INTRODUCTION

The objective of this section is to summarize a few topics that were published and discussed on the indexed journals, approaching themes that are clinically relevant. The subject chosen for this edition are bulk-fill composite resins. This kind of composite allows greater light curing depth than the conventional ones, which enables filling cavities with increments of 4-5mm, unlike the traditional 2mm, commonly recommended on the increment techniques. This change of concept demands a series of studies for evidences that support its clinical capabilities. These studies must approach technical concepts and discuss methodologies to assess physical and mechanical properties of the composites, which will impact on the practical activities in regular dental clinics. In the upcoming pages, we will review some studies that evaluated properties of the bulk-fill composites, such as its degree of conversion, shrinkage stress, influence of cavity depth for light curing and marginal adaptation, alongside clinical observation studies that followed the longevity of this material as well as the sculpture techniques for this new restoration concept.

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The first article evaluated the mechanical properties of bulk-fill resins, comparing them with conventional ones, evaluating the shrinkage stress, cuspal strain and fracture resistance of molars restored (paper published in the Journal of Dentistry, 2015).

MECHANICAL PROPERTIES, SHRINKAGE STRESS, CUSPAL STRAIN AND FRACTURE RESISTANCE OF MOLARS RESTORED WITH BULK-FILL COMPOSITES AND INCREMENTAL FILLING TECHNIQUE

Rosatto CM, Bicalho AA, Veríssimo C, Bragança GF, Rodrigues MP, Tantbirojn D, Versluis A, Soares CJ.

J Dent. 2015 Dec;43(12):1519-28.
doi: 10.1016/j.jdent.2015.09.007. Epub 2015 Oct 9.

OBJECTIVES: To compare bulk-fill with incremental filling techniques for restoring large mesio-occlusal-distal (MOD) restorations.

METHODS: Seventy-five molars with MOD preparations were divided into five groups: Z350XT, incrementally filled with Filtek Z350XT and four bulk-fills-FBF/Z350XT, Filtek Bulk Fill/Filtek Z350XT; VBF/CHA,

Venus Bulk Fill/Charisma Diamond; SDR/EST-X, SDR/Esthet-X HD; TEC, TetricEvoCeram Bulk Fill. Cuspal strains were measured using strain-gauges (n=10): CSt-Re, during restorative procedure; CSt-100N, during 100N occlusal loading; CSt-Fr, at fracture load. Before fracture load, teeth were load-cycled. Fracture resistance, fracture mode, and enamel cracks were recorded. The other five teeth were used for Elastic modulus (E) and Vickers hardness (VH). Post-gel shrinkage (Shr), diametral tensile strength (DTS) and compressive strength (CS) were determined (n=10). Shrinkage stresses were analyzed using finite element analysis.

RESULTS: SDR had similar CS values as TEC, lower than all other composites. CHA had similar DTS values as Z350XT, higher than all other composites. Z350XT had the highest mean Shr and SDR the lowest Shr. New enamel cracks and propagation was observed after the restoration, regardless of filling technique. Z350XT had lower fracture resistance than bulk-fill composite techniques. No significant differences in failure modes were found. E and VH were constant through the depth for all techniques. Bulk-filling techniques had lower stresses compared to Z350XT.

CONCLUSIONS: Flowable bulk-fill composites had lower mechanical properties than paste bulk-fill and conventional composites. All bulk-fill composites had lower post-gel shrinkage than conventional composite. Bulk-fill filling techniques resulted in lower cusp strain, shrinkage stress and higher fracture resistance.

COMMENTARY: This study shows positive evidences for bulk-fill composites use on extensive cavities in filling posterior teeth. Low contraction composites seems to cause less cusp deformations, which consequentially leads to lower tensions on the adhesive interface. The authors also concluded that this kind of composite shows greater fracture resistance when compared to a regular composite resin. These results lead to a conclusion where there may exist a positive trend to use bulk-fill on extensive cavities, which may decrease some undesired effects of conventional composites.

The second article evaluated monomer conversion, microhardness, internal marginal adaptation, and shrinkage stress of bulk-fill resin composite (article published in Dental Materials, 2015).

MONOMER CONVERSION, MICROHARDNESS, INTERNAL MARGINAL ADAPTATION, AND SHRINKAGE STRESS OF BULK-FILL RESIN COMPOSITES

Fronza BM, Rueggeberg FA, Braga RR, Mogilevych B, Soares LE, Martin AA, Ambrosano G, Giannini M.

Dent Mater. 2015 Dec;31(12):1542-51.

doi: 10.1016/j.dental.2015.10.001. Epub 2015 Nov 20.

OBJECTIVE: To evaluate degree of conversion (DC), Knoop microhardness (KHN), internal marginal adaptation (IA), and polymerization shrinkage stress (PS) of one conventional and four bulk-fill composites.

METHODS: Bulk-fill composites tested were Surefil SDR (SDR), Filtek Bulk-Fill (FBF), Tetric EvoCeram Bulk-Fill (TEC), and EverX Posterior (EXP). The conventional composite Herculite Classic (HER) was tested using both incremental and bulk-fill insertion techniques. Standardized Class I preparations (4-mm-depth) were made in extracted molars and restored with each product system (N=5). After 1-week wet storage, restorations were cross-sectioned and DC and KHN were evaluated at four depths (1, 2, 3, and 4mm) using confocal Raman spectroscopy and KHN techniques, respectively. Epoxy resin replicas of restorations were evaluated using scanning electron microscopy for IA. PS was determined using composite bonded to acrylic rods attached to a universal testing machine (N=5).

RESULTS: Within bulk-fill products, only SDR and FBF demonstrated similar DC at all depths, and KHN values did not statistically differ among depths, except for TEC. Neither placement method nor depth affected KHN or DC, except the DC of HER bulk-fill at 4mm. Incrementally layered HER, and bulk-fills SDR and TEC demonstrated the lowest proportion of internal gaps. Highest and lowest PS values were measured for EXP and TEC, respectively.

CONCLUSIONS: DC with depth was not uniform among all bulk-fill materials, although no difference in KHN was found. Higher PS correlated positively with higher proportion of interfacial gaps. The incremental technique using conventional composite showed reduced gap formation.

COMMENTARY: On the other hand, this study shows a slight inferiority of bulk-fill over conventional composites on some properties, mainly conversion ratio, marginal adaptation and lower shrinkage stress. This calls for more in depth investigations, as well as analysis of other methodologies. *In vitro* studies are conducted on favorable and ideal conditions, which are not always reproducible on day-to-day clinical routine. The large variability of cavity configurations must also be taken in account, which may have some influence on the polymerisation of a regular composite. This way, the simplified version of the restorative techniques may be considered and employed with bulk-fill composites, in order to minimize technical errors which could affect the restoration effectiveness.

The third article evaluated the influence of depth on the polymerization, correlating it with the formation of cracks in bulk-fill resins (article published in Operative Dentistry, 2015).

BULK-FILL RESIN COMPOSITES: POLYMERIZATION CONTRACTION, DEPTH OF CURE, AND GAP FORMATION

Benetti AR, Havndrup-Pedersen C, Honoré D, Pedersen MK, Pallesen U.

Oper Dent. 2015 Mar-Apr;40(2):190-200.

doi: 10.2341/13-324-L. Epub 2014 Sep 11.

The bulk-filling of deep, wide dental cavities is faster and easier than traditional incremental restoration. However, the extent of cure at the bottom of the restoration should be carefully examined in combination with the polymerization contraction and gap formation that occur during the restorative procedure. The aim of this study, therefore, was to compare the depth of cure, polymerization contraction, and gap formation in bulk-fill resin composites with those of a conventional resin composite. To achieve this, the depth of cure was assessed in accordance with the International Organization for Standardization 4049 standard, and the polymerization contraction was determined using the bonded-disc method. The gap formation was measured at the dentin margin of Class II cavities. Five bulk-fill resin composites were investigated: two high-viscosity (Tetric EvoCeram Bulk Fill, SonicFill) and three low-viscosity (x-tra base, Venus Bulk Fill, SDR)

materials. Compared with the conventional resin composite, the high-viscosity bulk-fill materials exhibited only a small increase (but significant for Tetric Evo Ceram Bulk Fill) in depth of cure and polymerization contraction, whereas the low-viscosity bulk-fill materials produced a significantly larger depth of cure and polymerization contraction. Although most of the bulk-fill materials exhibited a gap formation similar to that of the conventional resin composite, two of the low-viscosity bulk-fill resin composites, x-tra base and Venus Bulk Fill, produced larger gaps.

COMMENTARY: This study focus on the importance of the polymerization of composites. According to the employed methodology, the results showed that the extension of the polymerization on the lower part of the restoration must be carefully evaluated in tandem with shrinkage stress. These factors may lead to fissures on restorative procedures, leading to clinical failure.

The fourth article evaluated the physico-mechanical characteristics of bulk-fill composites (article published in the Journal of Dentistry, 2014).

PHYSICO-MECHANICAL CHARACTERISTICS OF COMMERCIALLY AVAILABLE BULK-FILL COMPOSITES

Leprince JG, Palin WM, Vanacker J, Sabbagh J, Devaux J, Leloup G.

J Dent. 2014 Aug;42(8):993-1000.

doi: 10.1016/j.jdent.2014.05.009. Epub 2014 May 27.

OBJECTIVE: Bulk-fill composites have emerged, arguably, as a new "class" of resin-based composites, which are claimed to enable restoration in thick layers, up to 4mm. The objective of this work was to compare, under optimal curing conditions, the physico-mechanical properties of most currently available bulk-fill composites to those of two conventional composite materials chosen as references, one highly filled and one *flow*able "nano-hybrid" composite.

METHODS: Tetric EvoCeram Bulk Fill (Ivoclar-Vivadent), Venus Bulk Fill (Heraeus-Kulzer), SDR (Dentsply), X-tra Fil (VOCO), X-tra Base (VOCO), Sonic Fill (Kerr), Filtek Bulk Fill (3M-Espe), Xenius (GC) were compared to the two reference materials. The materials were light-cured for 40s in a 2mm×2mm×25mm Teflon mould. Degree of conversion was measured by Raman spectroscopy, Elastic modulus and flexural strength were evaluated by three point bending, surface hardness using Vickers microindentation before and after 24h ethanol storage, and filler weight content by thermogravimetric analysis. The ratio of surface hardness before and after ethanol storage was considered as an evaluation of polymer softening. Data were analyzed by one-way ANOVA and post hoc Tukey's test (p=0.05).

RESULTS: The mechanical properties of the bulk-fill composites were mostly lower compared with the conventional high viscosity material, and, at best, comparable to the conventional *flow*able composite. Linear correlations of the mechanical properties investigated were poor with degree of conversion ($0.09 < R < 0.41$) and good with filler content ($R > 0.8$). Softening in ethanol revealed differences in polymer network density between material types.

CONCLUSION: The reduction of time and improvement of convenience associated with bulk-fill materials is a clear advantage of this particular material class. However, a compromise with mechanical properties compared with more conventional commercially-available nano-hybrid materials was demonstrated by the present work.

COMMENTARY: A few studies have showed inferior mechanical properties on the majority of *flow* type of bulk-fill composites. It's possible to assume that its use for restorations under high occlusal loads is somewhat risky. Therefore, it's safe to use this kind of composite for filling the majority of the cavity, using another more conventional composite for covering the occlusal part, in order to improve aesthetics (due to the translucency of bulk-fill) and to reduce degradation effects of daily occlusal loads.

The fifth article discusses the bond strength of bulk-fill resins in Class II cavities in dentin tissue (article published in the Journal of Adhesive Dentistry, 2015).

BOND STRENGTH OF A FLOWABLE BULK-FILL RESIN COMPOSITE IN CLASS II MOD CAVITIES

Kumagai RY, Zeidan LC, Rodrigues JA, Reis AF, Roulet JF

J Adhes Dent. 2015 Aug;17(5):427-32.

doi: 10.3290/j.jad.a35012.

OBJECTIVE: To evaluate the microtensile bond strength (μTBS) of a bulk-fill low-stress resin-based composite to dentin from gingival walls of Class II MOD cavities.

MATERIALS AND METHODS: Class II MOD cavities were prepared in 44 human molars with the distal and mesial proximal boxes 4 and 6 mm deep, respectively. Eight experimental groups (n = 11) were obtained by a factorial design including 1. "composite" in two levels: a bulk-fill low-stress composite (SureFil SDR Flow, Dentsply Caulk) and a conventional composite (Filtek Z350 XT, 3M ESPE); 2. "filling technique" in two levels: bulk-fill (Bf) and incremental (In); and 3. "depth" in two levels: 4 mm and 6 mm in order to create different polymerization conditions. Twenty-four hours after placement of restorations, teeth were sectioned into beams with a cross-sectional bonded area of approximately 1 mm2. Bonded beams obtained from the gingival walls of the proximal boxes were tested in tension at a crosshead speed of 1 mm/min.

Data were submitted to a 3-way ANOVA followed by a post-hoc Tukey's test ($p < 0.05$).

RESULTS: ANOVA failed to identify significant differences for the triple and double interaction between factors. However, significant differences were observed for the factors "composite" and "filling technique" ($p < 0.05$). SDR presented significantly higher μTBS values for bulk and incremental filling techniques ($p < 0.05$), and the incremental filling technique presented significantly higher μTBS values for both composites ($p < 0.05$).

CONCLUSION: It can be concluded that the bulk-fill *flow*able composite SDR may improve the bond strength to the gingival walls of Class II MOD cavities.

COMMENTARY: This study design favors correlations between a few clinical situations, such as Class II cavities, in which, on the proximal areas, gingival margins are somewhat deeper, making it harder for adaptation and curing. It may be assumed that in these cases, bulk-fill composites may significantly improve bonding resistance to dentin, in an area that is considered more sensible for adhesion.

The sixth article is a clinical study that evaluated the performance of class I and II posterior resin restorations placed with a bulk-fill resin composite (article published in the Journal of Adhesive Dentistry, 2015).

RANDOMIZED 3-YEAR CLINICAL EVALUATION OF CLASS I AND II POSTERIOR RESIN RESTORATIONS PLACED WITH A BULK-FILL RESIN COMPOSITE AND A ONE-STEP SELF-ETCHING ADHESIVE

van Dijken JW, Pallesen U.

J Adhes Dent. 2015 Feb;17(1):81-8.

doi: 10.3290/j.jad.a33502.

OBJECTIVE: To evaluate the 3-year clinical durability of the *flow*able bulk-fill resin composite SDR in Class I and Class II restorations.

MATERIALS AND METHODS: Thirty-eight pairs of Class I and 62 pairs of Class II restorations were placed in 44 male and 42 female patients (mean age 52.4 years). Each patient received at least two extended Class I or Class II restorations that were as similar as possible. In all cavities, a one-step self-etching adhesive (XenoV+) was applied. One of the cavities of each pair was randomly assigned to receive the *flow*able bulk-fill resin composite SDR in increments up to 4 mm as needed to fill the cavity 2 mm short of the occlusal cavosurface. The occlusal part was completed with an ormocer-based nanohybrid resin composite (Ceram X mono+). In the other cavity, only the resin

composite CeramX mono+ was placed in 2 mm increments. The restorations were evaluated using slightly modified USPHS criteria at baseline and then annually for 3 years. Caries risk and bruxing habits of the participants were estimated.

RESULTS: No post-operative sensitivity was reported. At the 3-year follow-up, 196 restorations – 74 Class I and 122 Class II – were evaluated. Seven restorations failed (3.6%), 4 SDR-CeramX mono+ and 3 CeramX mono+ only restorations, all of which were Class II. The main reason for failure was tooth fracture, followed by resin composite fracture. The annual failure rate (AFR) for all restorations (Class I and II) was 1.2% for the bulkfilled restorations and 1.0% for the resin composite-only restorations ($p > 0.05$). For the Class II restorations, the AFR was 2.2% and 1.6%, respectively.

CONCLUSION: The 4-mm bulk-fill technique showed good clinical effectiveness during the 3-year follow-up.

COMMENTARY: Clinical studies have a much greater proximity with the reality of clinical practice, and results of this kind of study are much well received for the importance they represent. This one showed a low failure rate, which can be compared to that of conventional composites, clinically showing that bulk-fill has a good effectiveness in long term results.

Finally, the seventh article addresses a very interesting subject, as it explores the technical aspects of sculpture with bulk-fill resin (article published in the Journal of Esthetic and Restorative Denstistry, 2015).

BULK FILL COMPOSITES: AN ANATOMIC SCULPTING TECHNIQUE

Hirata R, Kabbach W, de Andrade OS, Bonfante EA, Giannini M, Coelho PG.

J Esthet Restor Dent. 2015 Nov-Dec;27(6):335-43.
doi: 10.1111/jerd.12159. Epub 2015 Jul 14.

Composite resins have been routinely used for posterior cavities due to a phasedown on amalgam as a restorative option. However, clinical problems related to polymerization shrinkage demands careful and specific techniques for placement of the composite layers. New low shrinkage composites are now marketed for bulk filling of cavities without the need of a traditional layering. With this new concept, the restoration can be built in one or two layers, depending on the classification of the bulk fill material. This article discusses and presents two alternative techniques using the low shrinkage composites, suggesting a called "amalgam-like sculpting technique," one using a *flow*able bulk fill and other a regular bulk fill material. Clinical cases illustrate these two alternatives compared with the layered technique.

CLINICAL SIGNIFICANCE: New techniques using low shrinkage composites for bulk filling can provide a simpler technical approach for the clinician in sculpting and generating highly esthetic posterior composites.

COMMENTARY: This study outlines the differences between the increment technique and the technique for bulk-fill. This kind of composite drops the necessity of increments, allowing sculpture of dental structures with a single increment of composite. Therefore, it is of utmost importance for the clinician to be aware of these conceptual and technique changes, in order to execute anatomically correct, functional and occlusal-balanced restorations.

After going through these studies, it's safe to assume that there is a variability of methodologies and conclusions about the use of Bulk-fill composites. Summarizing, while they cannot be considered as perfect substitutes for conventional composites, they still have their niche. It is also important not to subjugate the importance of quantity and quality of the light source used for curing, something that clinicians need to never neglect.

EFFECT OF TOOTH SUBSTRATE AND PORCELAIN THICKNESS ON PORCELAIN VENEER FAILURE LOADS *IN VITRO*

Ge C, Green CC, Sederstrom DA, McLaren EA, Chalfant JA, White SN

J Prosthet Dent. 2018 Jul;120(1):85-91.

doi: 10.1016/j.prosdent.2017.10.018

INTRODUCTION: Bonded porcelain veneers are widely used esthetic restorations. High success and survival rates have been reported, but failures do occur. Fractures are the commonest failure mode. Minimally invasive or thin veneers have gained popularity. Increased enamel and porcelain thickness improve the strength of veneers bonded to enamel, but less is known about dentin or mixed substrates.

PURPOSE: The purpose of this *in vitro* study was to measure the influences of tooth substrate type (all-enamel, all-dentin, or half-dentin-half-enamel) and veneer thickness on the loads needed to cause initial and catastrophic porcelain veneer failure.

MATERIAL AND METHODS: Model discoid porcelain veneer specimens of varying thicknesses were bonded to the flattened facial surfaces of incisors with different enamel and dentin tooth substrates, artificially aged, and loaded to failure with a small sphere. Initial and catastrophic fracture events were identified and analyzed statistically and fractographically.

RESULTS: Fracture events included initial Hertzian cracks, intermediate radial cracks, and catastrophic gross failure. All specimens retained some porcelain after catastrophic failure. Cement failure occurred at the cement-porcelain interface not at the cement-tooth interface. Porcelain veneers bonded to enamel were substantially stronger and more damage-tolerant than those bonded to dentin or mixed substrates. Increased porcelain thickness substantially raised the loads to catastrophic failure on enamel substrates but only moderately raised the loads to catastrophic failure on dentin or mixed substrates. The veneers bonded to half-dentin-half-enamel behaved remarkably like those bonded wholly to dentin.

CONCLUSIONS: Porcelain veneers bonded to enamel were substantially stronger and more damage-tolerant than those bonded to dentin or half-enamel-half dentin.

COMMENTS: This *in vitro* study shows the effect of different thicknesses of ceramic laminate veneers and dental substrates, as well as the interference of mixed dental substrates, on the fracture strength of ceramic laminates. The results showed that cementation of veneers only in dental enamel increased the overall strength of the ceramic. Likewise, the increased ceramic thickness has substantially increased the load required for ceramic fracture when it is cemented on the enamel. Although it is an *in vitro* study, with simple loading conditions compared to what occurs in the mouth, these study showed a good indication for the conservative techniques of dental preparations, as well as the maintenance of the dental substrate in enamel for the use of laminate veneers.

FRACTURE RESISTANCE OF CERAMIC AND POLYMER-BASED OCCLUSAL VENEER RESTORATIONS

Al-Akhali M, Chaar MS, Elsayed A,
Samran A, Kern M

J Mech Behav Biomed Mater. 2017 Oct;74:245-250.
doi: 10.1016/j.jmbbm.2017.06.013.

OBJECTIVES: The purpose of this *in vitro* study was to evaluate the influence of thermodynamic loading on the durability and fracture resistance behavior of occlusal veneers fabricated from different biomedical dental CAD/CAM materials.

METHODS: The occlusal surfaces of 64 extracted premolars were prepared in the enamel layer and restored with occlusal veneers with a fissure/cusp thickness of 0.5/0.8mm made from four different dental CAD/CAM materials: group LD lithium disilicate (e.max CAD), group LS zirconia-reinforced lithium silicate (Vita Suprinity), group PI polymer-infiltrated ceramic (Vita Enamic), and group PM polymethylmethacrylate PMMA (Telio CAD). The prepared teeth were etched with phosphoric acid. The occlusal veneers were then bonded using an adhesive luting system (Multilink Primer A/B and Multilink Automix luting resin). Half of the specimens were subjected to thermodynamic loading in a chewing simulator (1.2 million cycles at 98N). All specimens were quasi-statically loaded until fracture. The statistical analysis was made using the t-test and one-way ANOVA followed by the Tukey HSD test (α = 0.05).

RESULTS: All aged specimens survived the thermodynamic loading. Thermodynamic loading significantly raised the fracture resistance in groups LS, PI, and PM ($P < 0.03$). Occlusal veneers made from lithium disilicate and zirconia-reinforced lithium silicate recorded higher fracture resistance than those made from polymer-infiltrated ceramic and PMMA resin.

CONCLUSIONS: All tested dental CAD/CAM biomaterials exhibited a fracture resistance considerably exceeding the average occlusal force in the posterior dentition. Therefore, they might present a viable long-term treatment for restoring the occlusal surfaces of posterior teeth.

COMMENTS: This *in vitro* study evaluated thermodynamic resistance of specimens restored with ceramic laminate veneers made from different restorative materials such as ceramics, polymers and hybrid polymers. An interesting aspect is the recent attempt to improve the properties of new polymers and hybrid polymers for use in areas of great masticatory effort. As the results showed, it is already observed a similar mechanical behavior between the ceramics and these new polymer materials.

FRACTURE-RESISTANT MONOLITHIC DENTAL CROWNS

Zhang Y, Mai Z, Barani A, Bush M, Lawn B

Dent Mater. 2016 Mar;32(3):442-9.

doi: 10.1016/j.dental.2015.12.010

OBJECTIVE: To quantify the splitting resistance of monolithic zirconia, lithium disilicate and nanoparticle-composite dental crowns.

METHODS: Fracture experiments were conducted on anatomically-correct monolithic crown structures cemented to standard dental composite dies, by axial loading of a hard sphere placed between the cusps. The structures were observed in situ during fracture testing, and critical loads to split the structures were measured. Extended finite element modeling (XFEM), with provision for step-by-step extension of embedded cracks, was employed to simulate full failure evolution.

RESULTS: Experimental measurements and XFEM predictions were self-consistent within data scatter. In conjunction with a fracture mechanics equation for critical splitting load, the data were used to predict load-sustaining capacity for crowns on actual dentin substrates and for loading with a sphere of different size. Stages of crack propagation within the crown and support substrate were quantified. Zirconia crowns showed the highest fracture loads, lithium disilicate intermediate, and dental nanocomposite lowest.

Dental nanocomposite crowns have comparable fracture resistance to natural enamel.

SIGNIFICANCE: The results confirm that monolithic crowns are able to sustain high bite forces. The analysis indicates what material and geometrical properties are important in optimizing crown performance and longevity.

COMMENTS: This study showed the fracture strength of various restorative materials when used to built monolithic crowns. The manufacture of monolithic crowns differs from other ceramic manufacturing techniques, as there is no addition of ceramic layers. Instead, the crown is made in a single layer. The results showed high levels of resistance of the monolithic crowns, being able to withstand high occlusal loads, being the material and the crown design important for longevity.

FATIGUE BEHAVIOR AND CRACK INITIATION OF CAD/CAM RESIN COMPOSITE MOLAR CROWNS

Yamaguchi S, Kani R, Kawakami K, Tsuji M,
Inoue S, Lee C, Kiba W, Imazato S

Dent Mater. 2018 Jul 23. pii: S0109-5641(18)30331-2.
doi: 10.1016/j.dental.2018.07.002

OBJECTIVE: The aim of this study was to evaluate long-term fatigue behavior using an *in vitro* step-stress accelerated life test (SSALT), and to determine the crack initiation point using in silico finite element analysis for computer-aided designed and manufactured (CAD/CAM) molar crowns fabricated from three commercial CAD/CAM resin composite blocks: Cerasmart (CS; GC, Tokyo, Japan), Katana Avencia Block (KA; Kuraray Noritake Dental, Niigata, Japan), and Shofu Block HC (HC; Shofu, Kyoto, Japan).

METHODS: Fifty-one mandibular first molar crowns luted on a resin core die were embedded in acrylic resin and covered with a polyvinyl chloride tube. Single compressive tests were performed for five crowns. SSALT was conducted for 36 crowns using three profiles and reliabilities at 120,000 cycles, and a Weibull analysis was conducted. The maximum principal strain of each CAD/CAM resin composite crown model was analyzed by three-dimensional finite element analysis.

RESULTS: Fracture loads of CS and KA (3784±144N and 3915±313N) were significantly greater than that of HC (2767±227N) ($p<0.05$).

Fracture probabilities at 120,000 cycles were 24.6% (CS), 13.7% (KA), and 14.0% (HC). Maximum principal strain was observed around the mesiolingual cusps of CS and KA and the distobuccal cusp of HC.

SIGNIFICANCE: CAD/CAM resin composite molar crowns containing nano-fillers with a higher fraction of resin matrix exhibited higher fracture loads and greater longevity, suggesting that these crowns could be used as an alternative to ceramic crowns in terms of fatigue behavior.

COMMENTS: In this study, the researchers evaluated the fatigue strength and biomechanical behavior of lower molar crowns in nano-particulate resins made by CAD/CAM. The results of this study showed that the crowns made with resins with nano-particles in a larger resin matrix presented high resistance to fracture, suggesting, in the Weibull test, a greater probability of clinical longevity.

INFLUENCE OF SURFACE FINISHING ON FRACTURE LOAD AND FAILURE MODE OF GLASS CERAMIC CROWNS

Mores RT, Borba M, Corazza PH, Della Bona Á, Benetti P

J Prosthet Dent. 2017 Oct;118(4):511-516.

doi: 10.1016/j.prosdent.2016.12.0

INTRODUCTION: Ceramic restorations often require adjustments using diamond rotary instruments, which damage the glazed surface. The effect of these adjustments on the fracture behavior of these restorations is unclear.

PURPOSE: The purpose of this *in vitro* study was to evaluate the influence of induced surface defects on the fracture load and mode of failure of lithium disilicate-based (LDS) glass ceramic restorations.

MATERIAL AND METHODS: Premolar crowns were obtained from LDS computer-aided design and computer-aided manufacturing blocks (n=60) and glazed. The crowns were bonded to dentin analog dies and divided into 5 groups (n=12), as follows: glaze; abrasion (diamond rotary instrument 2135); abrasion and reglaze; abrasion and polishing (diamond rotary instrument 2135F, 2135FF, and polishing devices); and polishing. The topography of the crowns

was examined by scanning electron microscopy, and roughness was measured. A compressive load (0.5 mm/min) was applied by a piston to the center of the lingual cusp until fracture. The fracture load was recorded and data were statistically analyzed by ANOVA and the Tukey HSD test (α=.05). Fractured crowns were examined to determine the fracture origin.

RESULTS: Polishing and/or reglazing resulted in lower roughness than for the abraded group (P<.05), which did not affect the fracture loads (P=.696). Catastrophic fracture with origin at the intaglio surface was the mode of failure for all the crowns.

CONCLUSIONS: The experiment design successfully submitted the crowns to a clinical stress state, resulting in a clinically relevant failure. Reglazing or polishing were effective in reducing surface defects. Surface treatments had no effect on the immediate catastrophic failure of LDS crowns.

COMMENTS: The present study, observed *in vitro*, the influence of occlusal adjustment done on the surface of ceramics based on lithium disilicate causes in the fracture resistance of the same. In addition, it evaluated different forms of ceramic polishing. The authors found a significant reduction of the surface porosity of the ceramic with either polishing or re-glazing. However, in this study, no relationship was found between surface structural defects and immediate catastrophic failures.

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