose/aim: Ceria-stabilized zirconia/alumina nanocomposite (Ce-TZP/A) is used as a framework that can be layered with veneering ceramics for dental fixed restorations. It shows a lower coefficient of thermal expansion (CTE) compared to conventional yttria-stabilized tetragonal zirconia polycrystals (Y-TZP). Commercial veneering ceramics are generally adjusted and set to have a lower CTE for Y-TZP. The present study was to clarify the influence of commercial veneering products by evaluating the biaxial flexural strengths of bilayered porcelain/Ce-TZP/A disks.

Materials and methods: Ninety Ce-TZP/A disk specimens (C-Pro Nano-Zirconia, Panasonic Healthcare) and three veneering products (VITA VM9, VITA Zahnfabrik; Cercon Ceram Kiss, Degudent; IPS e.max Ceram, Ivoclar Vivadent) were used as substrates and layering materials, respectively. After cleaning, the specimens (0.8 mm thickness) were veneered with the respective porcelain having different layering thicknesses (1.0, 1.5, 2.0 mm) and fired in a dental furnace (Austromat 654 press-i-dent, Dekema Dental-Keramiköfen). The biaxial flexural test was performed using a universal testing machine (Z010, Zwick) according to ISO6872 (piston-on-three-ball test). The loading of a piston was applied on the center of the top layer (Ce-TZP/A) in each specimen at a 1.0 mm/min crosshead speed and the fracture load was measured. The biaxial flexural strengths for multilayered disks were calculated using two analytical formulas. The strength values were analyzed by non-parametric tests ($p < 0.05$). The variability of strength values was analyzed by calculating the Weibull characteristic strength and Weibull modulus. After testing, the fractured specimen was observed by stereomicroscopy (M400, Wild Heerbrugg) and scanning electron microscopy (LEO 1430, Carl Zeiss).

Results: The top and bottom surfaces in the bilayered specimens showed the respective compressive and tensile stresses. These strength values from the stresses were not significantly different within commercial products; however, the values were significantly higher in the specimens with thinner porcelain layers ($p < 0.05$). The values at the interface in the bottom and top layers showed the tensile stress. The strength values at the interface are significantly higher in the thinner porcelain specimens ($p < 0.05$). Among the products, VM 9 showed significantly higher values at the interface in the top layer ($p < 0.05$). Porcelain delamination was not observed in the fractured specimen with 1 mm porcelain thickness while those with other thicknesses showed the delamination.

Conclusions: The different porcelain thickness and products influenced the stress distributions and the biaxial flexural strengths in bilayered porcelain/Ce-TZP/A disks.

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Assessment of tooth-composite bond vs. clinical performance of composite restorations

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Purpose/aim: To assess the initial clinical quality of restorations of non-cariou cervical lesions and the tooth-composite bond by optical coherence tomography (OCT).

Materials and methods: 50 patients with three or four non-cariou cervical lesions each received composite restorations (Venus[®] Diamond Flow, Heraeus Kulzer). The universal adhesive iBond[®] Universal (iB, Heraeus Kulzer) was applied with three different etching protocols: self-etch (SE, $n=50$), selective-enamel-etch (SEE, $n=29$) and etch-and-rinse (ER, $n=50$). One group restored with the etch-and-rinse adhesive OptiBond[™] FL (OFL, Kerr) served as a control. The fillings were imaged by spectral domain OCT (SD-OCT, Telesio II, Thorlabs, 1310 nm) directly after restoration (t_0). After 14 days (t_1) OCT imaging was repeated together with the clinical assessment (FDI criteria). Per restoration 25 equally distributed B-scans were examined out of 200–400 per OCT-image stack. The signal indicating “adhesive defect” at the enamel- and dentin/cement-composite interface was quantified (length, %). Groups were statistically compared by Friedman-/Wilcoxon- and McNemar-test ($\alpha=0.05$).

Results: The clinical criteria showed no initial differences between groups (t_1). At the enamel interface OCT assessment revealed more interfacial adhesive defects with iB/SE compared to OFL (t_0, t_1 ; $p \leq 0.02$) and with iB/ER vs. OFL ($t_2, p=0.027$). After 14 days defects have increased in the group iB/SE ($p < 0.001$). At t_1 OFL exhibited more adhesive defects at the dentin/cementum interface than iB in all etching modes ($p \leq 0.01$). Additionally, an increase of defects was measured with OFL compared to t_0 ($p < 0.001$).

Conclusions: Phosphoric acid etching did not decrease the adhesion of iBond Universal to dentin. In contrast to clinical evaluation OCT revealed differences in the tooth-composite bond both directly after application of the restoration and after 14 days. The prospective clinical relevance of these initial findings has to be verified during the further course of the clinical study.

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Conversion and color stability of luting agents for aesthetic rehabilitations

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Purpose/aim: Many luting strategies have been claimed by some educators, clinicians and companies as the best ways to conduct aesthetic rehabilitations, but without proper evidence. Thus, the current study aimed to determine the degree of conversion and the color stability of luting agents commonly indicated for aesthetic rehabilitations.

Materials and methods: Four luting strategies were considered: one conventional dual-activated resin cement (control, RelyX ARC, 3M – ARC), one “amine-free” dual-activated resin cement (RelyX Ultimante, 3M – ULT), one light-activated resin cement (RelyX Veneer, 3M – VEN) and one regular restorative composite (Z350XT, 3M) used after pre-warming by 68 °C for 30 min. The degree of C=C conversion was determined by Fourier-transformed infrared spectroscopy (FTIR; $n=5$), before and 10 min after light activation. All materials were photoactivated under one lithium-disilicate-based ceramic disc (e.max Press HT, Ivoclar Vivadent – 10 mm diameter, 1 mm thickness). CIELab method was used with a spectrophotometer (CM-2600D, Konica Minolta) to determine the color change (ΔE , $n=6$) by readings 24 h after photoactivation and repeated after 90 d of materials’ aging in distilled water. All readings were performed with the interposition of the ceramic disc. The collected data were submitted to one-way analysis of variance and Tukey’s test (95%).

Results: The luting agent statistically affects both conversion ($p < 0.001$) and color stability ($p < 0.001$). ARC produced the highest conversion among the tested groups (751%), while the pre-warmed composite the lowest one (513%). ULT and VEN produced intermediate values (631 and 652% respectively). VEN (4.40.4) and ARC (4.30.3) produced the highest ΔE , ULT produced intermediate values (3.70.1) and the pre-warmed composite the lowest (2.70.5).

Conclusions: The amine-free dual-activated cement produces higher color stability than the conventional dual-activated material, although presents lower degree of conversion. Only the pre-warmed composite promoted color change values below that considered perceptible by the human eyes.

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Do GIC last longer than resin (NCCL restorations) a meta-analysis



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Purpose/aim: To compare the retention rates and color match of glass ionomer cements (GIC) and resin-based composites (RC) in non-carious cervical lesions. Other secondary outcomes (surface texture, marginal adaptation, marginal discoloration and secondary caries) were evaluated in a systematic review and meta-analysis.

Materials and methods: A comprehensive search was performed in PubMed, Scopus, Web of Science, LILACS, BBO, CENTRAL and SIGLE (grey literature) The abstracts from the IADR (1990–2015), ongoing trials in trials registries and theses and dissertations and theses were searched. We included only randomized clinical trials. Quality of the evidence for each outcome was assessed using the GRADE tool.

Results: A total of 1530 articles were identified, but only 19 reports from 15 studies remained for analysis, which were all judged at “unclear” risk of bias. Ten out of 15 studies evaluated resin-modified glass ionomer cements. RMGIC/GIC showed higher retention rates in all follow-ups (1–3 years; $p < 0.0001$ and at 5 years; $p < 0.00001$). No difference was observed for marginal discoloration, marginal adaptation and secondary caries in all follow-ups ($p > 0.05$). RC showed better color match than RMGIC/GIC only at 2 years ($p = 0.03$). Higher surface texture was observed in RMGIC/GIC in all follow-ups (at 1 year $p = 0.0003$; at 3 years $p = 0.0004$). Quality of evidence was graded as moderate or low due to the unclear risk of bias and imprecision in some outcomes.

Conclusions: The retention rates of RMGIC/GIC were superior to composite resins in all study follow-ups, but a higher surface texture was observed in these the RMGIC/GIC compared to composite resins. Quality of evidence was judged as moderate to low in these two outcomes.

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Retention of all-zirconia prostheses retained by conical crowns



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Purpose/aim: The objective of this study was to measure the retention behavior of all-zirconia conical crown-retained prostheses in an in vitro model.

Materials and methods: Eight zirconia primary crowns were produced (cercon ht, DentsplySirona) and cemented to the abutment teeth of a phantom model. The abutment teeth were provided with calibrated strain gauges, thus enabling the measurement of prosthesis misfits. The primary crowns were scanned and ten removable full-arch prostheses (14-units) were designed, milled and sintered out of monolithic zirconia (cercon ht, Dentsply Sirona). The prostheses were fitted on the primary crowns with defined forces of $F = 100\text{ N}$, 200 N , 300 N , and 400 N (Universal Testing Machine, Zwick/Roell Z005) and the respective loosening forces were measured. Various abutment teeth distributions were tested by removing abutments from the model. Additionally, retention of the individual double crowns was evaluated with fitting forces $F = 12.5\text{ N}$, 25 N , 50 N , 75 N , and 100 N .

Results: The mean overall ratio of loosening to fitting force (L/F) was calculated to be 0.21 for tooth distributions with eight and four abutment teeth. Consequently, a fitting force of 400 N resulted in a mean retention force of 84 N . The difference in L/F to bilaterally and unilaterally shortened abutment constellations was not significant, although L/F dropped below 0.2 ($p = 0.07$). For individual double crowns, L/F analysis averaged 0.27 (with a theoretically ideal value of 0.33). The fit of the prostheses was clinically acceptable.

Conclusions: This study shows that the technical production of all-zirconia conical crown-retained prostheses is possible. Adequate retention was achieved for the overall structures as well as for the individual double crowns. Further studies with respect to fracture load are necessary before clinical application.

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Curing protocol effect on self-adhesive cement adhesion to radicular dentin



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Purpose/aim: This study evaluated the effect of three different curing protocols on the bond strengths of fiber glass posts to the coronal and apical area of human roots radicular dentin using dual-cured self-adhesive cements with an universal adhesive system. The null hypothesis tested was that the bond strength obtained with different self-adhesive is not affected by curing protocol.

Materials and methods: 60 single root teeth, were selected, endodontically treated and obturated. After 7 days, an 8 mm post space was prepared with dedicated drills. Samples were randomly divided into 2 groups according to the self-adhesive cement employed: G1) Panavia SA Cement Plus; G2) Bifix SA. Once applied in the post-space following the manufacturer instructions, specimens were then randomly divided into three subgroups ($n = 10$ each) according to the light curing

protocol: no light curing (subgroup 1); 20 s light-curing after 60 s from cement application (subgroup 2); 20 s light-curing after 300 s from cement application (subgroup 3). A poly-wave LED curing light (Translux Two-Waves, Heraeus, Germany) at 1400 mW/cm⁻² was employed. 1 mm slices were prepared to perform push-out test and nanoleakage analyses of the coronal and apical region after 24 h of storage in artificial saliva. Results were statistically analyzed with ANOVA and Tukey post-hoc tests. Statistical significance was set for $p < 0.05$.

Results: The three-way Anova analysis showed that the cement and the curing protocol had a significant influence on the bond strength ($p < 0.05$), while post space region did not influenced the results ($p > 0.05$). Pairwise Tukey post-hoc test showed that 60'' and 300'' waiting time showed significantly higher bond strength. No significant difference was found in bond strength between different areas of the same root canal.

Conclusions: The null hypothesis was rejected since waiting time affected fiber post bond strength. Panavia SA was less influenced by curing protocol than Bifix SA.

PANAVIA™ SA Cement Plus Automix						Bifix SE self-adhesive resin cement					
No light		Light 60''		Light 300''		No light		Light 60''		Light 300''	
Coronal	Apical	Coronal	Apical	Coronal	Apical	Coronal	Apical	Coronal	Apical	Coronal	Apical
9.39 ± 3.72	8.87 ± 3.07	8.22 ± 3.55	8.65 ± 2.54	11.68 ± 3.87	12.22 ± 4.72	8.22 ± 2.81	6.87 ± 2.54	14.26 ± 5.54	16.35 ± 7.1	15.18 ± 5.07	14.9 ± 4.71

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Effect of Er:YAG laser pulse width on zirconia bond strength



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Purpose/aim: This study evaluated the effects of different Er:YAG laser pulse width protocols applied to the surface of Yttrium-stabilized tetragonal zirconia polycrystal (Y-TZP) on the surface roughness, volume loss and bond strength to resin cements.

Materials and methods: Pre-sintered Y-TZP blocks were sliced providing 126 2 mm-thick specimens that were divided according to the surface treatment, as follows ($n = 19$): G1 (80 mJ/2 Hz/0.15W-50 μ s); G2 (-100 μ s); G3 (-300 μ s); G4 (-600 μ s); G5 (tribochemical silica coating); G6 (tribochemical silica coating after sintering); G7 (untreated). Specimens were sintered according to manufacturer's recommendations. Except for G6, all specimens were sintered prior to surface treatment. Roughness and volume loss were analyzed by 3D profilometric assessment. Microshear bond strength (μ SBS) specimens were produced with resin cement (PANAVIA F 2.0) and tested in a universal testing machine (crosshead

speed = 1.0 mm/min) after 24 h of water storage. Variations in the microstructural features of zirconia were examined by scanning electron microscopy (SEM). Three distinct 1-way ANOVA and Tukey's test ($\alpha < 0.05$) were performed.

Results: The roughness and volume loss values obtained for G1, G2, G3 and G4 were significantly higher than those obtained for G6 and G7. G5 showed satisfactory roughness with little volume loss. Regarding μ SBS, the highest value was obtained for G6 followed by G3. On the other hand, G1, G2 and G4 showed an intermediate μ SBS mean value. The lowest bond strength value was obtained for G5 and G7 - Table 1 (different letters indicate statistical difference). SEM evaluation indicated that irradiation of Y-TZP with Er:YAG laser promoted an effective ablation irrespective of the pulse width. An irregular surface without cracks or carbonization was observed.

Conclusions: Tribochemical silica coating was the most effective surface treatment method. Although laser irradiation

with 300 μ s increased the bond strength between resin cement and Y-TZP material, it also created a rough surface with great volume loss; therefore, its use is not recommended.

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Mechanical behavior of endodontically treated teeth with different endocrowns extensions



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Purpose/aim: The aim of this study was to evaluate the mechanical behavior of endodontically treated teeth restored using different extensions of endocrowns inside the pulp chamber by in vitro.

Materials and methods: Thirty mandibular human molars were endodontically treated. Standardized endocrown preparations were performed, as follow: shoulder-shaped margins with internal taper and width between 2.2 mm and 2.7 mm;

Table 1

Experimental groups	G1	G2	G3	G4	G5	G6	G7
Roughness (μ m)	14.14 ± 3.06 AB	15.85 ± 1.45 A	12.03 ± 0.69 B	12.47 ± 0.92 B	3.44 ± 2.11 C	0.88 ± 0.09 D	0.76 ± 0.19 D
Volume loss (μ m)	16.69 ± 5.53 C	24.28 ± 4.10 BC	26.91 ± 6.86 AB	34.62 ± 10.74 A	17.58 ± 4.71 C	4.14 ± 2.13 D	0.00 ± 0.00 D
μ SBS (MPa)	9.72 ± 1.20 CD	12.99 ± 2.64 B	14.03 ± 1.89 AB	12.36 ± 1.92 BC	5.99 ± 0.99 E	16.28 ± 2.46 A	7.95 ± 2.46 DE

internal cavity limited to the removal of undercut areas and maintenance of anatomical configuration of the pulp chamber with a depth of approximately 5 mm and extensions of 6 mm in the mesio-distal direction and 4 mm in the vestibulo-lingual direction; and, axial walls with an internal taper of 8–10°. Teeth were randomly divided into three groups ($n = 10$) according to different extensions of endocrowns inside the pulp chamber: G1, 5 mm extension; G2, 3 mm extension; and G3, 1 mm extension. A glass ionomer cement barrier was applied to the pulp chamber to seal the entrances and undercuts of mesial and distal canals, with a thickness varying according to the extension of endocrowns. Endocrowns of each group were milled in lithium disilicate ceramic. After adhesive cementation, all specimens were subjected to fatigue testing (starting with a load of 80 N, followed by stages of 120, 160, 200, 240, 280, and 320 N at a maximum of 20,000 cycles each and at a frequency of 5 Hz) and thermal oscillation (26 times between 5 °C and 55 °C in each bath at each finished stage). Surviving samples were subjected to fracture strength testing at a crosshead speed of 0.5 mm/min in a universal testing machine. A 6-mm diameter metal sphere was used as an antagonist both in fatigue testing and fracture strength testing. All fractured specimens were subjected to fractography. Data were analyzed by one-way ANOVA and Tukey's post hoc test ($p < 0.05$).

Results: After fatigue testing, survival rate of 100% was observed in all groups. The fracture strength results showed significant differences among the groups ($p < 0.05$) (G1 = 2008.61 N; G2 = 1795.41 N; G3 = 1268.12 N). Fractography showed a higher frequency of compression curls for G1 and G2 than for G3. Evaluating the occlusal surface (origin point for fracture) of fractured teeth, G3 showed fewer dental remnants (only one cusp) and larger fracture than G1 and G2, which showed greater conservations of the remaining teeth.

Conclusions: Greater extension of endocrowns inside the pulp chamber provided better mechanical performance.

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Mercury vapors measurement during amalgam removal in dental clinic



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Purpose/aim: Measure the mercurial vapor levels during amalgam removal in different dental offices of the city of Abidjan.

Materials and methods: A spectrophotometer called LUMEX.A 915+ manufactured in SAINT PETERSBURG (RUSSIA) is used for measurements. The work consisted in recording mercurial vapor from the ambient air at the opening of the dental office, during amalgam removal and after amalgam removal. Measurements are performed each 10 s. 13 measures are made before, during and after amalgam removal.

Results: A total of 13 teeth in 13 patients have been treated. At the opening of the dental office, we obtained lower values

of mercurial vapor, less than 400 ng/m³. During the deposition of amalgam, the mercury vapor values oscillated between 300 and 8500 ng/m³. 15 min after total removal of the amalgam from the tooth, the values obtained were between 2000 and 5000 ng/m³.

Conclusions: During amalgam removal, mercurial vapor increases in the dental office. So, as shown by several studies, the dentists using amalgam and their staff members are exposed to chronic mercurial intoxication.

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Color stability of hybrid and lithium disilicate ceramics veneers



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Purpose/aim: The objective of this study was to evaluate color stability over of hybrid ceramics and lithium disilicate ceramics processed by the CAD/CAM method over time.

Materials and methods: Sixty ceramic veneers were fabricated, following the manufacturer's instructions, on central incisors replicates of darkened (C4) and not darkened (A2) and distributed in experimental groups ($n = 10$) – HA2N, HC4N, HC4L, DA2N, DC4N, DC4L – according to ceramics – hybrid (H) and lithium disilicate (D), substrate color – A2 and C4, and cement color – neutral (N) and light (L). The spectrophotometer analysis was performed immediately after cementation, 48 h, 72 h and thermomechanical cycles of 250,000, 500,000, 750,000 and 1,000,000 cycles at 100 N load cycling machine. Data were analyzed by ANOVA-2 repeated measurements and Tukey test (5%).

Results: Both ceramics showed color stability. Although there is a statistical difference for the DA2N, DC4N and DC4L groups, all values of ΔE were below 1.7, i.e. they are not perceptible.

Conclusions: It was concluded that the veneers of hybrid ceramic and lithium disilicate exhibit excellent color stability over time.

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Biomimetic remineralizing agents influence the wettability of artificial caries-affected dentin



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Purpose/aim: Adhesive penetration to dentin has been considered one of the most important physical properties of adhesion and is directly related to wetting of dentin substrate. The use of biomimetic remineralizing agents that restructure and increase physical properties of caries-affected dentin, a substrate commonly preserved in restorative procedures, appears to be an interesting approach. Therefore, the present study evaluated the influence of wettability of remineralizing treatment with 0.2% Sodium Fluoride (NaF), MI Paste™ (MP) and Curodont™ Repair (CR) in artificial caries-affected dentin (CAD), after etching in bonding procedures.

Materials and methods: Fifty flat bovine dentin surfaces were prepared and randomly allocated into five groups, according to remineralizing approach ($n=10$): G1 – sound dentin – positive control (SD); G2 – caries-affected dentin (CAD) produced by formation of *Streptococcus mutans* biofilm – negative control; G3 – CAD+NaF; G4 – CAD+MP; and G5 – CAD+CR. The CAD groups submitted to demineralization had the infected dentine layer ground with 600-grit silicon carbide paper to the level of affected dentine. Then, wettability was evaluated using a goniometer by measuring the contact angle between water and the different dentin substrate conditions prior and after etching, and between Adper™ Single Bond 2 (SB) application and post-etched dentin, using the sessile drop technique. Data were analyzed by ANOVA and Tukey tests ($p < 0.05$).

Results: All groups presented a decrease in the contact angle value after etching ($p < 0.001$). CAD+MP showed the lowest values of contact angle, followed by CAD+CR, SD, CAD+NaF and CAD ($p < 0.05$), regardless the etching procedure. In respect to the contact angle between SB and post-etched dentin, MP and CR treatments presented the lowest values, which were similar to SD group ($p > 0.05$). In contrast, CAD and NaF showed the highest contact angle values, not differing to each other ($p > 0.05$).

Conclusions: MP and CR treatments showed smaller values of contact angle, thereby improving wettability. Thus, these therapies associated with SB were considered the best indication of wettability improvement of caries-affected dentin surface.

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Ultrasonic activation effect on physicochemical properties of root canal sealers



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Purpose/aim: This study evaluated the ultrasonic activation (UA) effect on physicochemical properties of AHPlus (AHP), MTA Fillapex (MTAF), ADSeal (ADS), GuttaFlow2 (GF2) and GuttaFlow Bioseal (GFB) sealers according to ANSI/ADA standards: setting-time (ST), flow (F), dimensional change (DC) and solubility (SB).

Materials and methods: A syringe (5 mL/11.9 mm-diameter) was adapted to receive 1.0 mL of sealer. After sealer manipulation, the UA was performed with a 20/02 ultrasonic insert (E1, HelseDentalTechnology, Brazil) adapted in ultrasound (EMS, Switzerland) (20 s/1 W), without touching in syringe walls. Subsequently, the physicochemical analysis molds were filled with the sealers. For ST analysis, the sealers were placed in stainless-molds (10 × 2 mm) and tested with a Gilmore-needle (100 g), every 60 s. For F, the sealers were placed on a glass plate and, 180 s after start of mixing, another plate with 120 g mass was pressed against the sealer. Diameters were recorded 10 min after the start of manipulation. For DC, the sealers were placed inside cylindrical Teflon-molds (3.58 × 3 mm), measured for length, immersed in distilled water for 30 d, dried and measured again to determine the percentage of the dimensional alterations. For SB, circular Teflon-molds were filled with the sealers, weighed, immersed in distilled water, reweighed after 7 d, and the liquids were analyzed by atomic absorption spectrometry (AAS). Data were analyzed statistically by ANOVA and Tukey's test ($\alpha = 5\%$).

Results: The ST increased after the UA for all tested sealers ($p < 0.05$), and without UA the AHP (462.0 ± 0.6) and MTAF (373.7 ± 137.7) showed the highest values ($p < 0.05$). After UA, the MTAF sealer (1534.0 ± 26.5) had the highest mean compared to GF2 (46.0 ± 3.6) and GFB (46.7 ± 1.5), that showed the lowest values ($p < 0.05$). MTAF sealer presented lowest DC values after UA (−4.96 ± 3.82) and the ADS had highest means independent of activation protocols ($p < 0.05$). For SB, without UA, the AHP (0.55 ± 0.40) and MTAF (2.65 ± 1.93) showed the highest values. After UA, the MTAF (7.74 ± 4.99) had a higher mean compared to the GFB (−3.39 ± 2.66) that presented the lowest values ($p < 0.05$). For F, the UA increased the flowability for all tested sealers ($p < 0.05$). The MTAF and ADS presented the highest values independent of UA ($p < 0.05$). The results of AAS showed the greater release of Na⁺, K⁺ and Ca²⁺ ions from MTAF sealer, independent of the activation protocol.

Conclusions: It may be concluded that UA altered negatively the root canal sealers physicochemical properties, mainly the ST and F. In addition, only AHP, ADS, GF2 and GBS

Table 1 – Physicochemical properties of the root canal sealers with and without ultrasonic activation (UA) protocols (mean ± standard deviation).

Sealer	Setting time (Min)		Dimensional change (%)		Solubility (%)		Flow (mm)	
	No UA	UA	No UA	UA	No UA	UA	No UA	UA
AH Plus	462.0 ± 0.6Ab	991.3 ± 7.5Ba	0.50 ± 0.36Ca	2.30 ± 2.02ABa	0.55 ± 0.40Aa	2.29 ± 0.40Ba	34.48 ± 0.07Bb	63.41 ± 0.22Ba
MTA Fillapex	373.7 ± 137.7Ab	1534.0 ± 26.5Aa	-5.40 ± 1.77Da	-4.96 ± 3.82Ca	2.65 ± 1.93Ab	7.74 ± 4.99Aa	55.33 ± 2.49Ab	72.74 ± 0.13Aa
AD Seal	241.3 ± 9.7Ba	142.0 ± 7.5Bb	8.83 ± 4.04Aa	6.07 ± 1.46Aa	-2.08 ± 1.04Ba	-1.44 ± 4.22BCa	55.16 ± 0.00Ab	70.70 ± 0.16Aa
GuttaFlow 2	25.3 ± 1.1Cb	46.0 ± 3.6Ca	6.85 ± 5.31ABa	-0.56 ± 2.49BCb	-0.88 ± 0.56ABa	0.13 ± 1.24BCa	33.72 ± 0.33Bb	54.63 ± 0.01Ca
GuttaFlow Bioseal	25.3 ± 1.5Cb	46.7 ± 1.5Ca	3.23 ± 5.03BCba	1.79 ± 3.34Ba	-0.76 ± 0.54ABa	-3.39 ± 2.66Cb	34.43 ± 0.28Bb	55.08 ± 0.50Ca

Uppercase different letters indicate statistically differences in column (between sealers) and lowercase letters indicate statistically differences in lines (between ultrasonic activation protocols) (Tukey's test; $p < 0.05$).

sealers without UA fulfilled all ANSI/ADA recommendations (Table 1).

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Photo-activated dark curing of dimethacrylates



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Purpose/aim: The ability to achieve maximum conversion potential throughout an optically thick photopolymer material requires extended irradiation of the exposed surface to obtain near-comparable levels of conversion at the light-attenuated, opposite surface. Due to the high efficiency of bi-radical termination processes in radical-based polymerizations, only limited post-cure occurs if access to the curing light and continued production of initiating radicals is interrupted. A strategy to uniformly maximize final conversion within photopolymers by extending radical initiation well beyond the temporal exposure of the curing light is advanced here through a photo-induced redox initiation reaction.

Materials and methods: For a demonstration of dark curing, triethylene glycol dimethacrylate (TEGDMA) was used as a benchmark monomer. A photobase generator (PBG) was synthesized per literature reports. The PBG releases 1,8-diazabicyclo[5.4.0]undec-7-ene (DBU) upon UV irradiation ($\lambda_{\max} = 359$ nm), which reacts over extended intervals with dilauroyl peroxide (DLPO) to provide initiating free radicals. The concentration of PBG and DLPO used is 1.46 wt% relative to TEGDMA. A mercury lamp was used with a 365 nm filter at an incident irradiant intensity of 20 mW/cm². The continuous polymerization after a short irradiation (dark curing) was confirmed by real-time FTIR, sampling the region from 760 to 860 cm⁻¹ for vinyl group disappearance. As a control, 2,2-dimethoxy-2-phenylacetophenone (DMPA) was used as a conventional Type I UV photoinitiator in TEGDMA.

Results: The PBG/DLPO initiating system achieved an initial conversion of ~15% during a brief irradiation period. However,

the continuous generation of radicals from the DBU interaction with DLPO achieved a final conversion of 84% over 100 min without reliance on any significant exothermic temperature rise. The initial photopolymerization was relatively rapid due to a synergistic effect of direct radical production from photodegradation of the PBG used in this study while the released DBU reacts with DLPO in redox fashion to provide latent initiating radicals via the redox mechanism. This photoredox dark cure result is juxtaposed against the analogous result with a conventional photoinitiator such as DMPA, which when interrupted at 12% conversion rapidly plateaued with a final conversion of 14%.

Conclusions: The potential to reach full conversion under non-ideal photocuring conditions or throughout highly light-attenuated, thick films, such as bulk fill dental composites, can be reliably accomplished with the photobase-redox initiation approach. This offers the prospect to change the situation where the final degree of conversion is determined by the duration of irradiation.

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Novel fast-sintered zirconia for chair-side dentistry



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Purpose/aim: Several ceramic materials are available for chair-side 1-day treatment. Recently, high-translucent fast sintering monolithic zirconia for chair-side was developed (Kuraray Noritake Dental Inc., KND). The purpose of this study was to evaluate the translucency and flexural strength of chair-side ceramic materials.

Materials and methods: Specimens were made from two zirconia and one glass ceramic materials: KATANA™ Zirconia Block (KND, group KZB), inCoris TZI (Sirona Dental Systems GmbH, inCoris), e.maxCAD LT (Ivoclar Vivadent AG, e.max). Sintering of zirconia materials and crystallization of glass ceramics were done according to manufacturer's instructions. For the translucency test, square-shaped specimens with a 0.5 mm thickness and 14 mm side length were prepared. Bars with 4 mm width, 18 mm length, and 1.5 mm thickness were fabricated to assess flexural strength. Translucency was taken using a spectrophotometer (Crystaleye, Olympus, Japan)

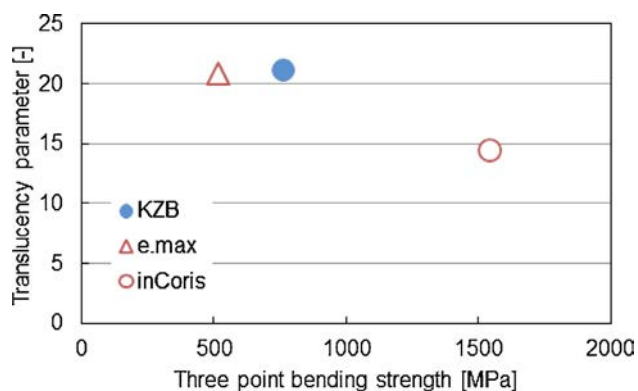


Fig. 1

against a white and black background ($n=3$). Translucency parameter was evaluated by calculating the luminosity (ΔL) between the L^* values against a white and black background. A three-point bending test was carried out in a universal testing machine (Model 5569, Instron, Japan) with a crosshead speed of 0.5 mm/min and a span length of 16 mm according to ISO6872:2015 ($n=30$).

Results: The relationship between translucency parameter and three-point bending strengths of all materials are shown in Fig. 1. KZB had the same translucency as e.max despite higher flexural strength than e.max.

Conclusions: KZB has favorable translucency and flexural strength compared to other chair-side 1-day treatment ceramic materials, indicating the suitability of KZB for not only posterior but also anterior teeth.

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Microtensile bond strength of three universal adhesive systems



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Purpose/aim: The aim of this study was to evaluate the microtensile bond strength of three self-etching universal adhesive systems.

Materials and methods: Twenty-four third human molar were selected for the study. The teeth were sectioned longitudinally along the long-axis to expose fresh dentin. Teeth were divided in four groups ($n=6$), according to adhesive system: G1 – Adper™ Scotchbond™ Multi Purpose (SMP) (control); G2 – Single Bond Universal (SBU); G3 – All-Bond Universal (ABU); and G4 – Clearfil Universal (CFU). All adhesives were applied according to manufacturer instructions and photopolymerized for 20 s. Composite resin blocks with 4 mm height were built incrementally on the dentin. Teeth were stored in distilled water at 37 °C for 24 h and for 3 months associated to thermocycling (5000 ciclos, 5/55 °C). After this period, the teeth were sectioned parallel to the long-axis to obtain 1.0 mm² sticks. The sticks were mounted in jigs and subjected to a uni-

versal testing machine with a crosshead speed of 0.5 mm/min until failure. The bond strength values (μ TBS) were submitted to statistical analysis using two-way ANOVA and Turkey test ($p < 0.05$). The fracture surfaces were examined under optical and scanning electron microscopy to evaluate the failure modes.

Results: The μ TBS main values for 24 h of storage were 32.31 (SMP); 49.11 (SBU); 44.86 (ABU); 43.61 (CFU); and for 3 months of storage were 30.03 (SMP); 44.12 (SBU); 17.77 (ABU); 27.15 (CFU). The 24 h of storage showed significantly higher values than the storage for 3 months associated to thermocycling ($p < 0.05$). ABU and CFU showed statistically difference between the different time of storage ($p < 0.05$). The adhesive types of failures were predominant for all adhesive systems.

Conclusions: The Single Bond Universal adhesive showed better results of microtensile bond strength after 24 h and 3 months of storage.

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Detection of oral bacterial flora using DNA array



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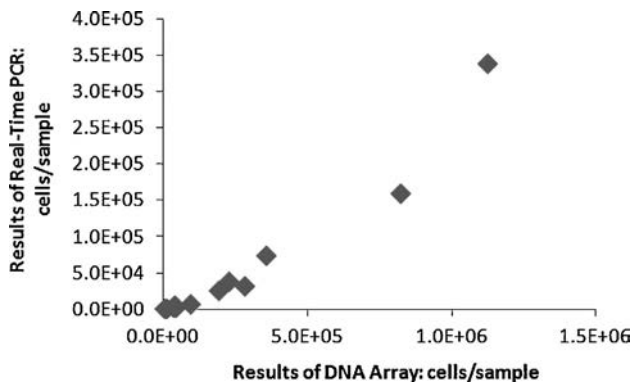
Purpose/aim: Periodontal diseases are inflammatory conditions caused by bacterial infection. In previous studies, a number of periodontopathic bacteria have been reported. However, it is rare case that the periodontopathic bacteria adhere to the tooth surface directly. Adhesion of early colonizers is needed for periodontopathic bacteria to adhere and increase on the tooth surface, which leads to the pathogenesis and progress of periodontal diseases. Therefore, it is important to evaluate the oral bacterial flora of the patient, in order to manage the periodontal disease. By the bacterial test using DNA array, wide species of bacteria could be detected at once, so that information of oral bacterial flora of the patient could be obtained. The aim of this study was to detect and evaluate the oral bacterial flora from clinical samples.

Materials and methods: 5 subjects were recruited for this study. The values of probing pocket depth (PPD) were recorded. 12 gingival crevicular fluid (GCF) samples were collected. Bacterial DNA from samples was extracted using QuickGene DNA tissue kit S (KURABO, Osaka, Japan). The numbers of 28 periodontal disease associated bacteria and total bacteria in the samples were determined using Oral Care Chip ORAG (Mitsubishi Chemical, Tokyo, Japan). Spearman's rank-correlation coefficient was determined using the numbers of total bacteria measured by DNA array and real-time PCR. These investigations were permitted by ethical committee of GC Corporation.

Results: The average of PPD was 3.1 mm (S.D. 0.8). The number of species detected by DNA array was 2.0 (S.D. 2.5). *Campylobacter rectus*, *Fusobacterium nucleatum* subsp. animalis, *Fusobacterium nucleatum* subsp. nucleatum and *Streptococcus gordonii* were seen with a relatively high frequency (33.3%, 33.3%, 33.3% and 41.7%, respectively). Because the subjects had healthy gum condition, the number of species detected by

DNA array might be low. Spearman's rank-correlation coefficient between the numbers of total bacteria measured by DNA array and real-time PCR was 0.969. As the result of DNA array correlates strongly with that of real-time PCR, the detection of DNA array has quantitative capability.

Conclusions: Oral Care Chip ORAG (DNA array) can detect the oral bacteria from GCF. The relationship between the results of DNA array and those of real-time PCR was indicated in this study. These results suggested that quantitative detection of oral bacteria is achieved using DNA array.



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Effect of molding temperature on peeling energy of laminated mouthguards



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Purpose/aim: Recently mouthguards (MG) are custom-made from sheet-type material with thermoforming technique, such as single-layered or double-layered or sometimes even multi-layered techniques. It has been known that molding temperature is most important for laminating the thermoplastic materials. However, there have been few reports about optimal laminating temperature for mouthguard materials. The purpose of this study was evaluation of peeling energy (PE) between the laminated mouthguard materials using various molding temperature.

Materials and methods: Three ethylene vinyl acetate (EVA)-based MG sheets (1: Drufosoft; Dreve Dentamid GmbH, Germany: DRU, 2: ERKOFLEX; ERKODENT, Germany: ERK, 3: BIOPLAST; Scheu Dental Technology, Germany: BIO) and one polyolefin-based MG sheet (4: MG21; CGK, Japan: PO) were used (clear 2 mm). Each MG sheet was laminated with the same company's sheet using vacuum forming machine (ERKOFORM 3D: ERKODENT) changing the melting temperature

Table 1

	90 °C	110 °C	130 °C	150 °C	170 °C
DRU	7.4 ± 2.6	45.7 ± 17.0	165.9 ± 30.8	273.8 ± 96.6	281.7 ± 117.0
ERK	14.6 ± 6.9	63.6 ± 33.8	305.9 ± 103.0	224.6 ± 77.3	220.0 ± 77.3
BIO	2.3 ± 1.1	29.0 ± 13.7	225.1 ± 44.0	252.2 ± 64.8	251.8 ± 50.8
PO	0 ± 0.0	165.6 ± 42.6	220.6 ± 77.7	313.6 ± 68.3	224.3 ± 56.5

J/mm (mean ± S.D.) n = 6.

(90 °C/110 °C/130 °C/150 °C/170 °C). After 24 h, the laminated sheets were cut out to dumbbell-shape according to JIS K6251:2010 and sectioned at the center. The specimens for delamination were with an adhesive area (4 × 7.5 mm) (n = 6). Next, each sample was fixed on a universal testing machine (Type 1123, Instron, USA) and de-lamination test was carried out at a crosshead speed of 50 mm/min. Loads during the test were recorded and PE was calculated as integral calculus in performed with peel width. The statistical analysis was done with one-way ANOVA and Tukey's HSD test ($p < 0.05$).

Results: Table 1 shows the PEs of all laminated mouthguard materials by the difference in molding temperature. PEs of all EVA sheets from 130 °C to 170 °C were significantly higher than at 90 °C and 110 °C, and PE of PO at 90 °C was significantly lower than others ($p < 0.05$). In the EVA sheets, PEs increased with increasing temperature from 90 °C to 130 °C, but did not change from 130 °C to 170 °C PEs. In the PO sheet, PEs increased from 90 °C to 110 °C but PEs did not changed from 130 °C to 170 °C

Conclusions: The results of this study showed the following: PEs of all materials have temperature dependence, and get stable over 130 °C.

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Fracture resistance of teeth restored with different post-cores materials



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Purpose/aim: The aim of this in vitro study was to evaluate the fracture strength and the type of failure of new materials used as post-core in human teeth roots.

Materials and methods: The teeth were sectioned crowns and endodontically root canal treated and, randomized into 4 groups (n = 12) as the material composition of post/cores: polyether ether ketone (PEEK) composite resin with nanoceramic load (CRN), molten metallic core with nickel-chromium alloy (NMF) and glass fiber post with composite resin (GFP). The roots were embedded in acrylic resin, the post/core cemented (all with the same resin cement dual self adhesive) and then the specimens were stored in distilled water at 37 °C for 60 days. In the following, we were subjected to compression fracture resistance test at 0.5 mm/min at an angle of 45° relative to the longitudinal axis of the tooth in a universal testing

machine until fracture. Fractures were classified as repairable and irreparable.

Results: The fracture resistance values thus obtained were submitted to ANOVA, with confidence level of 95% to detect statistical differences between the groups, which have been proven ($p < 0.001$). According to the Post-hoc Tukey test, resistance to fracture results of the NMF Group (939.61N) were statistically superior to the other groups ($p < 0.05$), whereas there was no statistical difference between the PFC Groups (449.6C), PEEK (396.1C), and RNCs (511.6C) ($p > 0.05$). Irreparable failures occurred in greater numbers in the NMF Group (10). Also in the CRN group there were two irreparable failures. Already in the PFC Groups and PEEK all faults were considered repairable.

Conclusions: Despite showing greater resistance to fracture, the NMF Group has irreparable flaws, unfavorable to retreatment. A root reconstruction material with high fracture resistance does not guarantee that the complex root/post and core be protected from a catastrophic failure as the root fracture.

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Effect of zirconia surface pre-treatments on bonding to composite cement



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Purpose/aim: To compare the effect of mechanical and/or chemical pre-treatments and type of cement on bonding between zirconia and composite cement by means of strain energy release rate (G-value, J/m²).

Materials and methods: Two different sizes of zirconia specimens (size 30 × 8 × 1.5 mm, 210 pieces and size 14.8 × 8 × 1.5 mm, 420 pieces) were fabricated and divided into 7 groups as follows: (i) alumina air abrasion with G-Multi primer and G-Cem LinkForce cement; (ii) alumina air abrasion with Clearfil Ceramic primer and Panavia F2.0 cement; (iii) alumina air abrasion with Multilink Speed cement; (iv) Cojet with RelyX Ceramic primer and RelyX Unicem 2 cement; (v) aluminium-nitride coating with RelyX Unicem 2 cement; (vi) DCMHotbond[®] followed by alumina air-abrasion, hydrofluoric acid, G-Multi primer and G-Cem Linkforce cement; and (vii) lithium disilicate coating followed by hydrofluoric acid, Monobond N primer and Multilink Speed cement. In each group, 30-mm length specimens and two 14.8-mm length specimens were cemented together (Fig. 1). During this process, a metal strip (0.4 mm thickness) was used to separate the two 14.8 mm specimens. After cementation, the metal strip was removed leaving a notch-like space between the two 14.8 mm specimens. This notch was used to promote crack propagation and was located in middle of the length of the

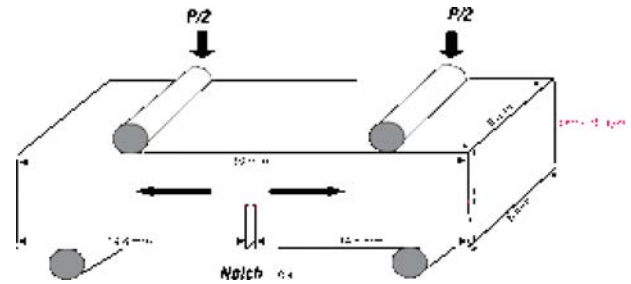


Fig. 1

30-mm specimen, where greater tensile stresses are likely to concentrate during loading. A total of 30 bi-layered specimens were stored in distilled water for 24 h and then divided into 3 aging conditions ($n = 10$): (i) immediate, (ii) thermocycling for 5000, and (iii) thermocycling for 10,000 cycles and tested in 4-point bending configuration. Data were analyzed using Kruskal-Wallis test followed by multiple pairwise comparisons ($\alpha = 0.05$).

Results: 1. The G-value of Cojet with RelyX Ceramic primer and RelyX Unicem 2 cement, and alumina air abrasion with Multilink Speed cement were significantly higher than the other groups among all aging conditions. 2. Thermocycling did not affect the G-value in all test groups.

Conclusions: Type of mechanical and chemical pre-treatments, and type of cement affect the G-value between zirconia and composite cement.

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Effects of alcoholic and acidic drinks on microhardness of Bulkfill-composites



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Purpose/aim: The aim of this study was to evaluate the surface microhardness of three bulk fill composites after immersion in alcoholic and acidic beverages.

Materials and methods: Eighty-four disc-shaped specimens (8 × 4 mm) were made from each of three bulk-fill composites (Tetric N Ceram Bulkfill [TNC], Filtek Bulk Fill [FBF], Kerr SonicFill [SF]) using a stainless steel cylindrical mold. The specimens were polymerized for 20 s with a light-curing unit (Optilux 501, Kerr) and then stored in distilled water for 24 h at 37 °C to ensure a complete polymerization. Thereafter, the top surface microhardness values of each specimen were measured using a Vickers microhardness tester. Seven randomly selected specimens from each composite material were then

immersed in one of the three drinks (orange juice, red wine, diet coke) each for 6 h daily or distilled water (control) for 2 weeks. After a 14-day storage period, samples were taken from the beverages and subjected to post-immersion surface micro-hardness testing. The data were evaluated using the one way ANOVA at a significant level of $\alpha=0.05$.

Results: Orange juice had significantly reduced the micro-hardness values of the TNC and FBF ($p < 0.05$) but significantly increased hardness values of SF ($p < 0.001$). There was no significant difference between materials after immersion in wine ($p > 0.05$). FBF specimens that were immersed in diet coke showed significantly reduced hardness values than SF group ($p < 0.05$).

Conclusions: It can be concluded that different kinds of drinks caused different hardness values on the bulk fill restorative materials. While alcohol containing drink has no effect on the surface hardness of the bulk fill composites whereas, acidic drinks have an effect on the surface hardness.

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Shark fin test analysis: Thixotropic behavior of elastomeric impression materials



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Purpose/aim: The aim of the present study is to compare the thixotropic behavior of low viscosity, automixed polyvinylsiloxane impression materials using a shark fin device.

Materials and methods: Nine commercially available low viscosity, automixed polyvinylsiloxane impression materials were subjected to shark fin test under a load of 150 g: Affinis Precious Light Body, President Light Body, President Xtra Light Body, Virtual Light Body, Variotime Light Flow, Variotime Extra Light Flow, Detaseal Hydroflow Lite, Detaseal Hydroflow Xlite and First Half Light Body. 5 specimens for each PVS impression material were created and a total of 45 specimens were tested. After the removal of the shark fins from the mold, the maximum height of the fin was measured using a digital caliper. The data were analyzed using the One-Way ANOVA method. Means were compared with Games-Howell test and the significance level is set at $p < 0.05$.

Results: Comparing the light wash materials no statistical significant differences were observed between Virtual Light Body and Affinis Precious Light Body ($p > 0.05$), President Light and First Half Light Body ($p > 0.05$), Variotime Light Flow and Affinis Precious Light Body ($p > 0.05$). Statistical significant differences were observed among the remaining groups compared ($p < 0.05$). Comparing the extra light wash materials no statistical significant differences were observed ($p > 0.05$) between the groups.

Conclusions: The light wash material with the highest shark fin value was Virtual Light Body followed by Affinis Precious Light Body. The extra light body with the highest shark fin value was Variotime Extra Light Flow. The thixotropic behavior of the majority of PVS materials tested is acceptable.

Impression material	Mean (mm)	Std. deviation
<i>Light wash materials</i>		
Virtual Light Body – Ivoclar Vivadent, Lichtenstein	22.21	1.70
First Half Light Body – Danville Materials, USA	13.19	1.48
Detaseal Hydroflow Lite – DETAX, Germany	16.28	0.57
Variotime Light Flow – Kulzer, Germany	18.02	0.32
President Light Body – Coltene, Whaledent, Switzerland	14.09	0.37
Affinis Precious Light Body – Coltene, Whaledent, Switzerland	18.73	0.36
<i>Extra light wash materials</i>		
Detaseal Hydroflow Xlite – DETAX, Germany	23.02	0.39
Variotime Extra Light Flow – Kulzer, Germany	23.31	0.69
President Xtra Light Body – Coltene, Whaledent, Switzerland	21.56	1.78

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Evaluation of propolis dental varnish against *Streptococcus mutans* in children



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Purpose/aim: The aim of the study was to longitudinally evaluate the antimicrobial efficacy of a 2.5% Brazilian red propolis dental varnish against *Streptococcus mutans* (*S. mutans*) in comparison with 1% Chlorhexidine and 5% Fluoride in children, with purpose of dental caries prevention.

Materials and methods: Seventy-five high-risk caries-free children, according of AAPD (The American Academy of Pediatric Dentistry) criteria, aged 36-71 months were recruited and randomly divided into three groups to receive treatment with varnishes containing: propolis, chlorhexidine or fluoride. Varnishes were applied to occlusal surfaces of second deciduous molars once every 3 months, during 6 months. Salivary *S. mutans* reduction was accessed before starting treatment (D1), 90 days after day 1 (D90) and 6 months (D180). Microbiological analysis was performed in duplicates (1:10 and 1:100mL dilutions). Statistics were carried out by applying repeated measures analysis of variance, Tukey's multiple comparisons test, and paired t-test.

Results: Propolis dental varnish demonstrated a significant *S. mutans* reduction: D90 versus D1 ($p < 0.01$), D180 versus

D1 ($p < 0.05$). Chlorhexidine varnish significantly reduced *S. mutans*: D180 versus D1 ($p < 0.01$). Fluoride varnish showed significant *S. mutans* reduction only at D180 versus D1 ($p < 0.05$). Propolis varnish showed consistent *S. mutans* reduction throughout the 180-day monitoring period. At D180, propolis (0.60 ± 0.40) produced significantly lower *S. mutans* levels when compared to fluoride (0.41 ± 0.24) and chlorhexidine (0.33 ± 0.14).

Conclusions: Three applications of the red propolis dental varnish showed antimicrobial activity against *S. mutans* for up to 6 months in high-risk caries-free children. Further studies to identify the anticaries effect of this varnish are required to establish its use in caries prevention.

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Microstructure of dental cements from small-angle scattering and X-ray tomography



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Purpose/aim: Micro-structural characterization of two formulations of commercial zinc phosphate cement in function of liquid/solid ratio. Nature of the detected porosity.

Materials and methods: In an innovative approach, the range in porosity from the nanometric to the millimetric scale has been covered combining small-angle neutron scattering and X-ray micro-computed tomography. The two formulations of dental zinc phosphate cement (Adhesor, SpofaDental a.s., Jičín, Czechia) had a liquid/solid ratio 0.348 and 0.571 and were recommended by the producer for filling and fixed bridge bonding materials, respectively. They have been prepared by hand mixing following the manufacturers' instructions and tested 3 days after preparation.

Results: In the range from few nm up to 130 nm in pore diameter, it is observed a bimodal distribution of pore size for both formulations, with higher porosity for the formulation with higher liquid/solid ratio. The surface per unit volume is comparable to that of sintered ceramics ($11\text{--}25 \times 10^6 \text{ m}^{-1}$). The visual inspection of the pore size within the sample volume, available thanks to X-ray micro-computed tomography, evidenced a spherical to sub-spherical shape for the pores. The increase in liquid/solid ratio resulted in a larger fraction of pores with $D \geq 50$ microns and, more in general, in the formation of larger pores. Features were observed inside the pores (see Fig. 1) of both samples and on the pore surface, pointing to the precipitation/crystallization of material within the pores.

Conclusions: Segregation of liquid seems to be a mechanism behind the development of micro-porosity in the investigated cements at variance with previous theories

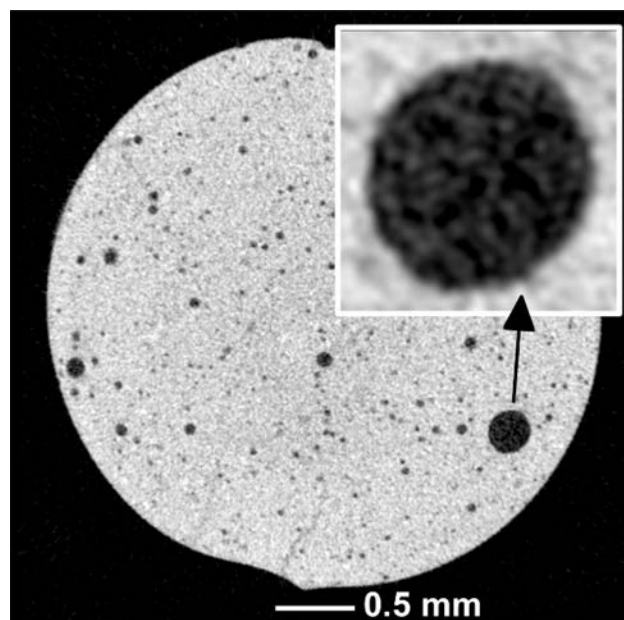


Fig. 1

invoking air entrapment. It is conjectured that the material precipitating in pores is an intermediate, highly hydrated (probably gel-like) precursor of the main cement reaction product, a view compatible with a previously proposed mechanism of chemical evolution of the cement. Increasing the liquid fraction increases total porosity and the relative fraction of largest pores, with detriment for the mechanical properties. The specific surface area is lower for the formulation recommended as filling material (lower liquid content). Therefore, this formulation should be less active with respect to fluoride release/uptake (surface dependent), and it should show a higher dissolution rate, because of the higher fraction of unreacted ZnO powder.

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Bonding of universal adhesives to dentine: A first-time user outcome



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Purpose/aim: The objective of this study was to investigate the resin-dentine bond strength of five Universal adhesive systems when applied by a clinician without previous experience with the adhesives.

Materials and methods: Caries-free extracted human third molars ($N = 30$) had their mid-coronal dentine exposed flat, and a standard smear layer was created with 320-grit SiC

Table 1

Adhesives	Application time	No. of beams	MPa	SD	CV%
Elect	20 s	37	29.3 A	9.7	33
Opti bond FL	15 s-primer/15 s adhesive	37	23.9 AB	12.7	53
Opti bond SOLO	15 s	34	19.4 BC	9.4	48
Scotchbond Universal	20 s	42	19.1 BC	11.4	59
Clearfill	5 s	31	13.0 C	7.6	58
Clearfill Extended	10 s	21	15.0 C	8.3	55

paper. The teeth were randomly divided into five groups ($n=6$) and bonded according to manufacturer's instructions using the self-etch mode with 5 Universal Adhesives: Prime Bond Elect (Dentsply), Opti Bond Solo (Kerr), OptibondFL (Kerr), ScotchBond Universal (3M ESPE) and Clearfil Quick Bond (Kuraray-Noritake). One additional group of 4 teeth was bonded with Clearfil Quick Bond using an extended application time of 10 s instead of the original recommendation of 5 s. The operator had no previous experience with the adhesives in the study and was only given verbal instructions and read the manufacturer's recommendations. The adhesives were applied to a dry, but not desiccated dentine surface using a rubbing motion. After curing the adhesive layer for 10 s (@ 1200 mW/cm², Bluephase 2.0i, Ivoclar Vivadent) a 4 mm resin build up was constructed with IPS Empress Direct (Ivoclar Vivadent) resin composite in two increments and cured individually for 40 s. The bonded teeth were stored for 24 h in distilled water at 370 °C and then sectioned to obtain beams of approximately 0.8 mm². Half of the beams were stored for future testing and half were immediately tested in tension at 0.5 mm/min (Shimadzu, AGS-X, Japan). The bond strength was recorded in MPa and the mode of failure examined under a stereoscope at 10×. Representative specimens from each group were further prepared and examined under SEM. Two additional teeth were bonded accordingly and the interface examined under SEM. Data were analyzed by ANOVA and Holm-Sidak at $\alpha=0.05\%$.

Results: See Table 1.

Conclusions: The overall bond strengths were relatively lower than usually reported in the literature and the coefficient of variation relatively high. This could be attributed to the sensitivity of the adhesives to operator's experience. The adhesives with the shortest application time resulted in lower bond strengths.

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Periodontal pathogens colonization on resin composite and hybrid CAD/CAM blocks



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Purpose/aim: The ideal restorative material should not favour colonization by species that can detrimentally affect the health of periodontal tissues. The aim of the current study was to investigate differences in colonization by periodontal pathogens in two different restorative materials at three timepoints.

Materials and methods: Ten volunteers participated in this split-mouth trial and wore an essix-like splint, in the upper arch for four weeks. Thirty specimens (4 × 4 × 1 mm) made of resin composite for direct restorations (RC) and thirty specimens of the same size made of resin composite blocks for CAD/CAM systems (BL) were prepared and polished with four standardized different roughness polishing discs each. Roughness of one specimen of each group was measured with a profilometer. Three specimens of the same material were adhered on the splint, corresponding to the buccal side of teeth #15, #16, #17, while three specimens of the other material were adhered on the splint corresponding to the buccal side of #25, #26, #27. Material placement was randomized and blinded for the patient and the investigator. Volunteers wore the splints all day except when they were eating or brushing. Dental plaque was collected at 1, 2 and 4 weeks from each group. It was examined for the presence of the "red complex" species – *T. forsythia* (T.f.), *P. gingivalis* (P.g.), *T. denticola* (T.d.) and *P. intermedia* (P.i.) and *F. nucleatum* (F.n) with Polymerase Chain Reaction (PCR). All experiments were conducted twice.

Results: In the current study, overall, a low percentage of periodontal pathogens was identified. On average, 15% of the specimens were positive for T.f., 18% for P.g., 38% for T.d., 13% for P.i. and 48% for F.n. As a trend, presence of the bacteria was the same or increased at 2 weeks, while it remained the same or decreased at 4 weeks. However, comparisons between groups showed statistically significant differences only for F.n. between 2 and 4 weeks and between the two materials at the fourth week (Fisher's exact test, $p<0.05$). Roughness values were 547 nm for RC and 512 nm for BL.

Conclusions: When restorations are polished meticulously and the patients have high oral hygiene levels, the presence of the periodontal pathogens is generally low and not increasing after 2 weeks. Detachment of the biofilm due to self-cleansing may be responsible for the decreases observed at 4 weeks. The

two materials acted the same, except from the fourth week, concerning FN.

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Biomechanical properties of a novel Bis-GMA-free fiber reinforced composites



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Purpose/aim: Bis-GMA composites have the potential to be cytotoxic due to the residual BPA monomers leaching from the bis-GMA, with their ability to mimic estradiol and to bind to or disrupt oestrogen. The purpose of this laboratory study was to investigate the biomechanical properties of a novel BPA-free composite-fluorinated urethane dimethacrylate (FUDMA)-based fiber reinforced composites (FRCs), assisting in the formulation of the next generation of bis-GMA-free materials for dental applications.

Materials and methods: The control groups were prepared using bis-GMA/TEGDMA (49/49 wt.%, 70/28 wt.%). FUDMA/TEGDMA with the varying ratios (28/70 wt.%, 49/49 wt.%, 70/28 wt.%) based FRCs were prepared as experimental groups. Accordingly, five FRCs groups ($n=90$) were prepared, with the flexural strength, Young's modulus, and Vicker's surface hardness evaluated in three conditions: before and after water storage 28 days and thermo-cycling 6000 times. The fiber content (vol.%) of the FRCs was determined using the ashing method ($n=6$). The water sorption of the FRCs ($n=30$) was tested at the time points of 1, 3, 5, 7, 14, 21, and 28 days. Representative specimens ($n=15$) from each subgroup, after three-point bending, were randomly selected for investigation of cross-section using scanning electron microscopy. Results were analyzed using one-way ANOVA followed by the Tukey's test ($\alpha < 0.05$).

Results: The fiber content was 42.00 ± 0.75 vol.%. With increased concentration of the FUDMA or bis-GMA in FRCs, the flexural strength tended to increase. Although 70 wt.% bis-GMA based FRCs group showed significantly higher strength than the remaining four groups on any conditions, yet the 49 wt.% FUDMA-FRCs group did not show any significant difference on the three conditions compared with 49 wt.% bis-GMA-FRCs. All specimens demonstrated significantly lower flexural strength after both two aging storage conditions ($p < 0.05$). In contrast, the surface hardness of all groups significantly increased ($p < 0.05$). After 28 days of water storage, the 70 wt.% FUDMA-FRCs group exhibited the highest weight increase, with the most hydrophobic resin being the 70 wt.% bis-GMA-FRCs. The SEM observations of tested samples revealed that some E-glass fibers were apparently dislodged from the cracked surface and the pulled-holes, indicating a reduction in adhesive bond strength.

Conclusions: It can be concluded that FUDMA was successfully capable of replacing bis-GMA as the resin matrix in FRCs. The 49 wt.% FUDMA:49 wt.% TEGDMA possesses satis-

factory and comparable properties with potential to substitute bis-GMA based FRCs in dentistry.

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Variables influencing development of residual stresses during crystallization firing



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Purpose/aim: Some dental CAD/CAM glass ceramics are marketed in a meta-sintered stage to facilitate machining and require a crystallization firing to achieve their final mechanical properties. However it is assumed that internal residual stresses might develop during the cooling phase of the firing step, being potentially detrimental for the restoration. The aim of this work was to assess the influence of different cooling rates in combination with different commercially available firing trays on the magnitude and distribution of residual stresses in VITA SUPRINITY[®] PC single molar crowns.

Materials and methods: Thirty crowns were milled out of VITA SUPRINITY[®] PC blocks (OM1-HT, PC-14, VITA Zahnfabrik, Bad Säckingen, Germany) and assigned to one of five experimental groups, according to the firing tray used for crystallization (i.e. platinum pin, dark ceramic pin, silicon nitride pin, fibrous pad or firing paste). Two crowns of each group were then crystallized following the protocol recommended by the manufacturer and cooled with the furnace closed until 680 °C (REF). The remaining crowns were either exposed immediately to the environment air after crystallization (fast cooling, FC) or were kept inside the closed oven until 550 °C (slow cooling, SC). One of the obtained crowns per sub-group was then sectioned sagittal into six thin slices, while the other one was cut into four transversal sections. Magnitude and distribution of residual stresses in the slices was measured with the light birefringence method using an automatic polarimeter (Strain-Matic M4/120.33, ilis, Germany).

Results: Average residual stresses ranged between 0 and 1.5 MPa among the groups, with maximum peaks of 5 MPa. Higher stress magnitudes were observed around support areas of the firing pins, even leading to spontaneous fracture of restorations during cooling (dark ceramic pin, FC protocol). The use of fibrous pads and firing pastes prevented concentration of residual stresses on the intaglio side of the crowns. An overall reduction in the magnitude of the generated residual stresses was observed after application of the SC protocol, whereas the REF cooling was not able to avoid development of hoop stresses, being similar in magnitude and distribution to those of FC specimens.

Conclusions: The use of fibrous pads or firing pastes ensures a homogeneous cooling during crystallization fir-

ing and hence prevents residual stress concentration at the intaglio side of single crowns. Firing pins, on the other hand, favor the local stress build up leading to spontaneous cooling fractures when combined with fast cooling protocols.

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Dental resins affect differently the expression of chemokines and chemokine-receptors



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Purpose/aim: To evaluate the influence of substances released from different direct and indirect dental resins in the expression of chemokines and chemokine receptors in human monocytes in vitro.

Materials and methods: Disks of direct resins (Filtek P90 and Filtek Z350 XT, 3M-ESPE, USA) as well as disks of indirect resins (BelleGlass, Kerr Corp., USA and Ceramage, Shofu Dental Corp., Japan) were prepared in a Teflon mold (11 mm diameter × 2 mm thick) and were light cured using LED unit (Flash Lite 1401, @1100 mW/cm², Discus Dental, USA) for 40 s. The resin discs were incubated in culture medium containing human peripheral blood mononuclear cells. The control group was pure medium. After short-duration culture (72 h), MTT assay was performed. Immunofluorescence reactions were performed to evaluate the expression of the chemokines CCL2, CCL3, CCL5, CXCL8 and the chemokine receptors CCR1, CCR2 and CCR5 in CD14+ monocytes, using flow cytometry. All data were statistically analyzed using One-Way ANOVA, followed by Tukey post hoc test ($p < 0.05$; GraphPad Prism Software Inc., USA).

Results: None of the evaluated resins significantly affected the cell viability by MTT assay. Ceramage significantly reduced the expression of CCL2 and CXCL8 when compared to the other groups. Only the direct resins reduced the CCL3 expression when compared to the control group. Moreover, the CCL3 expression was lower in Filtek Z350 than in Belleglass. Both direct resins and Ceramage reduced the expression of CCL5 when compared to the control. In contrast, Belleglass did not change the expression of any evaluated molecule when compared to the control. None of the evaluated resins affected the expression of CCR1 and CCR5 in monocytes. However, Filtek Z350 and Filtek P90 reduced the CCR2 expression when compared to the indirect resins.

Conclusions: Direct and indirect dental resins differently affected the expression of chemokines and chemokine receptors by human monocytes. Since these molecules are involved in the oral protective immunoinflammatory response, these

properties should potentially interfere with the clinical performance of these materials.

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Effect of ELP on physical properties of CPC



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Purpose/aim: The objective of this study was to investigate the effect of elastin-like polypeptides (ELPs) on physical properties and structure of calcium phosphate cement (CPC).

Materials and methods: The 2 types of ELPs fiber (V125, V125E8) was mixed with deionized water to make 10 wt% solution. The CPC powder was mixed with 3 types of liquids; DW group (CPC mixed with deionized water), V125 group (CPC mixed with 10 wt% V125 solution) and V125E8 group (CPC mixed with 10 wt% V125E8 solution). The samples were keeping in 100% humidity storage on 37 °C. Microhardness, compressive strength and anti-washout test were examined, and microstructure was observed using SEM.

Results: In microhardness and compressive tests, the results of V125E8 groups showed the highest value and DW groups showed the lowest value in all ratios. A decrease in value was seen with an increasing L/P ratio. But, a higher value was obtained at L/P ratio 0.4 than 0.3. The anti-washout ability of V125 and V125E8 groups was superior to DW group. Especially V125E8 group could almost keep its initial shape and did not degrade obviously during observation. The microstructure of DW group had larger pores than other groups. V125E8 group seemed much denser.

Conclusions: The ELP supplemented CPC showed a significantly enhanced microhardness, compressive strength, anti-washout property. The effect of V125E8 was greater than that of V125.

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Influence of saliva contamination on resin bonding to zirconia



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Purpose/aim: Saliva contamination occurs during clinical procedures for adjustment of zirconia ceramic restorations in the oral environment. The purpose of this study was to investigate the influence of saliva contamination and different cleaning methods on the shear bond strengths of two resin cements to zirconia.

Materials and methods: After saliva contamination, alumina-blasted zirconia specimens (Tosoh) were cleaned

Table 1

Group	Panavia SA Cement Plus		Panavia V5	
	TC0	TC10,000	TC0	TC10,000
CT	24.3 (1.9)d	23.7 (2.6)d	24.1 (1.4)d,e	22.5 (1.7)c,d
SA	9.1 (2.5)b	2.0 (0.4)a	18.9 (2.1)b,c	12.3 (2.3)a
PA	22.2 (3.1)d	12.7 (2.4)b	24.2 (3.1)d,e	15.6 (2.7)a,b
IC	23.1 (2.1)d	16.8 (2.0)c	28.0 (2.9)e	17.0 (3.3)b
ADG	29.1 (2.7)e	25.7 (2.9)d,e	26.7 (3.8)d,e	23.4 (4.2)c,d,e
AB	24.1 (3.4)d	23.3 (2.4)d	25.4 (2.6)d,e	21.7 (2.0)c,d

with one of five methods of water-rinsing (SA), K-etchant GEL (PA, Kuraray Noritake Dental), Ivoclean (IC, Ivoclar Vivadent), AD Gel (ADG, Kuraray Noritake Dental), or additional alumina-blasting (AB). Alumina-blasted zirconia without saliva-contamination was used as control group (CT). Composite cylinders were bonded to the zirconia with one of two dual-cured resin cements (Panavia SA Cement Plus Handmix and Panavia V5, Kuraray Noritake Dental). The bond strengths were measured by shear testing after 24 h (TC0) and after 10,000 thermal cycles at 4–60 °C (TC 10,000). Means and SDs (in parenthesis) of shear bond strength (MPa) are listed in Table 1. Data were analyzed by three-way ANOVA and identical letters were not significantly different within the same resin cement by Tukey compromise post-hoc tests ($p > 0.05$, $n = 8$). The influence of contamination and effectiveness of cleaning methods were evaluated using X-ray photoelectron spectroscopy (XPS).

Results: There were no significant differences in the bond strengths of two resin cements between the CT, ADG, and AB groups before and after TCs ($p > 0.05$). SA, PA, and IC groups did not exhibit durability of resin bonding to zirconia. XPS showed that carbon and nitrogen increase in the SA group detected in comparison to the CT group. The concentration of carbon in other four groups returned to the concentration range of the CT group, however, nitrogen was not detected in the only AB group.

Conclusions: Saliva contamination significantly reduced the bond strength of two resin cements to zirconia. Cleaning with ADG or AB resulted in effective cleaning of saliva contamination and preserved the durability of resin bonding.

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Effects of zirconia nano-filler on the mechanical properties of high impact heat-cured acrylic resin denture base

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Purpose/aim: The use of heat-cured acrylic resin whilst important in the field of dentistry does have some limitations. These include that denture bases often suffer short term “wear and tear”, and on occasions fracture. These issues limit its application in restoring the function and aesthetics of teeth that are lost or damaged. The aim of this study was to investigate the flexural strength and fracture toughness of high

impact heat-cured acrylic denture resin impregnated with different concentrations of zirconium oxide nano-fillers.

Materials and methods: Sixty heat-cured high impact acrylic resin specimens were fabricated for each test and divided into six groups. Group 1 was the control group and Groups 2, 3, 4, 5 and 6 were reinforced with different concentrations of zirconia nanoparticles (1.5%, 3%, 5%, 7%, and 10% respectively). The dimensions of the specimens were 65 mm × 10 mm × 2.50 mm for the flexural strength and 40 mm × 8 mm × 4 mm for fracture toughness—both in accordance with British International Standard Organization (BS EN ISO 20795-1:2008) and (BS 2487:1989 ISO 1567;1988). Tests were undertaken with a universal testing machine (Zwick/Roell Z020 Leominster, UK) and a two way – ANOVA statistical test was used followed by the post-hoc Bonferroni test to analyze the results.

Results: The measurements for G3 (3% zirconia nano-filler) demonstrate that the mean value for flexural strength were significantly higher when compared to the control and other groups ($P < 0.05$). However, comparison of the mean fracture toughness values for all sample groups demonstrated no significant difference ($P > 0.05$).

Conclusion: Whilst the flexural strength of the high impact heat-cured denture base acrylic resin was enhanced by the addition of zirconium oxide nano-fillers between 3% and 5%, there was no difference in the fracture toughness between groups.

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Self-adhesive resin cements: Hygroscopic expansion-stress impact on ceramic crown integrity



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Purpose/aim: The aim was to investigate the impact of hygroscopic expansion-stress of SARCs on all-ceramic CAD/CAM crowns, when used as luting agent and as partial build-up material.

Materials and methods: 48 human molars were prepared, respective anatomical feldspar all-ceramic crowns were designed ($n = 48$, 1.5 mm circumferential, 1.5 mm occlusal, 1.0 mm marginal thickness, 50 μm cement gap, VITABLOCS Mark II, VITA Zahnfabrik) and milled (M5 Milling-Unit, Zirkon-zahn). Intaglio surfaces were HF etched (60s, Vita Ceramics Etch) and silanized (Monobond Plus, Ivoclar Vivadent). The prepared teeth with their respective crowns were randomly divided into 6 groups ($n = 8$). For groups 1, 3 and 5 50% of the coronal dentin was removed to simulate a partial build-up. Group 1 and 2 were luted using the SARC iCEM (iCEM, Heraeus Kulzer), 3 and 4 with the SARC RelyX Unicem 2 Automix (RX2, 3MESPE), 5 and 6 with the conventional resin cement Variolink Esthetic DC (VDC, Ivoclar Vivadent) according to the manufacturers' instructions and light-cured (60s, 800 mW/cm² EliparTrilight, 3MESPE). All specimens were

stored in distilled water at 37 °C until measurements. Crown integrity was visually examined at baseline, after 24 h, 96 h, 7 d, 14 d and monthly until 6 m. Virtual three-dimensional fit and marginal analysis (z, xy, xyz axes) were performed with an optical 3D scanner (ATOS Triple scan, GOM) at baseline and after 6 m. Crown integrity was statistically analyzed using Kaplan–Meier survival analysis, virtual three-dimensional fit variation and marginal analysis with two-way ANOVA and Mann–Whitney-U tests ($p=0.05$).

Results: After 6 m of storage, crack formation could be observed in all specimens of group 1, while crown integrity was only affected in one specimen in group 2 and in two specimens in group 4. Crowns in group 1 had a median survival time of 96.0 days. There was a statistically significant difference in lifetime distributions for group 1 to all other groups except group 4. Two-way ANOVA showed a statistically significant interaction between material and material volume on virtual three-dimensional fit variation for iCEM but not for RX2 and VDC. Mann–Whitney U test showed a statistically significantly higher z-value for group 1 at 6 m (0.025 mm) than for baseline (−0.0025 mm). For group 4, median marginal fit was significantly higher for z for 6 m (0.0185 mm) than for baseline (0.005 mm) and for xyz for 6 m (0.037 mm) than for baseline (0.0295 mm).

Conclusions: Within the limits of this study the combination of SARCs with high hygroscopic expansion-stress as partial build-up material under feldspar CAD/CAM crowns is not recommended for clinical use.

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In vivo low thermal degradation of monolithic zirconia restorations



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Purpose/aim: A 5-year clinical study was designed to evaluate the *in vivo* low thermal degradation (LTD) of zirconia monolithic restorations on implants and natural teeth. Additionally, general behavior of restorations and material wear were studied. This work focuses on *ex vivo* analysis of zirconia phase transformation and on the influence of glaze protection and occlusal mechanical stress on this process.

Materials and methods: 74 posterior monolithic zirconia restorations including 101 tooth elements (molars and premolars) were included. Transformed monolithic volume fraction (V_{fm}) was measured with Raman micro-spectroscopy with a collection depth of 1.44 μm and a 1 μm² resolution. Four occlusal contact areas (OCA) and two axial buccal/lingual areas per molars were investigated (2 OCA per premolars). Half of the occlusal and axial areas were covered with a layer of glaze. Each area was probed on five distinct spots and only

the highest value for V_{fm} was registered. Baseline crystalline microstructure was assessed before placement. Restorations were removed, *ex vivo* analyzed and replaced after 6 months of use and then each year for up to 5 years. The layer of glaze was examined with SEM at the same stages.

Results: 96 elements were evaluated at baseline, 6-months and 1-year follow-up. 17.8% of restorations presented a transformation at baseline (restorations which were grinded for occlusal adjustments) and 41.1% after 1 year. Critical V_{fm} > 50% was detected in 1% and 8.4% of restorations after 6 months and 1 year respectively. This value is commonly considered as a threshold beyond which material properties can be affected by the LTD process. Glaze offered no protection to LTD since it wore out of most OCA after 6 months and out of 100% of OCA after 1 year. Transformation was more often identified on axial areas than on OCA (14.5% and 7.6% respectively).

Conclusions: The original design of the protocol will provide insights on *in vivo* LTD. Indeed, this phenomenon has only been studied *in vitro* yet. The number of restorations presenting transformation increased with time. With its high sensitivity (5%) and its fine resolution, Raman micro-spectroscopy detects early transformation spots with the limitation that they need to be situated in its collection probe. Future results will improve our knowledge of the influence of occlusal stress on LTD in monolithic zirconia restorations. Particularly it should confirm if axial areas are more prone to transformation or if mechanical stress worsens LTD damages on OCA.

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174

Chlorhexidine enhances antibacterial and antifungal activities of maxillofacial silicone elastomer



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Purpose/aim: Maxillofacial prostheses in clinical service can be contaminated by oral and skin microflora, which might risk the patient's tissue, thus leading to their replacement in short periods. Also, skin around craniofacial implants retaining maxillofacial prosthesis shows a microflora of potential pathogens causing peri-abutment infection. Hence, a silicone prosthesis holding antibacterial/fungal properties seems to be the optimum task. This study aimed to investigate the effect of two different inserts (ZnO and chlorhexidine) at three difference concentrations (1, 3, and 5%) on the antibacterial and antifungal activities of maxillofacial silicone elastomer.

Materials and methods: A commonly used maxillofacial silicone elastomer (M511, Technovent, UK) was mixed with nano inserts of ZnO and chlorhexidine diacetate salt at 1, 3 and

5% concentrations (by weight). Then it was packed inside disc-shaped steel moulds (40 mm diameter and 0.5 mm height). It was cured for 1 h at 100 °C then smaller silicone discs (10 mm diameter) were produced. Ten samples per concentration were made available for a microbial test inoculum. *Staphylococcus aureus* and *Candida albicans* were obtained and used to incubate the samples. The culture suspension of *S. aureus* and *C. albicans* was utilized to calculate the neat colony forming units for each organism using serial dilution method.

Results: There was a statistically significant decrease in colony forming units of *S. aureus* and *C. albicans* when tested against 1, 3, 5% concentrations of chlorhexidine ($P < 0.05$). The maximum growth inhibition of both organisms was obtained at 5% concentration of chlorhexidine where there was zero number of colonies (100% growth inhibition) ($P < 0.05$). On the other hand, there was a heavy growth (uncountable) of *S. aureus* and *C. albicans* when tested against 1, 3, 5% concentrations of zinc oxide ($P < 0.05$).

Conclusions: Current study showed that maxillofacial silicone elastomer mixed with chlorhexidine showed better antimicrobial activity than nano zinc oxide against *C. albicans* and *S. aureus* regardless of the concentration used which can be clinically beneficial for maxillofacial silicone prostheses.

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Paffenbarger Abstracts finalists

P1

Fractal analysis at varying locations on clinically failed zirconia implants

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Purpose/aim: Previous studies have shown that the fracture toughness of ceramics can be determined from the fractal dimensions (D) of their fracture surfaces and that the surface should be leveled to obtain an accurate D measurement. This study was to determine the effects of flattening operations and distance from the failure origin on the D values.

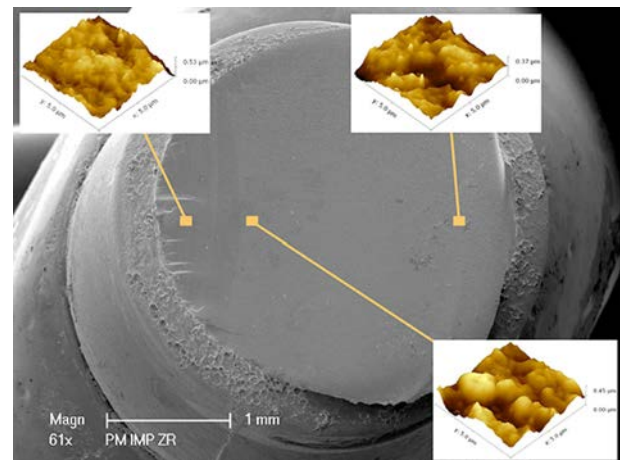
Materials and methods: Twelve clinically failed zirconia implants from four different brands: Axis Biodental ($n=7$), Z-Systems ($n=3$), Straumann ($n=1$), and SDS ($n=1$) were retrieved and thoroughly cleaned. Epoxy replicas were made of three locations along the crack path in the center region of each fracture surface (near origin (O), hackle (H), and near compression curl (CC)) using a light body polyvinyl siloxane material (Extrude, Kerr). Surfaces were scanned in ScanAsyst mode with a scan size of $5 \mu\text{m} \times 5 \mu\text{m}$ and a 0.592 Hz scan rate using the atomic force microscope (AFM, Bioscope Catalyst, Veeco). The scan surfaces were then subjected to 1st order flattening operations in the AFM analysis software to remove any tilt. The height data before and after the operation were imported into a custom MathCAD script, and

FRACTALS software (Fractal Surfaces, Russ) was used to determine the D value by Minkowski cover algorithm, which was shown previously to be the algorithm with highest precision. A Wilcoxon signed-rank test, two-way repeated measures ANOVA, and one-way repeated measures ANOVA were performed as detailed below.

Results: The data were not normally distributed (S-W $p < 0.05$), so a non-parametric repeated measures test (Wilcoxon signed-rank test) was selected. The median D values before and after flattening were 2.161 and 2.174, respectively. There was a significant difference before and after flattening operations ($p < 0.001$). The two-way repeated measures ANOVA showed no significant difference among the D values for different implant brands ($p=0.66$) and fracture surface locations ($p=0.83$). After eliminating implant brand as a factor, the data passed normality and equal variance tests (S-W $p=0.88$, BF $p=0.15$). The mean D values and standard deviations from the three locations (O, H, CC) were 2.183 ± 0.031 , 2.179 ± 0.024 , and 2.175 ± 0.018 , respectively. One-way repeated measures ANOVA showed no significant effect of location ($p=0.74$).

Conclusions: The flattening operation successfully removed the tilt without decreasing surface tortuosity, as it increased the D values significantly. The fractal dimension was the same at the three locations on the fracture surfaces. This means that hackle and compression curl regions can be used to determine fracture toughness when the failure origin has been lost.

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P2

From blue to red: New photoinitiator systems for dental materials



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Purpose/aim: Human retina is vulnerable to be damaged by light. This retinal damage is induced by a photochemical process that results from exposure of retina to short wavelengths (SW) in the visible spectra. Application of LED curing lights that are used in the dental settings has created a concern over the increased potential risk of eye damage due to their spectral emittance. The aim of this study was to develop long wavelength-emitting dental curing-lights and synthesize alternative photoinitiator systems activated under these spectra.

Materials and methods: The curing-lights developed were characterized by spectrophotometry and calorimetry. Alternative photoinitiator systems synthesized (coordination complexes) to be activated under LW were compared to the conventional photoinitiator system, camphorquinone (CQ), activated under SW. Spectral and molar absorbance of each coordination complexes synthesized were characterized by spectrophotometry. Raman spectroscopy was used to evaluate cure efficiency.

Results: LW presented 25% to 231% higher light-transmittance in depth than SW ($p < 0.001$) (Fig. 1). LW presented lower temperature rise (11.1°C to 16.4°C) than SW (41.2°C) ($p < 0.001$). A coordination complex synthesized was capable of absorbing light both into the LW and SW spectra. The molar absorbance of the coordination complex (1447) was 50 times higher than CQ (28). The coordination complex was capable of providing similar degree of conversion to CQ ($p > 0.05$).

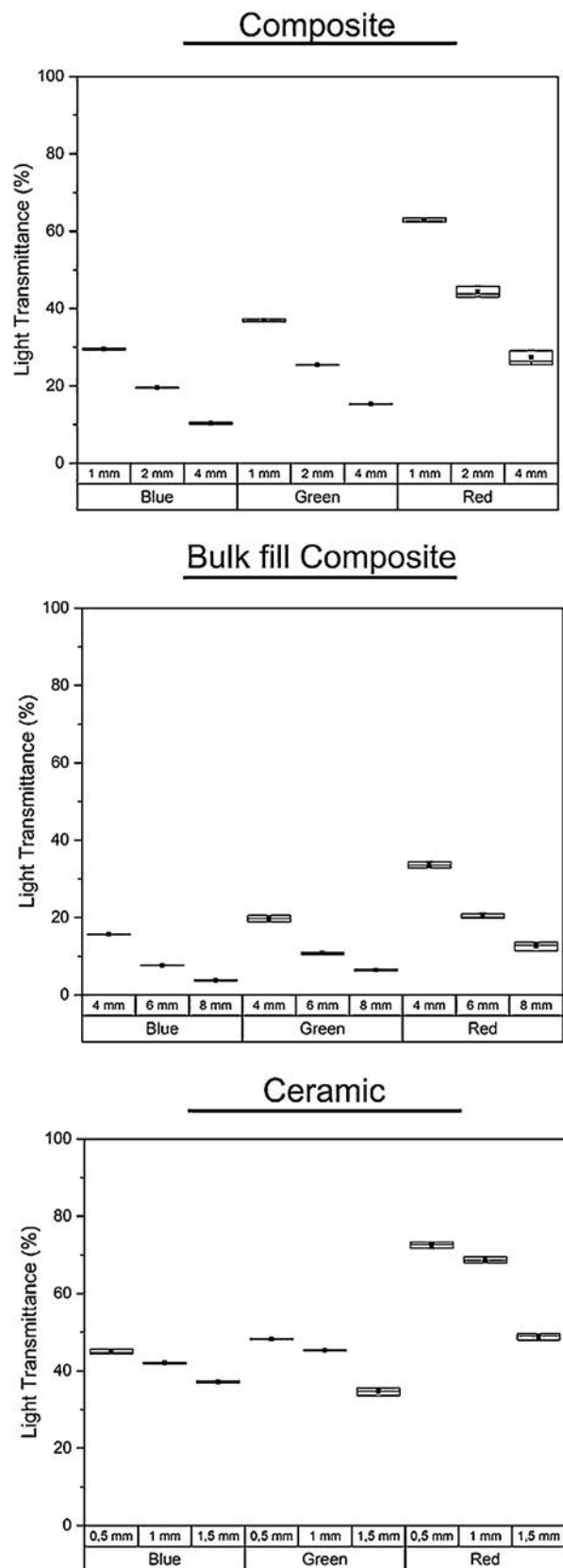


Fig. 1 – Light transmittance of SW (blue spectrum) and LW (green and red spectra) through different dental resin materials. A, regular resin-based composite; B, bulk fill composite; C, ceramic, with different thicknesses.

Conclusions: Photoinitiators activated under LW seems to be a viable less harmless alternative to substitute conventional photoinitiators activated under SW in resin materials used in Restorative Dentistry with other possible benefits as higher depth of cure and less heating.

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P3

Development and evaluation of new intracanal formulation of silver nanoparticles



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Purpose/aim: The objective of this study was standardize the synthesis of silver nanoparticles (AgNPs), based on green chemistry, to characterize and verify the potential antimicrobial, the cytotoxicity and the potential for staining of AgNPs, and, subsequently, develop a formulation for use intracanal for disinfection of root canals.

Materials and methods: The synthesis of AgNPs was performed by means of redox reaction between maltose and silver nitrate. For the standardization of synthesis, it was done the study of variation of reagent concentrations, temperature and reaction time. The resulting nanoparticles were characterized using the Tyndalls effect, the atomic absorption spectrometry and the spreading of dynamic light. The antimicrobial activity of the solutions of AgNPs was verify against the *E. coli*, *E. faecalis*, *P. aeruginosa*, *S. aureus* and *S. mutans* and were later verified the inhibitory concentration and minimum bactericidal for each strain bacterial wilt. It was performed the evaluation of cytotoxicity in culture of osteoblastic lineage by tests of MTT and activity of alkaline phosphatase. Sequentially, examined the potential of staining of the AgNPs that showed better results in previous tests by means of values of brightness in periods of 0, 7 and 30 days of exposure to the solution of AgNPs. Finally, the study was conducted of three possible vehicles for the incorporation of the solution of nanoparticles of silver: Natrosol, Carbopol and Carbowax.

Results: The results showed that concentrations of 0.031 mol/L and 0.062 mol/L of silver nitrate and maltose, respectively, the time interval of three hours of stirring at a temperature of 85 °C favored to obtain AgNPs. The tests antimicrobials demonstrated that AgNPs have antimicrobial action for all bacteria tested. In the evaluation of cytotoxicity, it appeared like statistically significant difference between the AgNPs and control used, for which it was observed higher cell viability in the time interval of 72 h when compared with Ca(OH)₂ and the chlorhexidine. The incorporation of the solution of nanoparticles in vehicles has resulted in stable formulations, however the use of natrosol propitiated the formulation more homogeneous when compared to other vehicles.

Conclusions: It was possible to conclude that the reaction using the green synthesis, having maltose as a reducing agent

in the selected conditions was adequate for obtaining silver nanoparticles, which showed antimicrobial action besides not presenting cytotoxicity and not staining the dental substrate. It was also concluded that the incorporation of the solution of AgNPs in natrosol may favor its implementation intracanal.

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P4

Effect of niobium containing bioactive glasses in pre-osteoblastic cell behavior



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Purpose/aim: The aim of this study was to evaluate the effect of Niobium containing bioactive glasses powders and scaffolds in proliferation and differentiation of pre-osteoblastic cells in vitro.

Materials and methods: Glasses powders were produced by sol-gel route with addition of Nb as mineral modifier. Glass scaffolds were also produced with Nb addition by sol-gel foaming. Powder and scaffolds without Nb were produced as well. The effect of glasses in proliferation and mineralization of pre-osteoblastic cells MC3T3-E1 was investigated. Cells were cultivated in α -mem with 10% FBS and 100 U/ml penicillin. Glass conditioned medium were produced by immersing glass powder (2.5 mg and 5 mg) and scaffolds (2 mm diameter \times 3 mm height) in 1 ml α -mem for 24 h. Aliquots of 100 μ l of glass conditioned medium was used to test cell viability with sulphoronamideB (SRB) ($n=5$) in 96-weel plates cultivated with 2×10^3 cells during 72 h. The number of cells was normalized for cell in α -mem without glass conditioned medium. Cell differentiation was evaluated through mineralization assay using Alizarin S Red ($n=5$) with 500 μ l of glass conditioned medium in contact with 104 cells in 24-weel plates. Glass conditioned medium was produced with 5 mg powders and scaffolds (2 mm diameter \times 3 mm height) and was changed every 3 days during 7 and 14 days of analysis. After cell culture Alizarin S Red was used to identification of mineralized granules in optic microscope. The number of mineralized nodules was quantified in an image software (ImageJ). Results were analyzed with Two Way ANOVA at 5% level of significance.

Results: Niobium addition to sol-gel derived bioactive glasses resulted in reduction in percentage of viable cells ($p < 0.05$). When cells were in contact with 5 mg of powders a increasing in cell number ($p < 0.05$) after 72 h analysis was observed with no statistical difference between glasses with Nb (121.94%) and without Nb (123.51%). Mineralized granules were observed in 7 and 14 days for powders and scaffolds in both compositions which can be related to mineralized matrix production and differentiation of pre-osteoblastic cells.

Conclusions: These results showed potential bioactivity of Nb-containing bioactive glasses powders and scaffolds for bone tissue engineering.

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P5

Characterization and bioactivity of a novel paste containing nanoscale medications



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Purpose/aim: The aim of this study was to characterize and assess the bioactivity of a novel intracanal dressing 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 paste was characterized regarding the flow, film thickness and radiopacity according to ISO 6876:2012. For bioactivity assays in mouse fibroblast cells (3T3-L1) and human osteoblast-like cells (Saos-2), the evaluated groups were: the experimental paste (EX), a calcium hydroxide-based paste (UC) and an iodoformium-based paste (GP). The pastes were manipulated and placed in the wells of 12-well plates, culture medium was added after mixing and after 24 h of setting, to create two types of extracts: fresh and after setting. Cells were plated at 1×10^4 cells/well ($n=3$) and exposed to culture medium containing extracts of the tested materials at different concentrations (24 h), for MTT and SRB assays (extract concentration of 10, 5 and 1%); and for 7 and 14 days for alkaline phosphatase enzyme activity (ALP) and Alizarin Red S assays (10% extract concentration). For the cell proliferation assay cells were plated at a concentration of 2×10^5 cells/well ($n=6$) and photos were taken every 6 h until complete wound healing (10% extract concentration). Data were analyzed using GraphPad Prism[®] 7.0, with Kruskal-Wallis and Dunn's post hoc test ($\alpha=0.05$).

Results: Flow ranged from 20.85 ± 0.14 mm to 16.68 ± 0.72 mm, mean film thickness was lower than $50 \mu\text{m}$ and radiopacity equivalent of 1.81 mm Al. It was possible to observe a dose-dependent effect on the inhibition of viability compared to the dilution of the materials. The more diluted the extract less cytotoxic it was in most cases. The highest concentration of EX and GP paste caused the greatest cytotoxic effect, 8.13% and 12.39% respectively, after setting on Saos-2 cells at MTT assay ($P < 0.05$), while these materials for SRB and 3T3 cells presented good values regarding viability, 187.03% and 90.46% respectively. ALP and mineralized nodules formation demonstrated a gradual increase in function of time, which were higher for UC in both cell lines ($P < 0.05$). The cell proliferation showed a continuous closure of the wound during the evaluated period.

Conclusions: In conclusion, materials showed a dose-dependent effect and EX could be a promising material for

periapical region with cytocompatibility and bioactivity properties.

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P6

Modification of filler-matrix interphase of restorative composites using reactive nanogels



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Purpose/aim: Nanogel additives in the resin matrix of dental composites can reduce volumetric shrinkage and polymerization stress. The purpose of this study is to modify filler surface treatment by nanogel addition, in order to create a well-controlled interphase between filler and resin matrix that is able to modulate the stress development during polymerization.

Materials and methods: Nanogels with different molecular weight (Mw) and glass transition temperatures (Tg) were synthesized from mono-functional monomers (isobornyl methacrylate or butyl methacrylate) and di-functional crosslinker (urethane dimethacrylate) (70:30 mol%) using different concentrations of mercaptoethanol (5–15 mol%) as chain transfer agent and pentaerythritol tetrakis (10 mol%) to introduce thiol functionalization. Nanogels were characterized by gel permeation chromatography and dynamic mechanical analysis. Glass fillers (1.0 micron) were treated with vinyltrimethoxy-silane and reacted with the ~ 10 nm nanogel prepolymer particles via free-radical polymerization. Surface treatment was assessed by diffuse reflectance spectroscopy (DFTIR) and thermogravimetric analysis (TGA). Fillers treated with conventional methacryloxypropyltrimethoxy-silane were used as control. Composites (60 wt% fillers) were formulated with a photoreactive BisGMA/TEGDMA (70:30 wt%) resin using nanogel-functionalized fillers and/or a similar reactive nanogel additive freely dispersed in the resin phase (15 wt%). Polymerization kinetics, rheological properties, volumetric shrinkage, polymerization stress and mechanical properties were evaluated.

Results: Three different nanogels with varied combinations of Mw and Tg were prepared and characterized: Ng 1 (17.8 kg/mol; 49 °C), Ng 2 (182.3 kg/mol; 65 °C) and Ng 3 (19.3 kg/mol; 28 °C). The amount of nanogel deposited on the filler surface was also varied to assess the effect of nanogel surface loading estimated as 3 ± 1 wt% by TGA and verified by DFTIR assessing presence of methacrylate carbonyl peak (1706 cm^{-1}) and multiple aliphatic peaks ($2856\text{--}2962 \text{ cm}^{-1}$). Material viscosity is affected the most when higher Mw and Tg nanogel is used. All nanogels were able to significantly reduce volumetric shrinkage and shrinkage stress of composites, while degree of conversion and mechanical properties were kept similar to control. Nanogel functionalized fillers or free nanogel additives in the resin reduced shrinkage stress in

25 ± 5% magnitude, and when both strategies were combined stress reduction was up to 40%.

Conclusions: An interphase between filler and matrix created with minimum amounts of nanogel is able to significantly reduce shrinkage stress without compromising elastic modulus. This approach can be combined with free nanogel additives in the resin phase to lower volumetric shrinkage, and reduce overall polymerization stress of restorative composites.

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P7

The limits of luting-composite photopolymerization through indirect restorative materials



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Purpose/aim: Using light-curable luting-composites to bond indirect restorations has several advantages. However, increased thickness of indirect material may result in a major decrease in light transmittance, potentially impeding luting-composite polymerization. The objective of this study was to determine the limits of such strategy by measuring light transmittance through various thicknesses of indirect restorative materials and the resulting degree of conversion (DC) of the luting-composites placed underneath.

Materials and methods: Various 10 mm-diameter disks were produced by CAD/CAM in LAVA Zirkonium and LAVA Ultimate (3M-ESPE) (shades A3 or Uncoloured and A3 or MC2, respectively). Each substrate was prepared in 4 different thicknesses (0.5, 1, 2 and 4 mm) and used as filters through which luting-composites were light-cured. Rely X Veneer (3M-ESPE) was used as control, and compared to four experimental luting-composites: two proportions of conventional monomers TEGDMA/BisGMA (50/50 and 30/70 wt%), either with camphorquinone/amine (0.2/0.8 wt%) or Lucirin-TPO (0.42 wt%) as photoinitiator. Barium glass microfillers and fumed silica nanofillers were added (55/10 wt%, respectively). The luting composites were placed in 1mm-thick Teflon molds, covered with a polyester film and a filter, and light-cured during 40s. Light sources were either the dual-peak BluephaseG2 (Ivoclar-Vivadent) or an experimental light-curing device emitting either in the blue or in the near-UV. Samples were analyzed by Raman spectroscopy to determine DC on the upper luting-composite surface ($n=3$). Light transmittance through various filters was measured by Ocean Optics Spectrometer ($n=3$).

Results: Resin type, filter shade and thickness, monomer and photoinitiator contents all influenced significantly DC. Irrespective of filter thickness, luting-composites with higher

TEGDMA content yielded higher DC. Using filters ≤ 1 mm, few differences were observed compared to uncovered luting-composites. On the contrary, for thicknesses ≥ 2 mm, significant DC drops were observed, depending on the filter specific absorption of light revealed by transmittance values. Transmittance values revealed higher filter absorption at 400 nm than at 470 nm, and minimal transmittance thresholds to maintain optimal DC after 40s irradiation could be identified for each luting-composite formulation.

Conclusions: The present work confirms pure light-curing of luting-composites through indirect restorative materials cannot be accepted as general rule. However, it also highlights the potential of achieving optimal photopolymerization through indirect restorations up to 4 mm thickness in specific conditions. The determination of such conditions is key to clinical success, and all the factors studied here (monomer composition, photoinitiator content, filter material and thickness) as well as others (prolonged curing time) need to be optimized.

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P8

Regenerative potential of simvastatin-loaded nano-fibrous scaffolds with LPS-stimulated pulp cells



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Purpose/aim: The aim of this study was to investigate the bioactive, anti-inflammatory and pro-angiogenic potential of nano-fibrous poly(L-lactic acid) (NF-PLLA) scaffolds associated with simvastatin (SIM) on dental pulp stem cells (DPSCs) under degenerative inflammatory stimulus.

Materials and methods: Designed NF-PLLA scaffolds with interconnected pore network and nano-fibrous topography surface were fabricated (Fig. 1). Human DPSCs were seeded onto scaffolds loaded or not with 0.1 μ M SIM, and the constructs were cultivated in contact or not with 10 μ g/mL LPS for 7 days, to induce a degenerative inflammatory stimulus

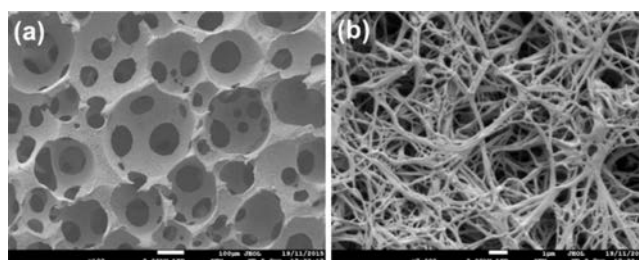


Fig. 1 – (a) Designed interconnected porous architecture of NF-PLLA scaffold, obtained by sugar sphere porogen. (b) Pore wall architecture, demonstrating the nano-fibrous surface simulating type I collagen features, obtained by phase-separation technique.

in vitro. Cell proliferation, adhesion and spread on scaffolds structure were evaluated, as well as the expression of pro-inflammatory mediators (TNF- α , IL-1 β and MMP-9) and odontoblastic markers (ALP, DSPP/DSP, DMP-1, BMP-2 and calcium) after several time-points. Western blot was performed to verify the signalling pathways. The pro-angiogenic potential of NF-PLLA/SIM was evaluated after 24 hours of in vitro co-culture with endothelial cells (tube-like assay and VEGF expression). The combined effects of SIM and NF-PLLA scaffolds was also assessed in vivo, after subcutaneous implantation in nude mice, and the deposition of mineralized collagenous matrix, odontoblastic phenotype expression and angiogenesis from surround tissue were evaluated (t-student = 5%).

Results: The in vitro studies demonstrated that, compared with the constructs in contact with LPS, in the presence of SIM the expression of the pro-inflammatory mediators was significantly minimized. SIM-loaded NF-PLLA scaffolds also reverted the negative effects of LPS on odontoblastic markers expression, with cells featuring intensely stained actin fibrils. Western blot analysis demonstrated that these effects

were related with reduction on phosphorylation of NF κ Bp65 and up-regulation of PPAR γ expression, as well as to increased phosphorylation of ERK1/2 and Smad1, mediated by SIM on LPS-stimulated DPSCs. The DPSC/NF-PLLA/SIM constructs also lead to increased vessel-like structures formation by co-cultured endothelial cells, which was related with VEGF expression on both DPSCs and endothelial cells. After transplantation of the DPSC/NF-PLLA constructs on subcutaneous tissue in nude mice, it was also observed increased deposition of calcium/collagen-rich matrix and DSP positive cells on SIM-loaded LPS-treated samples, as well as increased amount of blood vessels inside material structure, in comparison to DPSC/NF-PLLA LPS-treated group.

Conclusions: The association of low-dosage SIM and NF-PLLA scaffolds seems to be a promising strategy for dentin regeneration dental pulp tissue under inflammation, by minimizing inflammatory reaction and increasing the regeneration potential of resident stem cells.

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General information:

The Academy of Dental Materials is a body composed of individuals interested in the science of dental materials. The Academy of Dental Materials exists solely for the purpose of advancing the science and technology of dental biomaterials. This is accomplished by sponsoring annual scientific meetings, conferences, an international journal, transactions of scientific proceedings, awards for students, awards for outstanding scientists, and the confirmation of Fellowship for special members.

Membership information and instructions:

Membership dues are kept at a minimal level to encourage membership (US\$ 175 regular, US\$ 40 student, US\$ 175 fellow, and US\$ 2000 corporate). These rates include a hardcopy and online subscription to the *Dental Materials* journal except for student members who will receive online only access to the journal. Regular members and fellows can choose to receive an online only copy of the journal for \$26 discount. Academy members receive a discounted registration fee for the annual ADM meeting. ADM meetings are conducted using a style that promotes interaction among participants. The opportunity for student and faculty presentations is afforded through poster presentations during meeting days. For membership application forms, meeting information, and general instructions, please contact: Ricardo M. Carvalho, DDS, PhD, FADM, Professor, Department of Oral Biological and Medical Sciences, UBC Faculty of Dentistry, 2199 Wesbrook Mall, JBM 368, Vancouver, BC V6T 1Z3, Canada, Phone: +1-604-827-0566, E-mail: rickmc@dentistry.ubc.ca

Corporate membership information:

As a Corporate Member, the company will be recognized in the *Dental Materials* journal (circulation approximately 1,800). The corporation name and logo will appear on a special page (in each issue of the journal) acknowledging the Corporate Members. In addition, a complimentary subscription to *Dental Materials* will be sent to the corporate contact during the year of membership. Meeting sponsorship is independent of corporate membership. The Corporate Member fee is US\$ 2000 per year. For corporate membership information, please contact: Deanna Hilton, Executive Manager, E-mail: admin@academydentalmaterials.org, 21 Grouse Terrace, Lake Oswego, or 97035-1013, Phone: (503) 636-0861, Fax: (503) 675-2738

Fellowship and Student Award information:

Academy members in good standing may apply for Fellowship in the Academy. Applications must include a current c.v. and two letters of recommendation from current Fellows of the Academy. The criteria to apply for Fellowship are (1) achievement of advanced degrees: at least a master's degree and preferably a Ph.D., Odont Dr., or equivalent degree; (2) publication of at least ten peer-reviewed, scientific articles in refereed journals of which the candidate should be first author on one-half of the articles; (3) at least five years of leadership through research, training, service, and/or education beyond formal education; and (4) normally at least five years membership in the Academy.

Students pursuing graduate studies in dental materials or biomaterials sciences and dental students who have conducted research in dental materials or biomaterials sciences are encouraged to compete in the Paffenbarger Award competition at the annual meeting of the Academy. The winner of the award competition receives a prize of US\$ 1,750, the second-place winner receives US\$ 1,250, and the third-place winner receives US\$ 1,000. All 3 students also receive free registration for the next ADM Meeting. In addition to the Paffenbarger Award, the Academy presents an annual award at each dental school to the student who has demonstrated outstanding academic achievement in dental materials science. For information regarding the Paffenbarger Award competition, please contact: Paulo Francisco Cesar, E-mail: paulofc@usp.br, Depto. de Biomateriais e Biologia Oral, Faculdade de Odontologia da USP, Av. Prof. Lineu Prestes, 2227, Cidade Universitária - São Paulo - SP05508-000, Phone: +5511995003766. For information regarding Fellowship in the Academy and annual dental student awards, please contact: Ulrich Lohbauer, Universitätsklinikum Erlangen, Zahnklinik 1 - Zahnerhaltung und Parodontologie, Forschungslabor für dentale Biomaterialien, Glückstraße 11, 91054 Erlangen, Germany, Tel.: +49 9131 8543740, Fax.: +49 9131 8534207, E-mail: ulrich.lohbauer@fau.de

Founder's Award information:

The ADM has initiated an award to honor Dr. Evan Greener in recognition of his contributions to the Academy. The Founder's Award will be given to an ADM Member who is nominated by one or more fellow ADM Members as exhibiting excellence in dental materials research and in service to the Academy. Nominations should document the contributions of the individual and should be sent to the President of the Academy: Paulo Francisco Cesar, E-mail: paulofc@usp.br, Depto. de Biomateriais e Biologia Oral, Faculdade de Odontologia da USP, Av. Prof. Lineu Prestes, 2227, Cidade Universitária - São Paulo - SP05508-000, Phone: +5511995003766. The nominations will be reviewed by the Board of Directors for acceptance. This is an honorary award, not a cash award, but up to US\$ 1000 will be provided to the awardee for expenses in attending the annual Academy meeting to receive the award in person.



ACADEMY OF DENTAL MATERIALS

<http://www.academydentalmaterials.org>

MEMBERSHIP APPLICATION

FIRST NAME: _____ LAST NAME: _____

ADDRESS1: _____

ADDRESS1: _____

CITY: _____ STATE: _____

COUNTRY: _____ ZIP: _____

AFFILIATION: _____

DEPARTMENT: _____

SPECIALIST REGISTRATION: _____

PHONE#: _____ FAX #: _____

E-MAIL: _____

MEMBERSHIP: All memberships are on a calendar year ending December and include On-Line access to Dental Materials Journal.

- FIRST YEAR NEW MEMBER US\$74/year (Select this option if this is your first time applying for ADM Membership)
- REGULAR MEMBER US\$149/year (Select this option if you have previously been a member of the ADM or you are an inactive member reactivating your membership.)
- STUDENT US\$40 (Select this option if you are currently enrolled as a student in an accredited education program)

Please send a confirmation letter of your student status from either a sponsoring member or your learning institutions and provide the following:

Program Director/Advisor: _____ Phone Number or Email: _____

Projected Graduation Date: ____/____(Month/Year)

- CORPORATE MEMBER US\$2000/year (Special membership for business corporations includes name and logo publication in each issue of Dental Materials journal and complimentary hardcopy subscription)

JOURNAL SUBSCRIPTIONS:

- ON LINE ONLY \$0 Included in your membership application
- HARDCOPY \$26 Journals sent to your mailing address

PAYMENT: Please check one of the following:

Check Visa Master Card American Express Discover **TOTAL: US\$** _____

Account or Card No.: _____ 3-digit security code: _____

Expiration date: _____ Cardholder's Name: _____

Signature: _____

SIGNATURE OF THE APPLICANT: _____ **DATE:** _____

SEND FORM AND PAYMENT TO:

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 Lake Oswego, OR 97035-1013
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