

**LUCAS SILVEIRA MACHADO and RODOLFO BRUNIERA ANCHIETA****FIBER POSTS**

With the objective of discuss and present results of hot topics on aesthetic dentistry, the Highlights sections has brought to you a few important and recent researchs published on the mainstream international periodics, with the focus of this edition being intracanal posts on endodontically treated teeth.

Due to the difficult and challenging scenario that this kind of treatment imposes to the clinician, and in part also due to the recent innovations on the field, a few studies were highlighted, approaching the use of different kinds of posts and clinical state of teeth (with and without coronal remains), as well as the bio-mechanical behavior of these restorations on laboratorial trials, simulations and clinical studies.

*The article compared direct and indirect restorations, with or without fiber post, using mechanical tests. The article was published in the Journal of Adhesive Dentistry, 2018.*

**DIRECT OR INDIRECT RESTORATION OF ENDODONTICALLY TREATED MAXILLARY CENTRAL INCISORS WITH CLASS III DEFECTS? COMPOSITE VS. VENEER OR CROWN RESTORATION**

von Stein-Lausnitz M, Mehnert A, Bruhnke M, Sterzenbach G, Rosentritt M, Spies BC, Bitter K, Naumann M

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**PURPOSE:** The aim of this ex-vivo study was to evaluate the load capacity of direct or indirect endodontically restored maxillary central incisors with Class III defects, with or without glass-fiber posts.

**MATERIAL AND METHODS:** Seventy-two extracted human maxillary central incisors were

endodontically treated and bi-proximal Class III cavities were prepared. Specimens were randomly allocated to six groups (n = 12): direct restoration with composite (C); direct restoration with composite and additional glass-fiber post (CP); ceramic veneer restoration (V), ceramic veneer restoration and additional glass-fiber post (VP), ceramic crown restoration (Cr), ceramic crown restoration and additional glass-fiber post (CrP). Specimens were exposed to thermomechanical loading (TML: 1.2 million cycles, 1 to 50 N; 6000 thermal cycles between 5°C and 55°C for 1 min each), and subsequently linearly loaded until failure (Fmax [N]) at an angle of 135 degrees 3 mm below the incisal edge on the palatal side. Statistical tests were performed using the Kruskal-Wallis and Mann-Whitney U-Test.

**RESULTS:** During dynamic loading by TML, one early failure occurred in group C, CP, and CrP. Subsequent linear loading resulted in mean fracture load values [N] of C =  $483 \pm 219$ , CP =  $536 \pm 281$ , V =  $908 \pm 293$ , VP =  $775 \pm 333$ , Cr =  $549 \pm 258$ , CrP =  $593 \pm 259$ . The Kruskal-Wallis test showed significant differences of load capacity between groups ( $p < 0.05$ ). Mann-Whitney U-test revealed significantly lower maximum fracture load values of group C compared to group V ( $p = 0.014$ ), after Bonferroni-Holm correction. Non-restorable root fracture was the most frequent type of failure.

**CONCLUSION:** Endodontically treated maxillary central incisors with Class III defects directly re-stored with composite are as loadable as indirect crown restorations. Compared to

full-coverage restorations, less invasive veneers appear to be more beneficial. Additional placement of glass-fiber posts shows no positive effect.

**COMMENTS** Depending on the specific clinical circumstances, one might conclude that direct composite restorations are less invasive and more time saving due to the need for only one treatment appointment, and last but not least because they are a more economical alternative to any indirectly manufactured restoration from the dental laboratory, ie, veneer, incisal edge-up, or crown. Veneer restorations have the advantages of good esthetics and a demonstrated strengthening effect under functional loading condition. Crown restorations involve the highest amount of hard tissue loss during preparation and show load capacities similar to those of direct restorations. Considering also that additional placement of glass-fiber posts shows no positive effect.

The following article, published in the Brazilian Oral Research, in 2018, compared the bond strength values of fiberglass post to flared root canals reinforced with different materials.

#### BOND STRENGTH VALUES OF FIBERGLASS POST TO FLARED ROOT CANALS REINFORCED WITH DIFFERENT MATERIALS

Bakaus TE, Gruber YL, Reis A, Gomes OMM, Gomes GM

Braz Oral Res. 2018 Mar 1;32:e13  
doi: 10.1590/1807-3107bor-2018.vol32.0013

**PURPOSE:** The aim of this study was to compare *in vitro* the bond strength (BS) between fiber-glass posts and flared root canals reinforced with different materials.

#### MATERIALS AND METHODS:

The roots of 48 premolars were endodontically treated. After one week, the root canals were prepared to simulate an oversized root canal, except for the positive control group (PCG), which was cemented with a prefabricated

fiber post (PFP) compatible with the root canal size, simulating an ideal adaptation. The other sam-ples (n=8/group) were used to test alternative restorative techniques for filling root canals: negative control group (NCG [PFP with a smaller diameter than of the root canal]), composite resin group - CRG, bulkfill group - BFG, self-adhesive cement group - SAG, and glass ionomer group - GIG. The posts were cemented and after 1 week, each root was sectioned transversely into six 1-mm thick discs and the push-out test was done to evaluate the BS. Data were analyzed by two-way repeated measures ANOVA and Tukey's tests ( $\alpha=0.05$ ).

**RESULTS:** The highest BS value was observed for PCG. The NCG and the GIG groups showed the lowest BS values. Root reinforcement with conventional and bulk-fill composite resins showed the highest BS values; however, the bulk-fill resin was the only treatment able to maintain high BS values in all regions of the root canal. The self-adhesive cement showed intermediate results between CRG and GIG.

**CONCLUSION:** Root reinforcement with bulk-fill composite resin is an effective option for flared root canals before cementation of a prefabricated fiber post.

**COMMENTS:** Clinically, dentists should keep the greatest possible amount of dentin structure prior to cementing a fiber post, as the positive control group showed the highest bond strength results. However, when necessary, root canal reinforcement with a bulkfill composite resin can attain higher bond strength values than the negative control group in all thirds of the root canal, and

it is considered the technique of choice for root reinforcement of flared root canals.

*The article compares the influence of photodynamic therapy on the mechanical properties and bond strength of glass-fiber posts to endodontically treated intraradicular dentin. The article was published in the Journal of Prosthetic Dentistry, in 2018.*

#### **EFFECT OF PHOTODYNAMIC THERAPY ON THE MECHANICAL PROPERTIES AND BOND STRENGTH OF GLASS-FIBER POSTS TO ENDODONTICALLY TREATED INTRARADICULAR DENTIN**

Strazzi Sahyon HB, Pereira da Silva P, Silva de Oliveira M, Angelo Cintra LT, Gomes-Filho JE, Henrique Dos Santos P, Sivieri-Araujo G

J Prosthet Dent. 2018 Aug;120(2):317.e1-317.e7  
doi: 10.1016/j.prosdent.2018.05.009

**PURPOSE:** The purpose of this *in vitro* study was to evaluate the influence of photodynamic therapy on the bond strength of glass-fiber posts using a push-out test and, additionally, to measure the Martens hardness (MH) and elastic indentation modulus (Eit) of intraradicular dentin when different photosensitizers are used.

**MATERIAL AND METHODS:** Eighty bovine teeth were used to simulate experimental endodontic treatments. Bio-mechanical instrumentation was performed for all root canals, and the teeth were distributed into 5 groups: control-deionized water; methylene blue 50 mg/L + red laser; methylene blue 100 mg/L + red laser; curcumin 500 mg/L + blue LED; and curcumin 1000 mg/L + blue LED. The MH and Eit of intraradicular dentin were measured using an ultramicrohardness tester under a load of 3 mN (n=8). The push-out bond strength of glass-fiber posts to dentin was measured using a universal testing machine (n=8). Mechanical properties and bond strength data were subjected to the Kruskal-Wallis test, ANOVA, and Fisher least significant difference test ( $\alpha=.05$ ). Images of representative specimens were obtained using a scanning electron microscope.

**RESULTS:** The MH, Eit, and bond strength of intraradicular dentin were influenced by the photosensitizer used. In general, curcumin promoted lower mechanical properties values but higher bond strength values.

**CONCLUSIONS:** Photosensitizers influenced the mechanical properties of intraradicular dentin and the bond strength of glass-fiber

posts, and methylene blue at 50 mg/L had no marked effect on the mechanical properties of the dentin or the bond strength values.

**COMMENTS:** The use of photosensitizers in photodynamic therapy promotes intraradicular microbial reduction during nonsurgical endodontic therapy. However, studies are lacking on the consequences of the application of these agents on the mechanical properties of intraradicular dentin and on the bond strength of glass-fiber posts. With the results it can be observed that the photodynamic therapy associated with methylene blue is a viable clinical procedure for the disinfection of the root canals before the cementation of the fiberglass pins to the intraradicular dentine.

*The article evaluated the fracture resistance of Endodontically Treated Maxillary Pre-molars Restored With Different Methods. The article was published in Brazilian Oral Research, 2018.*

### **FRACTURE RESISTANCE OF ENDODONTICALLY TREATED MAXILLARY PREMOLARS RESTORED WITH DIFFERENT METHODS**

Mergulhão VA, de Mendonça LS, de Albuquerque MS, Braz R

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doi: 10.2341/17-262-L

**PURPOSE:** The purpose of this *in vitro* study was to evaluate the resistance and patterns of fracture of endodontically treated maxillary premolars (ETPs) restored with different methods.

**MATERIALS AND METHODS:** Mesio-occluso-distal cavities were prepared in 50 extracted caries-free human maxillary premolars after endodontic treatment. The teeth were divided into five groups (n=10), according to the restorative method. G1: intact teeth (control group); G2: conventional composite resin; G3: conventional composite resin with a horizontal glass fiber post inserted between buccal and palatal walls; G4: bulk-fill flowable and bulk-fill restorative composites; and G5: ceramic inlay. For direct restorations, Filtek Z350 XT, Filtek Bulk Fill Flowable Restorative, and Filtek Bulk Fill Posterior Restorative were used.

Indirect restorations were fabricated from a pressable lithium disilicate glass-ceramic (IPS e-max Press) and adhesively cemented (RelyX Ultimate). All specimens were subjected to thermocycling (5°C to 55°C/5000 cycles) and additionally submitted to cyclic loading 50,000 times in an Electro-Mechanical Fatigue Machine. Next, the specimens were subjected to a compressive load at a crosshead speed of 1 mm/min until fracture. The fractured specimens were analyzed to determine the fracture pattern using a stereomicroscope, and then representative specimens were carbon coated to allow for the studying of the fracture surface under scanning electron microscopy. One-way analysis of variance (ANOVA) was used to compare fracture resistance of the groups. The results of fracture patterns were submitted to the Fisher exact test ( $\alpha=0.05$ ).

**RESULTS:** All specimens survived fatigue. Mean (standard deviation) failure loads (N) for groups were as follows: G1: 949.6 (331.5); G2: 999.6 (352.5); G3: 934.5 (233.6); G4: 771.0 (147.4); and G5: 856.7 (237.5). The lowest fracture resistance was recorded for G4, and the highest ones were recorded for G2, followed by that of G1 and G3. One-way ANOVA did not reveal significant differences between groups ( $p>0.05$ ). The highest repairable fracture rates were observed in G1 (100%) and G3 (80%).

**CONCLUSIONS:** ETPs restored with conventional composite resin with or without horizontal fiber post, bulk-fill composite, and ceramic inlay showed fracture resistance similar to that of sound teeth. Conventional composite resin restorations exhibited the highest prevalence of unrepairable fractures, and the insertion of

a horizontal fiber post decreased this prevalence. Intact teeth showed 100% of repairable fractures. It is difficult to extrapolate the results directly to a clinical situation due to the limitations of this study.

**COMMENTS:** With the limitations of this study, because of the difficulty of extrapolating the conditions that are clinically present, the design of this study allowed us to consider that restorations in endodontically treated teeth with ceramic inlays, as well as composite resin restorations with or without a fiber pin, seem to restore the fracture resistance of endodontically treated maxillary premolars at a level similar to intact teeth. Ceramic inlays, as well as composite resin restorations with or without a horizontal fiber post, seem to restore the fracture resistance of endodontically treated maxillary premolars to a level compared to that of intact teeth.

*The article compared the effect of different crowns post, and remaining coronal dentin on the biomechanical behavior of endodontically treated maxillary central incisors. The article was published in The Journal of Prosthetic Dentistry, in 2014.*

#### **EFFECT OF THE CROWN, POST, AND REMAINING CORONAL DENTIN ON THE BIOMECHANICAL BEHAVIOR OF ENDODONTICALLY TREATED MAXILLARY CENTRAL INCISORS**

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doi: 10.1016/j.prosdent.2013.07.006

**PURPOSE:** The purpose of this study was to evaluate the effects of the type of post, type of crown, and the amount of remaining coronal dentin on the biomechanical behavior of endodontically treated teeth.

**MATERIAL AND METHODS:** The investigation was conducted by using 3-dimensional finite element analysis and laboratory tests.

Three-dimensional models of a maxillary central incisor were generated: without remaining coronal dentin, with 1.0 mm of remaining coronal dentin, with 2.0 mm of remaining coronal dentin, and restored with a glass-fiber post or a cast post and core in combination with a metal crown or an alumina-reinforced ceramic crown. The results were evaluated by using the von Mises criterion and Maximum Principal Stress. One hundred twenty bovine incisors were selected and divided into 12 treatment groups (n=10). Specimens were loaded at a 135-degree angle to perform strain measurements and were then loaded until fracture. The strain and fracture resistance results were analyzed with 3-way analysis of variance and the Tukey honestly significant difference test ( $\alpha=.05$ ).

**RESULTS:** The alumina-reinforced ceramic crowns and metal crowns associated with a glass-fiber post showed a homogeneous stress distribution within the root. The cast post and core concentrated higher stresses at the post-dentin interface. Significant differences were found among the mean fracture resistance values for all groups ( $P<.05$ ). The presence of 2.0 mm of coronal remnants resulted in lower strains and higher fracture resistance for both the metal and ceramic crowns. Roots restored with glass-fiber posts exhibited more favorable fractures.

**CONCLUSIONS:** The presence of 2 mm of remaining coronal dentin improved the mechanical behavior of the endodontically treated maxillary incisors. Teeth restored with glass-fiber posts and composite resin cores showed a homogeneous stress distribution within the root dentin..

**COMMENTS:** In this *in vitro* study, different remaining coronal dentin were compared using a glass-fiber post or a cast post and core in combination with a metal crown or an alumina-reinforced ceramic crown. The presence of remaining coronal dentin is an important factor that positively influences the strain, stress distribution, fracture resistance, and mode of failure of endodontically treated incisors, regardless of the method of crown-root rehabilitation. As also verified by Watanabe et al. 2012, the coronary remnant with higher height improved the mechanical behavior of the two types of post. In addition to providing more retention and stability, the high remnant tends to direct the level of fracture to the more cervical or coronal region when the limit of tooth rupture is reached, often making it possible to reuse the tooth. The best behavior of fiberglass post with composite resin compared to metallic, is due to the similarity between the modulus of elasticity (“hardness”) of the fiber post and the tooth, causing more homogeneous dissipation of the tension levels. Clinically, based on the article, it is suggested the preservation of the coronary remnant.

1. Watanabe MU, Anchieta RB, Rocha EP, Kina S, Almeida EO, Freitas AC Jr, Basting RT. Influence of crown ferrule heights and dowel material selection on the mechanical behavior of root-filled teeth: a finite element analysis. J Prosthodont. 2012 Jun;21(4):304-11. doi: 10.1111/j.1532-849X.2011.00832.x. Epub 2012 Feb 28.

*The article compared the influence of post system design and material on the biomechanical behavior of teeth with little remaining coronal structure. The article was published in the Journal of Prosthodontics, IN 2019.*

#### THE INFLUENCE OF POST SYSTEM DESIGN AND MATERIAL ON THE BIOMECHANICAL BEHAVIOR OF TEETH WITH LITTLE REMAINING CORONAL STRUCTURE

Pinto CL, Bhering CLB, de Oliveira GR, Maroli A, Reginato VF, Caldas RA, Bacchi A

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doi: 10.1111/jopr.12804

**PURPOSE:** To evaluate the influence of different post systems on the biomechanical behavior of teeth with a severe loss of remaining coronal structure.

**MATERIALS AND METHODS:** Fifty standardized bovine teeth (n = 10 per group) were restored with: cast post-and-core (CPC), prefabricated metallic post (PFM), parallel glass-fiber post (P-FP), conical glass-fiber post (C-FP), or composite core (no post, CC).



The survival rate during thermomechanical challenging (TC), the fracture strength (FS), and failure patterns (FP) were evaluated. Finite element models evaluated the stress distribution after the application of 100 N.

**RESULTS:** All specimens survived TC. Similar FS was observed among post-containing groups. Groups P-FP and CC presented 100% repairable fractures. The von Mises analysis showed the maximum stresses into the root canal in groups restored with metallic posts. Glass-fiber posts and CC presented the maximum stresses at the load contact point. Glass-fiber groups showed lower stresses in the analysis of maximal contact pressure; CPC led to the highest values of contact pressure. The modified von Mises (mvM) stress in dentin did not show differences among groups. Moreover, mvM values did not reach the dentin fracture limit for any group.

**CONCLUSIONS:** The type of intracanal post had a relevant influence on the biomechanical behavior of teeth with little remaining coronal structure.

**COMMENTS:** Different types of intracanal post were evaluated in teeth with severe loss of tooth structure. Among the post systems evaluated, the best results were for the groups using the fiberglass post, and in fatigue tests, the stress levels in the structures in the numerical analysis, as well as in the obtained fracture pattern (in the largest part of the time fractures where it was possible to repair the damage). The fracture pattern obtained in the rupture test was similar to the voltage distribution seen in the voltage maps. Based on the study, it is suggested that the use of fiberglass posts be biomechanically more compatible in teeth with severe loss of coronary structure.

*The article compared rigid versus flexible dentine-like endodontic posts—clinical testing of a biomechanical concept, in a follow-up of 7 years. The article was published in the Journal of Endodontics, IN 2012.*

**RIGID VERSUS FLEXIBLE DENTINE-LIKE ENDODONTIC POSTS—CLINICAL TESTING OF A BIOMECHANICAL CONCEPT: SEVEN-YEAR RESULTS OF A RANDOMIZED CONTROLLED CLINICAL PILOT TRIAL ON ENDODONTICALLY TREATED ABUTMENT TEETH WITH SEVERE HARD TISSUE LOSS**

Sterzenbach G, Franke A, Naumann M

J Endod. 2012 Dec;38(12):1557-63.

doi: 10.1016/j.joen.2012.08.015

**INTRODUCTION:** This is the first clinical long-term pilot study that tested the biomimetic concept of using more flexible, dentine-like (low Young modulus) glass fiber-reinforced epoxy resin posts (GFREPs) compared with rather rigid, stiff (higher Young modulus) titanium posts (TPs) in order to improve the survival rate of severely damaged endodontically treated teeth.

**METHODS:** Ninety-one subjects in need of postendodontic restorations in teeth with 2 or less remaining cavity walls were randomly assigned to receive either a tapered TP (n = 46) or a

tapered GFREP (n = 45). The posts were adhesively luted using self-adhesive resin cement. The composite core build-ups were prepared ensuring a circumferential 2-mm ferrule. The primary endpoint was a loss of restoration for any reason. To study group differences, the log-rank test was calculated (P < .05). Hazard plots were constructed.

**RESULTS:** After 84 months of observation (mean = 71.2 months), 7 restorations failed (ie, 4 GFREPs and 3 TPs). The failure modes were as follows: GFREP:root fracture (n = 3), core fracture (n = 1) and TP:endodontic failure (n = 3). No statistical difference was found between the survival rates (GFREPs = 90.2%, TPs = 93.5%, P = .642). The probability of no failure was comparable for both post materials (risk ratio; 95% confidence interval, 0.965-0.851/1.095).

**CONCLUSIONS:** When using self-adhesive luted prefabricated posts in severely destroyed abutment teeth with 2 or less cavity walls and a 2-mm ferrule, postendodontic restorations achieved high long-term survival rates irrespective of the post material used (ie, glass fiber vs titanium).

**COMMENTS:** In this “in vivo” study, when comparing the success rate of glass fiber post (less modulus of elasticity) and titanium (greater modulus of elasticity), with a filling core made of both composite resin, with 2 mm or with 2 remaining walls, observed a similar success rate after 71 months of follow-up (90% glass fiber and 93% titanium). Monitoring for a longer period may bring important information about this comparison, evidencing statistical differences between the two materials

*The article compared the influence of remaining coronal thickness and height on bio-mechanical behavior of endodontically treated teeth: survival rates, load to fracture and finite element analysis. The article was published in the Journal Applied of Oral Sciences, in 2018.*

**INFLUENCE OF REMAINING CORONAL THICKNESS AND HEIGHT ON BIOMECHANICAL BEHAVIOR OF ENDODONTICALLY TREATED TEETH: SURVIVAL RATES, LOAD TO FRACTURE AND FINITE ELEMENT ANALYSIS.**

Corrêa G, Brondani LP, Wandscher VF, Pereira GKR, Valandro LF, Bergoli CD

J Appl Oral Sci. 2018;26:e20170313

doi: 10.1590/1678-7757-2017-0313

**OBJECTIVE:** To evaluate the effect of restorative strategy (fiber post vs cast post and core), coronal height (0 mm vs 2 mm) and thickness (higher than 1 mm vs lower than 1 mm) on survival rate, fracture resistance and stress distribution.

**MATERIAL AND METHODS:** Seventy-two bovine teeth were cleaned and allocated in six groups (n = 12). Twenty-four teeth were sectioned at 13 mm length (no remaining coronal structure) and forty-eight were sectioned at 15 mm (2 mm remaining coronal structure). Half of the forty-eight had remaining coronal thickness lower than 1 mm and the other half had thickness higher

than 1 mm. All root canals were prepared at 10 mm (luting length), fiber posts were cemented in thirty-six specimens and cast post and core in other thirty-six. All teeth were restored with metallic crowns. Specimens were submitted to 1.5 million cycles (100 N, 45°, 10 Hz at 2 mm below incisal edge) and evaluated at each 500,000 cycles to detect failures. Specimens that survived were submitted to load to fracture test. Bidimensional (Rhinceros® 4.0) models were obtained survival data submitted to Kaplan-Meier ( $\alpha=0.05$ ) analysis and load to fracture values submitted to ANOVA and Tukey tests ( $\alpha=0.05$ ).

**RESULTS:** Groups without remaining coronal structure showed survival rates lower than other groups ( $p=0.001$ ). ANOVA showed higher values of load to fracture for groups with coronal thickness higher than 1 mm ( $p=0.0043$ ). Finite element analysis showed better stress distribution in groups with remaining coronal structure and restored with fiber post.

**CONCLUSION:** Specimens without remaining coronal structure have lower survival rates. Specimens with remaining structure lower than 1 mm and without coronal structure support the same load to fracture value independently of the restorative strategy.

**COMMENTS:** The authors of this study, through *in vitro* and virtual analysis, observed greater resistance to fracture, and higher survival rate of teeth that presented coronary remnants. Voltage distribution was also better for remnant specimens, especially for those restored with fiber post. The importance of the fatigue test to obtain clinically relevant results should be highlighted in this study. Although the teeth with and without remnant support the same force to occur the fracture, in static test, it is emphasized that in the fatigue test, the teeth with remnant had better survival rates.

*After a meticulous filter of articles which studied different aspects regarding endodontic posts used for teeth crown restorations, it becomes clear that there is a shared concern shown by all researchers on the biomechanical behavior of endodontically treated teeth that hosts any kind of intracanal posts. The reviewed articles all show an evident conclusion that the height of remaining tooth crown is na important factor to be considered. The presence of coronal remains are associated with better results on restoration longevity, better distribution of occlusal tensions, as well as less complex fractures when the restorative system stress limit is overloaded.*

*Additionally, it is clear that there is a common sense with all researchers that new techniques and posts materials are constantly being evaluated in order to achieve a biomimetic behavior with dental structures. In this context, all of the reviewed articles compared the behavior of glass fiber posts with other materials used for the same purpose, such as fused metal, biological and prefabricated metal posts. Generally speaking, results shows that glass fiber posts presents good traits of retention and homogeneous stress dissipation when compared with other kinds of posts, while retaining the same success rates, sometimes even improving them.*

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