

# ANGELUS FIBER POST BIBLIOGRAPHY



## EXACTO ARTICLE

VIEIRA, E.M.M.P.M.; ET AL.; **Bond Strength of Fiber Posts to Intraradicular Dentin After the Use of Ultrasonically Activated Irrigants.**  
OHDM- Vol. 17- No.1-February, 2018

### **Abstract**

**Aim:** This study evaluated the bond strength of glass-fiber posts (GFP)(Exacto-Angelus) to intraradicular dentin in cervical, middle and apical thirds, after using ultrasonically activated irrigants. **Methods:** One hundred and twenty lower premolars sectioned and distributed into 10 groups (n=12), according to irrigant and ultrasonic treatments. The groups were 2.5% NaOCl (HS), 2% chlorhexidine digluconate (CL), 17% EDTA, saline (SF) distilled water (AD), plus or minus ultrasonic instrumentation, and posts were cemented with RelyX ARC. **Results:** The bond strength was evaluated by means of the push-out test. Repeated measures three-way analysis of variance and Tukey test revealed that compared to EDTA 17%, CL and SF significantly reduced the bond strength of GFP, regardless of ultrasonic instrumentation and also independently from root third ( $p=0.015$ ). The most prevalent failure type was adhesive between the dentin and cement for the EDTA and HS groups, followed by mixed failure for the CL and HS groups. GFP bond strength was not affected by ultrasonic instrumentation ( $p=0.114$ ), nor was it different between root thirds ( $p=0.280$ ). **Conclusion:** The GFP bond strength to root dentin was influenced by the irrigant used, being the greatest values obtained with 17% EDTA when compared to CL and SF with or without passive ultrasonic instrumentation.

Souza Batista, V.E.; et al **Surface Characterization of a Glass Fiber Post after Nonthermal Plasma Treatment with Hexamethyldisiloxane.** J Adhes Dent 2017; 19: 525–533.

**Purpose:** To characterize the surface of glass fiber posts (GFP) after different surface treatments and evaluate which method incorporates higher amounts of silicon (Si) particles, as well as to evaluate the bond strength at the post/composite-cement interface with four different surface treatments of glass fiber posts luted with composite cement. **Materials and Methods:** Twelve glass fiber posts (Exacto – Angelus) were obtained from the manufacturer. The posts were randomly distributed into four groups (n = 3): Co (control), no surface treatment; S, 70% alcohol and silane (60 s); HF + S, 10% hydrofluoric acid gel (60 s) and silane (60 s); NTP, nonthermal plasma of hexamethyldisiloxane (HMDSO) associated with argon (30 min). The surface of each GFP was characterized through scanning electron microscopy (SEM) and energy dispersive spectroscopy (EDS). Forty GFPs were randomly divided into 4 groups according to the surface treatments (n = 10) and cemented with one composite cement (Rely X U200) into artificial canine teeth. The specimens were placed in a universal testing machine and subjected to tensile testing until failure occurred. Statistical analysis of the atomic percentage and bond strength was performed using ANOVA, followed by the post-hoc Tukey test (p = 0.05). **Results:** EDS graphics showed that the NTP group had a higher Si atomic percentage (at%) than the other groups (p < 0.001). The HF + S group had a higher Si at% than did the Co and S groups. SEM images illustrated that the surfaces of the GFPs were variously modified after different treatments. The NTP group incorporated higher Si levels on the GFP surface and yielded the highest bond strengths (p < 0.005) compared to the other tested groups. **Conclusion:** Treatment with HMDSO + Ar plasma (NTP) incorporated higher Si levels on the surface of the GFPs without inducing critical defects. NTP treatment promoted better bond strength results when compared to the other tested group when GFPs were cemented with composite cement.

**GOMES, G.M.;ET AL. Use of a Direct Anatomic Post in a Flared Root Canal: A Three-year Follow-up. Operative Dentistry, 2016, 41-1**

**Clinical Relevance**

A standard fiber post does not adapt well to a flared root canal preparation, leaving a large cement space between the post and the tooth structure. Direct anatomic posts provide an alternative technique for restoring these teeth with less chance of debonding.

**Summary:** The following case report describes the three-year follow-up after rehabilitation of a flared root canal using a direct anatomic post (a resin composite combined with a prefabricated glass fiber post (Exacto -Angelus) associated with metal-free ceramic restoration. The report presents the clinical protocol for the fabrication of the posts, which provide an intimate fit to the remaining root and mechanical properties similar to those of the dental structure. These posts serve as an alternative to conventional metal cores.

**NOVAIS, V.R.; ET AL.; Correlation between the Mechanical Properties and Structural Characteristics of Different Fiber Posts Systems.**  
Brazilian Dental Journal (2016) 27(1): 46-51

The aim of this study was to evaluate the flexural strength and flexural modulus of different fiber-reinforcement composite (FRC) posts and determine the correlation between mechanical properties and structural characteristics. Eleven brands of fiber posts were analyzed (n=10): Exacto Cônico (Angelus), DT Light SL (VDW), RelyX Fiber Post (3M-Espe), Glassix Radiopaque (Nordim), Para Post Fiber White (Coltène), FRC Postec Plus (Ivoclar), Aestheti-Plus Post (Bisco), Superpost Cônico Estriado (Superdont), Superpost Ultrafine (Superdont), Reforpost (Angelus), and White Post DC (FGM). The posts were loaded in three-point bending test to calculate the flexural strength and flexural modulus using a mechanical testing machine (EMIC 2000 DL) at 0.5 mm/min. Data were submitted to one-way ANOVA and Scott-Knot test ( $p < 0.05$ ). The cross-sections of the posts were examined by scanning electron microscopy (SEM). Correlation between the mechanical properties and each of the structural variables was calculated by Pearson's correlation coefficients ( $p < 0.05$ ). The flexural strength values ranged from 493 to 835 MPa and were directly correlated with the fiber/matrix ratio ( $p = 0.011$ ). The flexural modulus ranged from 4500 to 8824 MPa and was inversely correlated with the number of fibers per mm<sup>2</sup> of post ( $p < 0.001$ ). It was concluded that the structural characteristics significantly affected the properties of the FRC posts. The structural characteristic and mechanical properties of fiber glass posts are manufacture-dependent. A linear correlation between flexural strength and fiber/matrix ratio, as well as the flexural modulus and the amount of fiber was found.

**NOVAIS, V.R.; ET AL. Correlation between the Mechanical Properties and Structural Characteristics of Different Fiber Posts Systems. Brazilian Dental Journal (2016) 27(1): 46-51**

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MACHADO, M.B.M.; ET AL. **Effects of immediate and delayed intraradicular preparation on bond strength of fiber posts.** Indian Journal of Dental Research, 26(3), 2015

**Abstract**

**Background:** To assist the retention of restorations prepared in endodontically treated teeth, fiber posts are widely used in dental practice. The ideal time to prepare space for the post is still controversial. **Aim:** The purpose of this study was to evaluate the effects of immediate and delayed postspace preparation on the retention of the self-adhesive resin cement. **Materials and Methods:** Twelve bovine teeth were used with sectioned roots standardized to 19 mm. The teeth were properly instrumented and filled with gutta-percha and eugenol-free cement AH Plus. Two experimental groups (n = 6) were created based on the different times of post preparation (immediate and delayed). Using cemented cylindrical fiber posts ( Exacto – Angelus), the teeth were put in acrylic resin and polyvinyl chloride tubes, where the cuts were made. Two slices were obtained from the cervical third, two from the medium third and two from the apical third. Subsequently, the samples were subjected into push-out tests. Statistical analysis were performed using ANOVA and Tukey's test (P = 5%). **Results:** The results indicated that, for all of the evaluated thirds, delayed preparation showed greater bond strength than immediate preparation. **Conclusion:** A delayed post preparation of the root space, following the root canal filling, is recommended.

WEBBER,M.B.F.; ET AL. **Analysis of Bond Strength by Pull Out Test on Fiber Glass Posts Cemented in Different Lengths.**Journal of International Oral Health 2015; 7(4):7-12

**Abstract**

**Background:** The aim of this study was to evaluate, by means of pull-out test, the bond strength of fiberglass posts when cemented with different lengths in endodontically treated teeth. **Materials and Methods:** Sixty single-rooted bovine roots were cut in the cemento-enamel junction with 21 mm length. They were endodontically treated and randomly divided into three groups (n = 20). Group 1 - Preparation of 2/3 of the remaining roots; Group 2 - Preparation of 1/2 of the remaining roots and Group 3 - Preparation of 1/4 of remaining roots. For all groups it were used posts n = 3 (Exacto, Angelus, Brazil), and cemented with self-etching resin cement (RelyXU200). After cementing posts, the samples were thermocycled (10.000 cycles/5°C and 55°C). The pull-out test was performed on a universal testing machine (EMIC - DL500) and the values obtained were statistically analyzed by analysis of variance (one-factor ANOVA) and multiple comparison test of Tukey, with level of significance of 5%. **Results:** The mean values ± standard deviation in Newtons (N) were: Group 1 = 120.5 (±42.8) A, Group 2 = 103.1 (±31.2) AB, Group 3 = 41.2 (±22.4) C, P < 0.005. **Conclusion:** The preparation of 1/2 of remaining root appears to be a viable alternative when 2/3 of the preparation of the remaining root is not possible, but more results are needed for clinical validation.

REZAEI, D. M et al. **Fracture resistance of upper central incisors restored with different posts and cores.** RDE <http://dx.doi.org/10.5395/rde.2015.40.3.229>

**Objectives:** To determine and compare the fracture resistance of endodontically treated maxillary central incisors restored with different posts and cores. **Materials and Methods:** Forty-eight upper central incisors were randomly divided into four groups: cast post and core (group 1), fiber-reinforced composite (FRC) post( Exacto -Angelus) and composite core (group 2), composite post and core (group 3), and controls (group 4). Mesio-distal and bucco-lingual dimensions at 7 and 14 mm from the apex were compared to ensure standardization among the groups. Twelve teeth were prepared for crown restoration (group 4). Teeth in other groups were endodontically treated, decoronated at 14 mm from the apex, and prepared for posts and cores. Resin-based materials were used for cementation in groups 1 and 2. In group 3, composite was used directly to fill the post space and for core build-up. All samples were restored by standard metal crowns using glass ionomer cement, mounted at 135° vertical angle, subjected to thermomechanical aging, and then fractured using a universal testing machine. Kruskal-Wallis and Mann-Whitney U tests were used to analyze the data. **Results:** Fracture resistance of the groups was as follows: Control (group 4) > cast post and core (group 1) > fiber post and composite core (group 2) > composite post and core (group 3). All samples in groups 2 and 3 fractured in restorable patterns, whereas most (58%) in group 1 were non-restorable. **Conclusions:** Within the limitations of this study, FRC posts showed acceptable fracture resistance with favorable fracture patterns for reconstruction of upper central incisors.

ARAUJO, D.F.G. et al . **Influence of 2% chlorhexidine digluconate on bond strength of a glass-fibre post luted with resin or glass-ionomer based cement.** journal of dentistry 42(2014) 735–74

**Abstract**

**Objectives:** This study evaluated the influence of 2% chlorhexidine digluconate (CHX) on the bond strength (BS) of a glass-fibre post ( Exacto – Angelus) to the root canal, regarding the cements (dual-cured resin or resin-modified glass-ionomer cement), the root thirds and the time of storage. **Method:** Eighty bovine roots were selected and endodontically treated, before being randomly assigned to the following groups according to the luting protocol: ARC (RelyX ARC); ARC + CHX; RL (RelyX Luting 2); and RL + CHX. After 24 h of luting, the roots were sliced to obtain 1 mm-thick slices. Half of each group was submitted to either 7-day or 6-month storage in artificial saliva (n = 10). The specimens were subjected to push-out tests with a crosshead speed of 0.5 mm/min. The data were analysed with four-way ANOVA and Tukey's test ( $P \leq 0.05$ ). The failure modes were analysed with a digital microscope (50 $\times$  and 200 $\times$ ). **Results:** ARC yielded a significantly higher BS compared to RL ( $P < 0.001$ ). Despite CHX exerted a significant effect; it depends on the interaction with the luting cement and time ( $P < 0.001$ ). Thus, CHX decreased the values of BS to those of ARC after 6 months ( $P < 0.001$ ). On the 7th day of storage, the ARC + CHX presented higher BS to the cervical and middle thirds compared to RL + CHX ( $P = 0.012$ ). Time solely was not a significant factor ( $P = 0.081$ ). Adhesive cement-dentine type and mixed failures were predominant modes for the ARC groups. For the RL groups, the main failures were adhesive cement-post and mixed modes. **Conclusions:** Glass-fibre posts luted with RelyX ARC dual-cure resin cement exhibited higher BS than those luted with RelyX Luting 2 resin-modified glass-ionomer cement. Furthermore, CHX was not effective to improve the BS and negatively affected the BS of RelyX ARC after 6 months of storage. **Clinical significance:** The use of chlorhexidine solution seems not to improve the bond strength of fibre posts to root canals, disregarding the composition of the luting cement.

**VALDIVIA, A.D.C.M.; ET AL . Effect of Surface Treatment of Fiberglass Posts on Bond Strength to Root Dentin. Brazilian Dental Journal (2014) 25(4): 314-320**

This study evaluated the influence of the surface treatments of fiberglass posts on bond strength to root dentin using push-out test. Forty bovine incisor roots were endodontically treated. The surface of the fiberglass posts (Exacto #2, Angelus) were treated using 4 different protocols (n=10): Control - 70% ethanol for 1 min; 37% phosphoric acid for 1 min; 10% hydrofluoric acid for 1 min; and 24% hydrogen peroxide for 1 min. After a silane coupling agent was applied for 1 min and all posts were cemented using self-adhesive resin cement (RelyX Unicem, 3M-ESPE). The roots were sectioned and two 1-mm-thick slices were obtained from each third: cervical, middle and apical. The specimens were subjected to the push-out test with a crosshead speed of 0.5 mm/min. Data were analyzed by repeated measures ANOVA followed by Tukey's HSD tests ( $\alpha=0.05$ ). The surface treatment ( $p<0.001$ ) and root third region ( $p=0.007$ ) factors were significant. The retention to root canal was affected by surface treatment type. The post surface treatment with 24% hydrogen peroxide for 1 min yielded significantly higher bond strength when the fiberglass posts were cemented with RelyX Unicem.

SHARAFEDDIN, F.; ET AL. **Fracture resistance of structurally compromised premolar roots restored with single and accessory glass or quartz fiber posts.** Dent Res J (Isfahan). 2014 Mar-Apr; 11(2): 264–271.

#### **Abstract**

**Background:** Glass and quartz fiber posts are used in restoration of structurally compromised roots. Accessory fiber posts are recently introduced to enhance the fiber post adaptation. This study evaluated the effectiveness of glass versus quartz accessory fiber posts.

**Materials and Methods:** In this experimental study, 40 mandibular premolar roots with similar dimension (radius of  $3.5 \pm 0.2$  mm and length of  $13 \pm 0.5$  mm) were selected and their root canals were flared until 1.5 mm of dentin wall remained. They were randomly assigned to four groups ( $n = 10$ ) and restored as follows: Exacto glass fiber post (EX) (Exacto – Angelus), Exacto glass fiber post + 2 Reforpin accessories (EXR) (Reforpin -Angelus), D. T. Light quartz fiber post (DT), and D. T. Light quartz fiber post + 2 Fibercone accessories (DTF). All posts were cemented with Duo-Link resin cement and the cores were built with the particulate filler composite. Following 1-week water storage, specimens were subjected to fracture loads in a universal testing machine. The maximum loads and failure modes were recorded and analyzed with the two-way analysis of variance (ANOVA) and Fisher's exact tests ( $\alpha = 0.05$ ). **Results:** The mean fracture resistance values (N) were 402.8 (EX), 378.4 (EXR), 400.1 (DT), and 348.5 (DTF). Two-way ANOVA test showed neither reinforcing method ( $P = 0.094$ ), nor post composition ( $P = 0.462$ ) had statistically significant differences on fracture resistance of the structurally compromised premolar teeth. Fisher's exact test also demonstrated no statistically significant difference regarding two variables ( $P = 0.695$ ). Core fracture was the most common failure mode (62.5%). **Conclusion:** Glass and quartz fiber posts with or without accessories restored the weakened premolar roots equally.

WANG, L. et al . **Effect of 2% chlorhexidine digluconate on bond strength of a glass-fibre post to root dentine.** International Endodontic Journal. 2013

#### **Abstract**

**Aim:** To assess the immediate influence of dentine bonding systems (DBS) associated with 2% chlorhexidine digluconate (CHX) on glass-fibre post-bond strength to root dentine, in terms of coronal, middle and apical thirds. SBMP (3-step etch-and-rinse system, Scotchbond Multi-Purpose), SB (2-step etch-and-rinse system, Single Bond 2), SE (2-step self-etching system, Clearfil SE Bond) and SBMP-CHX, SB-CHX and SE-CHX, respectively, associated with CHX. For all groups, a glassfibre post ( Exacto- Angelus) was luted with a dual-cure resin cement, RelyX ARC. After 7-day storage, specimens were subjected to the push-out test. Failure modes were analysed under optical microscopy (40x). Bond strength values were statistically analysed by two-way ANOVA and Bonferroni tests ( $P < 0.05$ ). **Results:** The effect of DBS was significant ( $P < 0.05$ ), and SE reached higher bond strength in comparison with the other DBS tested. CHX association did not show improvement with any DBS ( $P > 0.05$ ); rather, it negatively affected SE, which was detected for all thirds. There was no difference between thirds ( $P > 0.05$ ), except for the SE-CHX, which presented lower values for the apical third ( $P < 0.05$ ). Adhesive cement/dentine adhesive failure was predominant for all groups. CHX did not influence the failure mode for any DBS ( $P > 0.05$ ). **Conclusions:** The performance of the dentine bonding systems was material dependent. CHX did not improve immediate bond strength; however, CHX negatively affected the bond strength of the self-etching system, especially in the third apical.

LUIZ, B.K.M.; ET AL, **Fracture resistance, two point bending strength and morphological characteristics of pulpless teeth restored with fiber-reinforced composite posts.** RSBO. 2012 Jul-Sep;9(3):272-9

**Abstract**

**Introduction:** Fiber-reinforced composite posts (FRC posts) have been used for tooth reinforcement after endodontic treatment. The mechanical characteristics of FRC posts can influence the clinical prognostic. **Objective:** The aim of this study was to evaluate the flexural strength and fracture resistance of commercially available FRC posts **Material and methods:** Fourteen human single-rooted premolars with completely formed apices were selected and received endodontic treatment. The specimens were divided into two groups related to the post system: i) Group A – cylindrical-conical fiber-reinforced post (White post DC, FGM), and ii) group B – conical fiber-reinforced post (EXACTO, Angelus). The fracture resistance was evaluated and two point bending tests were carried out. The glass fiber characteristics and the tag penetration of the luting material into the radicular dentin structure were evaluated through scanning electronic microscopy in an illustrative way. One-way ANOVA and Tukey's HSD test ( $\alpha = 0.05$ ) were applied. **Results:** The values obtained for fracture resistance and two point bending test were, respectively, 399.29 N and 109.5 N for group A, and 386.25 N and 119.5 N for group B. No significant differences in strength values among the groups were found. **Conclusion:** There were no significant statistical differences between the two post groups regarding to fracture strength and two point bending strength. It can be concluded that the posts selected for this study performed satisfactorily in terms of mechanical properties so that they can be used for tooth reinforcement after endodontic treatment.

**MOSHARRAF, R.; ET AL; Comparative evaluation of effects of different surface treatment methods on bond strength between fiber post and composite core. J Adv Prosthodont 2012;4:103-8**

**Purpose.** Debonding of a composite resin core of the fiber post often occurs at the interface between these two materials. The aim of this study was to evaluate the effects of different surface treatment methods on bond strength between fiber posts and composite core. **Materials and methods.** Sixty-four fiber posts were picked in two groups (Hetco and Exacto - Angelus). Each group was further divided into four subgroups using different surface treatments: 1) silanization; 2) sandblasting; 3) Treatment with 24% H<sub>2</sub>O<sub>2</sub>, and 4) no treatment (control group). A cylindrical plexiglass matrix was placed around the post and filled with the core resin composite. Specimens were stored in 5000 thermal cycles between 5°C and 55°C. Tensile bond strength (TBS) test and evaluation using stereomicroscope were performed on the specimen and the data were analyzed using two-way ANOVA, Post Hoc Scheffe tests and Fisher's Exact Test ( $\alpha=.05$ ). **Results.** There was a significant difference between the effect of different surface treatments on TBS ( $P<.001$ ) but different brands of post ( $P=.743$ ) and interaction between the brand of post and surface treatment ( $P=.922$ ) had no significant effect on TBS. Both silanization and sandblasting improved the bonding strength of fiber post to composite resin core, but there were not any significant differences between these groups and control group. **Conclusion.** There was not any significant difference between two brands of fiber posts that had been used in this study. Although silanization and sandblasting can improve the TBS, there was not any significant differences between surface treatments used.

CUNHA,L.F,ET AL.; **Compromised Bond Strength after Root Dentin Deproteinization Reversed with Ascorbic Acid.** JOE – Volume 36, Number 1, January 2010

**Abstract**

**Introduction:** The present study evaluated the effect of a reducing agent on the bond strength of deproteinized root canal dentin surfaces when using a self-adhesive versus dual-cured cement. Regional differences were also evaluated.

**Methods:** A total of 45 bovine incisor roots were divided into 3 groups: irrigation with physiologic solution (control), 10-minute deproteinization with 5% NaOCl, and 10-minute deproteinization with 5% NaOCl followed by 10 minutes of 10% ascorbic acid. Fiber posts (Exacto – Angelus) were cemented with either RelyX U100 or RelyX ARC (with SingleBond 2 or Clearfil SE Bond). The push-out bond strength was evaluated after 24 hours of storage. Data were submitted to three-way analyses of variance and Dunnett T3 tests ( $\alpha = 0.05$ ).

**Results:** No differences between cements were observed within the testing conditions, regardless of the adhesive ( $P < .05$ ). Deproteinization reduced bond strengths. Subsequent treatment with ascorbic acid was capable of reversing bond strength value changes to levels similar to those of controls. Regional radicular differences were also found, where coronal > middle > apical. **Conclusions:** The reducing agent was capable of reversing the effect of dentin deproteinization, and RelyX U100 behaved similarly to RelyX ARC.

SILVA, N.R.; ET AL. **The effect of post, core, crown type, and ferrule presence on the biomechanical behavior of endodontically treated bovine anterior teeth.** J Prosthet Dent 2010;104:306-317)

**Statement of problem:** Unresolved controversy exists concerning the remaining coronal tooth structure of anterior endodontically treated teeth and the best treatment option for restoring them. **Purpose:** The purpose of this study was to evaluate the effect of post, core, crown type, and ferrule presence on the deformation, fracture resistance, and fracture mode of endodontically treated bovine incisors. **Material and methods:** One hundred and eighty bovine incisors were selected and divided into 12 treatment groups (n=15). The treatment variations were: with or without ferrule, restored with cast post and core, glass fiber post ( Exacto -Angelus)with composite resin core, or glass fiber post with fiber-reinforced core, and metal- or alumina-reinforced ceramic crown (n=15). The restored incisors were loaded at a 135-degree angle, and the deformation was measured using strain gauges placed on the buccal and proximal root surfaces. Specimens were subsequently loaded to the point of fracture. Strain and fracture resistance results were analyzed by 3-way ANOVA and Tukey HSD tests ( $\alpha=.05$ ). **Results:** Ferrule presence did not significantly influence the buccal strain and fracture resistance for the ceramic crown groups, irrespective of core and crown type. Ferrule presence resulted in lower strains and higher fracture resistance in the metal crown groups, irrespective of core. The cast post and core showed lower strain values than groups with glass fiber posts when restored with metal crowns. **Conclusions:** Core type did not affect the deformation and fracture resistance of endodontically treated incisors restored with alumina-reinforced ceramic crowns. The presence of a ferrule improved the mechanical behavior of teeth restored with metal crowns, irrespective of core type.

COELHO, C. S. M.; et al. **Finite element analysis of weakened roots restored with composite resin and posts** Dental Materials Journal 2009; 28(6): 671–678

Finite element analysis (FEA) was used to investigate the influence of different post systems on the stress distribution of weakened teeth under oblique-load application. A maxillary central incisor root obtained from a sound tooth was weakened by partial removal of dentin inside the root canal. Seven two-dimensional numerical models, one from the sound tooth and six from the weakened root restored with composite resin and post systems were created as follows – ST: sound tooth; CPC: cast CuAl post and core; SSP: stainless steel post + composite core; GP: fiberglass (Exacto-Angelus) + composite core; CP: carbon fiber + composite core; ZP: zirconium dioxide post + composite core; TP: titanium post + composite core. The numerical models were considered to be restored with a leucite-reinforced all-ceramic crown and received a 45° occlusal load (10 N) on the lingual surface. All the materials and structures were considered linear elastic, homogeneous, and isotropic, with the exception of fiberglass and carbon fiber posts which assumed orthotropic behavior. The numerical models were plotted and meshed with isoparametric elements, and the results were analyzed using von Mises and Sy stress criteria. When compared with the sound tooth, FEA revealed differences in stress distribution when post systems were used. Among the restored teeth, the use of CPC, SSP, ZP, and TP resulted in higher stress concentration in the post itself when compared to GP and CP. Therefore, results from the FEA images suggested that the use of non-metallic post systems could result in improved mechanical behavior for the weakened restored teeth.

**MONTE-ALTO,R.V.; ET AL. Restauração de Dentes Tratados Endodonticamente com Pino de Fibra de Vidro e Acessório em Canais Amplos.** Clínica - International Journal of Brazilian Dentistry, Florianópolis, v.4, n.2, p. 174-181, abr./jun. 2008

**Abstract**

The use of fiber glass posts(Exacto Angelus) in the restoration of endodontically treated teeth has been extensively increased. However, due to different diameters and shapes (too elliptical or too large) of the root canals, the cement layer could be very thick, potentially increasing microleakage and decreasing the post and core fracture strength. This article reports a clinical sequence of fabrication of a post and core in a maxillary lateral incisor which had a large root canal. After clinical and radiographic analyses, the use of a fiber glass post associated with accessory fiber glass post was indicated.

FRANCO,A.P.G.O; **Análise não linear do mecanismo de cimentação de pinos intra-radiculares utilizando método dos elementos finitos**.162 p.2008 Dissertação (Mestrado em Dentística Restauradora) - Universidade Estadual de Ponta Grossa, Ponta Grossa.2008.

#### NO-LINEAR ANALYSIS OF CEMENTATION MECHANISM IN ROOT POSTS USING THE FINITES ELEMENTS METHOD

The aim is to analyze a non-linear mechanism of the cementation of root posts considering the existence of gaps in cement-dentin and cement-post interfaces analyzing the correlation of mechanical test and computational model. Were selected 15 mandibular pre-molars, to receive root posts Exacto (Angelus®/Londrina - Brazil) fixed with chemical resin cement Cement-Post (Angelus®/Londrina - Brazil). The teeth were thermocycled, radiographed and cuted themselves getting cervical, middle and apical discs of roots. These discs were treated and molded with addition of silicone and epoxy resin replicas was obtained before and after the compression test (220 N-0, 2 mm / min). The replicas were analyzed in MEV to observe the formation of gaps at the interfaces on the upper surfaces of the specimens, which were measured in the Image Tool program. For statistical analysis of the comparison between the mensures of gaps ( $\mu\text{m}$ ) in the interface was used in the Wilcoxon test which showed that there were statistical differences between groups ( $p < 0.0001$ ). In the comparison between the mensures of gaps in the same interface of the cervical, middle and apical discs before and after the compression test, there was no statistically significant difference ( $p = 0.4304$ ) and ( $p = 0.7766$ ), respectively. In cement-post interface there was no gaps in most specimens. The dentin discs were photographed and their images obtained from three-dimensional models simulating the compression test using the Finite Elements Method, considering linear-elastic material with values of module of elasticity and Poisson's coefficient, and obtained in the mechanical test of the traction, compression and bending resistance in the post and/or the cement. There was the Poisson's effect and a low stress concentration in dentin-cement and cement-post interfaces promoted by the force application, geometry and materials properties. In assessing the match of the mechanical test with the computational model, met a difference because of the consideration of perfect adhesion in computational model of the cervical and middle discs, which does not occur clinically, as there was formation of gaps in some root regions of the dentin discs. The apical discs were modeled like non-linear and it was considered an area of contact between the faces.

## REFORPOST FIBER GLASS POST ARTICLE

BOLHARI,B.; ET AL. **Fracture Resistance of Simulated Immature Teeth Obturated with Gutta-Percha or Resilon and Reinforced by Composite or Post.** Journal of Dentistry, Tehran University of Medical Sciences, Tehran, Iran (2015; Vol. 12, No. 2)

### Abstract

**Objectives:** The purpose of this ex- vivo study was to evaluate the fracture resistance of simulated immature teeth, obturated with Gutta-percha or Resilon and reinforced by either composite resin or fiber post. **Materials and Methods:** Eighty-four human maxillary incisors were divided into seven groups (n=12). Teeth in all groups were prepared until Peeso #5 (1.5mm) could be passed through the apex. Root ends received 4mm of MTA plug as an apical barrier. Groups received the followings: 1.Gutta-percha, 2.Resilon, 3.Gutta-percha + composite resin, 4.Resilon + composite resin, 5.Gutta-percha + fiber post (Reforpost – Angelus) , 6.Resilon + fiber post ( Reforpost -Angelus) and 7.No obturation (control group). Access openings were filled with composite resin. Specimens were then subjected to oblique load using Instron Testing Machine. The mean peak load at fracture was recorded and analyzed using ANOVA. **Results:** Experimental groups had a significantly more fracture resistance than the control group ( $P < 0.05$ ). No significant difference was seen between experimental groups. Teeth reinforced by fiber post showed favorable fracture resistance. **Conclusion:** Treatment plans used in this study increase the fracture resistance of immature teeth. Use of fiber posts in immature teeth, may be the most favorable clinically applicable technique.

DALAPRANE, B.; PEREIRA, N.B.; BUENO, A.C.; VAZ, R.R.; MOREIRA, A.N. MAGALHÃES, C.C.. **The Effect of Light-curing Access and Different Resin Cements on Apical Bond Strength of Fiber Posts**; Operative Dentistry, 2014, 39-2, 000-000

### **Clinical Relevance**

Cementation of fiber glass posts with self-adhesive cement (RelyX U100) is more predictable than cementation with resin cement using a three-step etch-and-rinse adhesive system (RelyX ARC/SBMP) as its bond strength to apical dentin was not influenced by the level of light-curing access.

### **Summary**

**Purpose:** This study evaluated the effect of light-curing access on the bond strength of fiber glass posts to the apical area of bovine roots using self-adhesive cement or dual-cured cement with an etch-and-rinse adhesive system. **Materials and Methods:** The root canals of 60 bovine teeth were endodontically treated and filled. A 15-mm-length post space was prepared and roots were randomly divided into three groups, simulating the levels of light-curing access: coronal (C), with 15-mm post space; middle (M), in which the coronal thirds of roots were cut out, leaving a 10-mm post space; and apical (A), in which the coronal and middle thirds of roots were cut out, leaving a 5-mm post space. Fiber glass posts (Reforpost # 3, Angelus) were cemented with RelyX U100 (3M ESPE) or RelyX ARC/Scotchbond Multi Purpose Plus (SBMP) (3M ESPE) (n=10) and lightcured. After 24 hours, the apical thirds of roots were sectioned perpendicularly to the long axis and submitted to a push-out test (0.5/ mmmin, 200 N). The Kruskal-Wallis test compared the three levels of light-curing access, and the Mann-Whitney test compared the cements. Results: The bond strength was significantly higher in the groups C (p=0.028) and M (p=0.016) when U100 was used, whereas it was similar for both cements in group A. The bond strengths of posts cemented with ARC/ SBMP were significantly higher in group A compared to group C (p=0.031). **Conclusions:** The type of cement used and the light-curing access level influenced the bond strength between glass fiber posts and root canals. The bond strength of the RelyX ARC/ SBMP cement proved to be more dependent on photoactivation than was the RelyX U100 cement. The light-curing access level did not influence the apical bond strength of RelyX U100.

SARI, T. et al. **Microleakage of Teeth Restored with Different Adhesive Dowel Systems: An In Vitro Study.** Journal of Prosthodontics 23 (2014) 45–49

**Abstract**

**Purpose:** Commercial fiber-reinforced dowel systems are marketed as having better adhesion and sealing ability than conventional metallic dowel systems. The aim of this in vitro study was to evaluate the microleakage of teeth restored with nine dowel systems. **Materials and Methods:** Ninety mandibular second premolar teeth were decoronated, and nine homogenous groups were composed of ten teeth each. Root canal and dowel space preparations were made, and eight fiber-reinforced composite dowel systems and one stainless steel dowel system were used to fabricate dowel restorations. Microleakage measurements of the restored teeth were made with a modified fluid filtration method, and data were collected. One sample Kolmogorov-Smirnov, oneway ANOVA, and Tukey-HSD tests were performed on the relative microleakage data of the groups. **Results:** Microleakage values were reported relative to those for teeth with unfilled canals. The highest and lowest relative microleakage values were recorded for the metallic Parapost ( $7.06 \times 10^{-4}\%$ ) and fiber-reinforced Everstick ( $3.55 \times 10^{-4}\%$ ) groups, respectively. Significant differences in relative microleakage between the fiber-reinforced dowels and stainless steel dowels were observed. Significant differences among the fiber-reinforced dowel groups were observed as well. **Conclusions:** The sealing ability of all fiber-reinforced composite dowels is not better than that of stainless steel dowels, and there are significant differences among different fiber-reinforced dowel systems as well. Differences among commercial dowel systems must be taken into consideration when making a selection.

KESWANI, K.; ET AL. **A Comparative Evaluation of the Retention of Tooth Coloured and Stainless Steel Endodontic Posts: An In-vitro Study.** *Journal of Clinical and Diagnostic Research.* 2014 Apr, Vol-8(4): ZC04-ZC06

**Abstract**

**Aims:** This in vitro study evaluated: a) the retention of stainless steel posts of 1.5 mm diameter which were cemented with Zinc Phosphate cement versus Glass fiber posts( Reforpost – Angelus) with 1.1 mm, 1.3 mm and 1.5 mm diameters which were cemented with resin cement and b) the effect of change in diameter on the retention of Glass fiber posts with 1.1 mm, 1.3 mm and 1.5 mm diameters. **Materials and Methods:** Sixty extracted mandibular premolar teeth were endodontically treated and randomly assigned to four groups of fifteen teeth each. In Groups I, II and III glass fibre posts with diameters 1.1 mm, 1.3 mm and 1.5 mm were cemented by using resin cement. In Group IV, stainless steel posts with diameter 1.5 mm were cemented by using zinc phosphate cement. The specimens were tested for tensile loading at a cross head speed of 2.0 mm/min, on a universal testing machine. **Statistical Analysis Used:** One way analysis of variance and Tukey's (post-hoc) test. **Results:** Mean tensile strength from highest to lowest was in the order of Group IV, Group II, Group III, Group I. Statistically significant differences were observed between the mean tensile strengths between Groups I and II, Groups I and III, Groups I and IV, Groups II and IV, Groups III and IV, while non significant differences were observed between Groups II and III. **Conclusion:** Stainless steel posts were more retentive than glass fibre posts. Glass fibre posts with 1.3 mm or 1.5 mm diameters provided significantly greater retention as compared to 1.1 mm diameter posts.

FULETRA, H.; ET AL. **Comparative Evaluation of the Tensile Bond Strength of Custom and Pre-Fabricated Posts – An in Vitro Study.** Adv Hum Biol 2014; 4(2):9-13.

**Abstract**

**Aim:** To evaluate the effect of cyclic loading on the tensile bond strength and retention of customfabricated cast posts, prefabricated metal posts and glass fiber posts. **Materials and Method:** Thirty extracted human maxillary central incisors were decoronated at the cemento-enamel junction (CEJ) and randomly divided into three groups (n=10). Specimens were instrumented and obturated. Twenty four hours after obturation, post space was prepared upto no. 5 Peeso Reamer. Groups A, B and C were restored using custom cast post and core, Para Post (Whale dent) and Reforpost (Angelus) respectively thereafter. Five specimens from each group were subjected to cyclic loading. Tensile bond strength (TBS) of teeth before and after cyclic loading was evaluated. **Results:** For both, with and without loading, Groups A and B were not significantly different from each other but Group C was significantly different from Groups A and B. The results indicated that cyclic loading reduces retention potential of all three types of post, but it was minimum in group C. **Conclusions:** Cyclic loading reduced the retention of all posts but was comparatively lesser for the glass fiber post. This system provides sufficient retention required for clinical success.

MACEDO, V.C.; SOUZA,N.A.Y.; FARIA, A.L.;COTES,C.; SILVA, C.; MARTINELLI,M. KIMPARA, E.T. **Pullout Bond Strength of Fiber Posts Luted to Different Depths and Submitted to Artificial Aging.** Operative Dentistry, 2013, 38-4

### **Clinical Relevance**

Increased depth of luting tended to improve the fiber post retention. The bond strength of the self-adhesive resin cement was less affected by aging than the conventional resin cement.

### **Summary**

**Introduction:** The extension of fiber post cementation often does not seem to influence the fracture resistance of restorations. This study evaluated the effects of cementation depths on the retention of fiber posts submitted to artificial aging.

**Methods:** One hundred and sixty bovine incisors were selected to assess post retention. Following endodontic treatment, the canals were flared with diamonds burs. Postholes were prepared in lengths of 5 or 10 mm, after which fiber posts (Reforpost – Angelus) were relined with composite resin and luted with RelyX ARC or RelyX Unicem. The samples were then submitted to thermal and/or mechanical cycling before testing their pullout bond strengths. Absence of cycling was used as a control. The results of each cement were submitted to two-way and post hoc Tukey tests ( $\alpha=0.05$ ). **Results:** Independent of the aging protocol, a depth of 10 mm showed higher pullout bond strength than did 5 mm, except for RelyX Unicem without cycling. For RelyX ARC, thermomechanical cycling resulted in lower values than in the absence of cycling. Mechanical cycling alone promoted the highest bond strength when the posts were luted with RelyX Unicem. **Conclusion:** The effect of artificial aging on the pullout bond strength is dependent on the type of material and the depth.

SARI, T. et al .**The fracture resistance of teeth restored with different adhesive dowels.** Acta Odontologica Scandinavica, 2013; Early Online, 1–6

#### **Abstract**

**Objective:** Fiber-reinforced composite dowels are suggested to be a better alternative to metal dowels. This in vitro study evaluated the fracture resistance and fracture modes of teeth restored with nine different dowel systems. **Materials and methods:** Ninety mandibular pre-molar teeth were decoronated and nine homogenous groups were composed. Root canal and dowel canal preparations were made and nine different dowel systems were used to fabricate restorations. Core build-ups were made with a composite resin core material. Specimens were mounted in acrylic resin blocks and continuous compressive force was applied until fracture occurred. Fracture resistance and fracture mode data were collected. One-sample Kolmogorov-Smirnov and one-way ANOVA tests were performed for the fracture resistance data of the groups. **Results:** There were no significant differences among the fracture resistances of the groups. All specimens of the pre-fabricated stainless steel dowel group fractured catastrophically. However, even in the worst-case, five specimens of the fiber-reinforced composite groups had favorable fracture modes. **Conclusions:** The teeth restored with fiber reinforced composite dowels were as resistant to fracture as teeth restored with stainless steel dowels. Fracture modes of teeth restored with fiber reinforced composite dowels were more advantageous than teeth restored with pre-fabricated stainless steel dowels.

BACCHI,A.; ET AL. **Influence of post-thickness and material on the fracture strength of teeth with reduced coronal structure.** J Conserv Dent. 2013 Mar-Apr; 16(2): 139–143.

#### **Abstract**

**Purpose:** To evaluate the fracture strength of endodontically treated teeth with reduced coronal structure reinforced with glass-fiber posts and cast posts and core (nickel–chromium alloy) with different thickness. **Materials and Methods:** Forty maxillary central incisors were sectioned at 1 mm of the cemento-enamel junction and endodontically treated. The teeth were divided into four groups (n = 10) and restored with cast post and core and glass-fiber posts (Reforpost – Angelus) with diameters of 1.5 mm and 1.1 mm. The fracture strength was evaluated using a Universal Testing Machine (Instron 1144) at 45° of angulation. The results were submitted to analysis of variance two-way and Tukey's test (P < 0.05). The failure mode was also evaluated.

**Results:** Cast post and core were statistically superior to the glass-fiber posts with the self-post diameter (P = 0.001). When the self-post material was considered, no significant difference was observed between the two post-diameters (P = 0.749). The glass-fiber post-groups presented more fractures in the cervical third than the cast post and core groups. **Conclusion:** Teeth restored with cast post and cores present higher fracture strength than those reinforced with glass-fiber posts. An increased post-thickness does not increase the fracture strength. Glass-fiber posts lead to less severe fractures.

PEREIRA, J.R. ET AL. **Evaluation of push-out bond strength of four luting agents and SEM observation of the dentine/fibreglass bond interface.** 2013 International Endodontic Journal. Published by Blackwell Publishing Ltda

**Abstract**

**Aim:** To assess the dentine/fibreglass-bonded interface by scanning electron microscopy and the push-out bond strength of four luting cements. **Methodology:** Forty root-filled human canines, with similar root lengths, were restored with fibreglass posts (Reforpost – Angelus) and randomly divided into four groups according to the cements employed (CG Gold Label I, RelyX ARC, BisCem and RelyX U100). After standardized post-space preparation, the root dentine was pretreated for dual-polymerizing resin cements and untreated for the other cements. The mixed luting cement paste was inserted into root canals with a spiral filler and applied to the post-surface that was seated into the root canal. After 7 days, the teeth were sectioned perpendicular to their long axis into 1-mm-thick sections and submitted to a push-out test (1 mm min<sub>-1</sub>). Statistical analyses were carried out by two-way ANOVA and Tukey's tests ( $P < 0.05$ ). **Results:** The bond strength was significantly affected by the type of cement ( $P < 0.001$ ) and by the longitudinal region of the root canal ( $P < 0.031$ ). All cements exhibited gaps at the dentine/cement interface. **Conclusions:** The self-adhesive materials and the glass ionomer cements had the highest push-out bond strength values when compared with the dual-curing resin cement.

**PEREIRA, J.R.; ET AL. Push-out bond strengths of different dental cements used to cement glass fiber posts. J Prosthet Dent 2013;110:134-140**

**Statement of problem:** Since the introduction of glass fiber posts, irreversible vertical root fractures have become a rare occurrence; however, adhesive failure has become the primary failure mode. **Purpose:** The purpose of this study was to evaluate the push-out bond strength of glass fiber posts (Reforpost -Angelus) cemented with different luting agents on 3 segments of the root. **Material and methods:** Eighty human maxillary canines with similar root lengths were randomly divided into 8 groups (n=10) according to the cement assessed (Rely X luting, Luting and Lining, Ketac Cem, Rely X ARC, Biscem, Duo-link, Rely X U100, and Variolink II). After standardized post space preparation, the root dentin was pretreated for dual-polymerizing resin cements and untreated for the other cements. The mixed luting cement paste was inserted into post spaces with a spiral file and applied to the post surface that was seated into the canal. After 7 days, the teeth were sectioned perpendicular to their long axis into 1-mm-thick sections. The push-out test was performed at a speed of 0.5 mm/min until extrusion of the post occurred. The results were evaluated by 2-way ANOVA and the all pairwise multiple comparison procedures (Tukey test) ( $\alpha=0.05$ ). **Results:** ANOVA showed that the type of interaction between cement and root location significantly influenced the push-out strength ( $P<0.05$ ). The highest push-out strength results with root location were obtained with Luting and Lining (S3) ( $19.5 \pm 4.9$  MPa), Ketac Cem (S2) ( $18.6 \pm 5.5$  MPa), and Luting and Lining (S1) ( $18.0 \pm 7.6$  MPa). The lowest mean values were recorded with Variolink II (S1) ( $4.6 \pm 4.0$  MPa), Variolink II (S2) ( $1.6 \pm 1.5$  MPa), and Rely X ARC (S3) ( $0.9 \pm 1.1$  MPa). **Conclusions:** Self-adhesive cements and glass ionomer cements showed significantly higher values compared to dual-polymerizing resin cements. In all root segments, dual-polymerizing resin cements provided significantly lower bond strength. Significant differences among root segments were found only for Duo-link cement.

NAGASE,D; FREITAS, P.M; MORIMOTO S; ODA,M; VIEIRA G.F; **Influence of laser irradiation on fiber post retention**;Lasers in Medical Science; v. 26, n. 3, p. 377-380, MAY 2011.

### **Summary**

**Objective:** The purpose of this in vitro study was to compare the bond strength between fiber post and laser-treated root canals. **Methods:** Forty single-rooted bovine teeth were endodontically treated and randomly divided into four groups (n=10) according to the root canal treatment: G1 - conventional treatment (without laser irradiation), G2 - Nd:YAG laser (1.5 W, 10 Hz, 100 mJ), G3 - Er,Cr:YSGG laser (0.75 W, 20 Hz) and G4 - Nd:YAG + Er,Cr:YSGG lasers. Fiber posts( Reforpost - Angelus) were cemented with an adhesive system + resin cement, in accordance with the manufacturers' instructions. A mini acrylic pipe was fixed on the coronal section of the post using a light polymerized resin. Specimens were mounted on an acrylic pipe with a self-polymerized resin. Retention force was determined using a universal testing machine (0.5mm/min). Data were analyzed using one-way ANOVA and Tukey tests (p<0.05). **Results:** The Nd:YAG laser-treated group (G2) revealed a lower retention force when compared with the other experimental groups. The fractures were observed at the interface between dentin and resin in all groups. **Conclusion:** High intensity lasers can be associated with conventional endodontic treatment, however, root canal surface irradiation using the Nd:YAG laser was shown to negatively affect the post retention force.

**SILVA, G.R.; ET AL; Effect of Post Type and Restorative Techniques on the Strain and Fracture Resistance of Flared Incisor Roots; Braz Dent J (2011) 22(3): 230-237**

Restoring flared endodontically treated teeth continues to be a challenge for clinicians. This study evaluated the effect of post types and restorative techniques on the strain, fracture resistance, and fracture mode of incisors with weakened roots. One hundred five endodontically treated bovine incisors roots (15 mm) were divided into 7 groups (n=15). The two control groups were (C) intact roots restored with Cpc (cast posts and core) or Gfp (glass fiber posts)( Reforpost -Angelus). The five experimental groups were (F) flared roots restored with GfpAp (Gfp associated with accessory glass fiber posts), GfpRc (anatomic Gfp, relined with composite resin), and GfpRcAp (anatomized Gfp with resin and accessory glass fiber posts). All teeth were restored with metal crowns. Mechanical fatigue was performed with 3x10<sup>5</sup>/50 N. Specimens were loaded at 45°, and the strain values (μS) were obtained on root buccal and proximal surfaces. Following that, the fracture resistance (N) was measured. One-way ANOVA and Tukey's HSD tests (α=0.05) were applied, and failure mode was checked. No significant difference in strain values among the groups was found. Cpc presented lower fracture resistance and more catastrophic failures in flared roots. Gfp associated with composite resin or accessory glass fiber posts seems to be an effective method to improve the biomechanical behavior of flared roots.

GORACCI. C. et al. **Current perspectives on post systems: a literature review.** Australian Dental Journal 2011; 56:(1 Suppl): 77–83

### **Abstract**

This literature review summarizes the most recent and reliable evidence on post systems. A search was limited to review articles published over the last 10 years in dental journals with an impact factor. Papers cited in the initially retrieved review articles were also included if significant. Preservation of tooth tissue, presence of a ferrule effect, and adhesion are regarded as the most effective conditions for long-term success of post-endodontic restorations. Adhesively luted fibre-reinforced composite post restorations have demonstrated satisfactory survival rates over relatively long follow-up periods. The clinical effectiveness of such restorations has been mainly ascribed to the more biomimetic behaviour of fibre-reinforced composite posts that reduces the risk of vertical root fractures. The most common type of failure when using fibre posts is post debonding and it is generally agreed that achieving stable adhesion to intraradicular dentine is more challenging than to coronal dentine. Several factors related to endodontic treatment, root canal shape, post space preparation, post translucency, adhesive cement handling and curing may have an influence on the outcome of the luting procedure. The most reliable results in fibre post cementation are obtained by etch-and-rinse adhesives in combination with dual-cure resin cements. The use of self-adhesive resin cements has also been proposed. Simplification is an obvious advantage of these new materials. However, the durability of their bond still needs to be verified with long-term clinical studies. Several techniques for pre-treating the fibre-reinforced composite post surface have been tested with the aim of improving the bond strength at the post-core and post-cement interfaces. Silicoating followed by silanization currently appears to be the most effective and convenient method for this purpose. In conclusion, the available evidence validates the use of fibre posts as an alternative to metal posts and preferably to other tooth-coloured posts, such as zirconia dowels, in the restoration of endodontically treated teeth. Longer term clinical trials are expected to further strengthen this evidence.

NAVES, L.Z.; ET AL. **Surface Treatment of Glass Fiber and Carbon Fiber Posts: SEM Characterization.** Microsc. Res. Tech. 74:1088–1092, 2011.

**Abstract**

Morphology, etching patterns, surface modification, and characterization of 2 different fiber posts: Gfp, Glass fiber post (Reforpost - Angelus) ; and Cfp, carbon fiber were investigated by SEM analysis, after different surface treatments. Thirty fiber posts, being 15 Gfp and 15 Cfp were divided into a 5 surface treatments (n 5 3): C-alcohol 70% (control); HF 4%-immersion in 4% hydrofluoric acid for 1 min; H3PO4 37%-immersion in 37% phosphoric acid for 30s; H2O2 10%-immersion in 10% hydrogen peroxide for 20 min; H2O2 24%-immersion in 24% hydrogen peroxide for 10 min. Morphology, etching patterns, surface modification and surface characterization were accessed by SEM analysis. SEM evaluation revealed that the post surface morphology was modified following all treatment when compared with a control group, for both type of reinforced posts. HF seems to penetrate around the fibers of Gfp and promoted surface alterations. The Cfp surface seems to be inert to treatment with HF 4%. Dissolution of epoxy resin and exposure of the superficial fiber was observed in both post groups, regardless the type of reinforcing fiber, H2O2 in both concentrations. Relative smooth surface area was produced by H3PO4 37% treatment, but with similar features to untreated group. Surface treatment of fiber post is a determinant factor on micromechanical entanglement to resin composite core. Post treatment with hydrogen peroxide resulted strength of carbon and glass/ epoxy resin fiber posts to resin composite core.

AMANAJAS NETO, G.P.; ET AL.; **Pull-out strength of endodontically treated teeth restored with glass fiber posts of different diameters.** RGO - Rev Gaúcha Odontol., Porto Alegre, v.59, n.4, p. 609-614, out./dez., 2011

#### **Abstract**

**Objective:** To evaluate the pull-out strength of endodontically treated teeth restored with glass fiber posts through different techniques in enlarged conduits. **Methods:** A total of 15 bovine teeth were endodontically treated, divided into three groups. Group 1- restored with number 1 glass fiber posts (Reforpost -Angelus), Group 2- restored with number 3 glass fiber posts (Reforpost -Angelus), Group 3- restored with number 3 glass fiber posts (Reforpost -Angelus) associated with accessory glass fiber posts 9. The pins in all groups were cemented with same self-adhesive resin cement. All test specimens were subjected to the pull-out strength test in the testing machine at a speed of 0.5mm per minute and the results obtained in kilogram-force. **Results:** The pull-out strength values were as follows: group 1 - 24.47 kilograms-force; group 2 - 25.28 kilograms-force; group 3 - 23.59 kilograms-force. The following standard deviations were observed: 4.33 kilograms-force for group 1, 4.03 kilograms-force for group 2 and 8.39 kilograms-force for group 3. No statistically significant differences between groups were found using the ANOVA test. **Conclusion:** The decrease in the thickness of the cement film by using pins of larger diameter and/or accessories, does not interfere with the retention and stability prediction of the rehabilitation of the complex.

PELEGRINE, R. A. et al. **Influence of chemical irrigants on the tensile bond strength of an adhesive system used to cement glass fiber posts to root dentin**, Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2010

**Objective.** The aim of this study was to evaluate the influence of endodontic irrigants on the tensile bond strength of an adhesive system used to cement glass fiber posts to dentin. **Study design.** Fifty bovine roots were divided into 5 groups according to the solution used during instrumentation: G1, 0.9% NaCl (control); G2, 1.0% NaOCl; G3, 2.5% NaOCl; G4, 5.25% NaOCl; G5, 2% chlorhexidine gel + 0.9% NaCl. The root canals were obturated with gutta-percha and AH Plus sealer, and the glass fiber posts (Reforpost – Angelus) were cemented with Clearfil SE Bond/RelyX ARC. The specimens were submitted to tensile strength testing and the results were analyzed by analysis of variance. **Results.** There were no statistically significant differences regarding the irrigant solution factor ( $P > .70$ ). **Conclusion.** It was concluded that the different irrigant solutions did not affect the tensile bond strength of the fixation system used to cement the intraradicular glass fiber posts to dentin. (Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2010;xx:xxx)

MACEDO; V.C.; SILVA, A.L.F.; MARTINS, L.R.M. **Effect of Cement Type, Relining Procedure, and Length of Cementation on Pull-out Bond Strength of Fiber Posts.**Endod 2010;36:1543–1546

#### **Abstract**

**Introduction:** As opposed to the cementation metal posts, the cementation of fiber posts has several details that can significantly influence the success of post retention. This study evaluated the effect of the relining procedure, the cement type, and the luted length of the post on fiber posts retention. **Methods:** One hundred eighty bovine incisors were selected to assess post retention; after endodontic treatment, the canals were flared with diamonds burs. Post holes were prepared in lengths of 5, 7.5, and 10 mm; the fiber posts (Reforpost – Angelus) were relined with composite resin and luted with RelyX ARC, RelyX Unicem, or RelyX Luting 2. All cements are manufactured by 3M ESPE (St. Paul, MN). Samples were subjected to a pull-out bond strength test in a universal testing machine; the results (N) were submitted to a three-way analysis of variance and the Tukey post hoc test ( $\alpha = 0.05$ ). **Results:** The improvement of post retention occurred with the increase of the post length luted into the root canal; the relining procedure improved the pull-out bond strength. RelyX Unicem and RelyX ARC showed similar values of retention, both showing higher values than RelyX Luting 2. **Conclusion:** Post length, the relining procedure, and the cement type are all important factors for improving the retention of fiber posts.

CLAVIJO, V.G.R.; REIS, J.M.S.; KABBACK.W.; SILVA, A.L.F; OLIVEIRA JUNIOR,O.B; ANDRADE, M.F - **Fracture strength of flared bovine roots restored with different intraradicular posts**, J Appl Oral Sci. 2009;17(6):574-8

#### **Abstract**

**Objective:** The aim of this study was to evaluate the fracture strength and failure mode of flared bovine roots restored with different intraradicular posts. **Material and Methods:** Fifty bovine incisors with similar dimensions were selected and their roots were flared until 1.0 mm of dentin wall remained. Next, the roots were allocated into five groups (n=10): GI- cast metal post-and-core; GII- fiber posts (Reforpost -Angelus) plus accessory fiber posts; GIII- direct anatomic post; GIV- indirect anatomic post and GV- control (specimens without intraradicular post). A polyether impression material was used to simulate the periodontal ligament. After periodontal ligament simulation, the specimens were subjected to a compressive load at a crosshead speed of 0.5 mm/min in a servo-hydraulic testing machine (MTS 810) applied at 135° to the long axis of the tooth until failure. The data (N) were subjected to ANOVA and Tukey's post-hoc test ( $\alpha=0.05$ ). **Results:** GI and GIV present higher fracture strength ( $p<0.05$ ) than GII. GIII presented intermediate values without statistically significant differences ( $p>0.05$ ) from GI, GII and GIV. Control specimens (GV) produced the lowest fracture strength mean values ( $p<0.05$ ). Despite obtaining the highest mean value, GI presented 100% of unfavorable failures. GII presented 20% of unfavorable failures. GIII, GIV and GV presented only favorable failures. **Conclusions:** Although further in vitro and in vivo studies are necessary, the results of this study showed that the use of direct and indirect anatomic posts in flared roots could be an alternative to cast metal post-and-core.

SPAZZIN, A.O; MORAES, R.R; CECCHIN, D; FARINA, A.P; CARLINI-JÚNIOR, B; CORRER-SOBRINHO, L.M. **Morphological analysis of glass, carbon and glass/carbon fiber posts and bonding to self or dual-cured resin luting agents**, J. Appl. Oral Sci. vol.17 no.5 Bauru Sept./Oct. 2009

#### **ABSTRACT**

**Objective:** The aim of this study was to evaluate the morphology of glass (GF) (Reforpost -Angelus), carbon (CF) and glass/carbon (G/CF) fiber posts and their bond strength to self or dual-cured resin luting agents. **Material and Methods:** Morphological analysis of each post type was conducted under scanning electron microscopy (SEM). Bond strength was evaluated by microtensile test after bisecting the posts and re-bonding the two halves with the luting agents. Data were subjected to two-way ANOVA and Tukey's test ( $\alpha=0.05$ ). Failure modes were evaluated under optical microscopy and SEM. **Results:** GF presented wider fibers and higher amount of matrix than CF, and G/CF presented carbon fibers surrounded by glass fibers, and both involved by matrix. For CF and GF, the dual-cured material presented significantly higher ( $p<0.05$ ) bond strength than the self-cured agent. For the dual agent, CF presented similar bond strength to GF ( $p>0.05$ ), but higher than that of G/CF ( $p<0.05$ ). For the self-cured agent, no significant differences ( $p>0.05$ ) were detected, irrespective of the post type. For GF and G/CF, all failures were considered mixed, while a predominance of adhesive failures was detected for CF. **Conclusion:** The bonding between fiber posts and luting agents was affected by the type of fibers and polymerization mode of the cement. When no surface treatment of the post is performed, the bonding between glass fiber post and dual-cured agent seems to be more reliable.

SILVA, L. M.; ANDRADE, A. M.; MACHUCA, M. F. G.; SILVA, P. M. B.; SILVA, R. V. C.; VERONEZI, M. C. **Influence of different adhesive systems on the pull-out bond strength of glass fiber posts** J. appl. oral sci;16(3):232-235, May-June 2008.

#### **Abstract**

This in vitro study evaluated the tensile bond strength of glass fiber posts (Reforpost – Angelus-Brazil) cemented to root dentin with a resin cement (RelyX ARC – 3M/ESPE) associated with two different adhesive systems (Adper Single Bond - 3M/ESPE and Adper Scotchbond Multi Purpose (MP) Plus – 3M/ESPE), using the pull-out test. Twenty single-rooted human teeth with standardized root canals were randomly assigned to 2 groups (n=10): G1- etching with 37% phosphoric acid gel (3M/ESPE) + Adper Single Bond + #1 post (Reforpost – Angelus) + four #1 accessory posts (Reforpin – Angelus) + resin cement; G2- etching with 37% phosphoric acid gel + Adper Scotchbond MP Plus + #1 post + four #1 accessory posts + resin cement. The specimens were stored in distilled water at 37°C for 7 days and submitted to the pull-out test in a universal testing machine (EMIC) at a crosshead speed of 0.5 mm/min. The mean values of bond strength (kgf) and standard deviation were: G1- 29.163 ± 7.123; G2- 37.752 ± 13.054. Statistical analysis (Student's t-test;  $\alpha=0.05$ ) showed no statistically significant difference ( $p<0.05$ ) between the groups. Adhesive bonding failures between resin cement and root canal dentin surface were observed in both groups, with non-polymerized resin cement in the apical portion of the post space when Single Bond was used (G1). The type of adhesive system employed on the fiber post cementation did not influence the pull-out bond strength.

MARTELLI JR,H.; PELLIZZER, E. P. ,ROSA, B. T. ; LOPES, M. B.. GONINI JR, A.; **Fracture resistance of structurally compromised root filled bovine teeth restored with accessory glass fibre posts**, International Endodontic Journal, 41, 685–692, 2008

#### **Abstract**

**Aim:** To evaluate the mechanical behaviour of structurally compromised root filled bovine roots after restoration with accessory glass fibre posts. **Methodology:** Fifty roots of bovine teeth received conventional post preparations with a cervical diameter of 3.5 mm. The roots were assigned to five groups (n = 10): group MP – cast metal post, group GP – glass fibre post (Reforpost – Angelus) and group AGP – glass fibre post (Reforpost -Angelus) plus accessory glass fibre posts( Reforpin -Angelus). In groups GP-R and AGP-R (similar to groups GP and AGP), 2 mm of coronal tooth structure were left intact. All groups were subjected to an elastic limit assay and tested in an universal machine for fracture resistance. Repeated measures anova were performed to examine differences in fracture resistance; fracture modes were analysed by Fischer's exact test. **Results:** The mean fracture resistance values (kgf) were 61.8 (MP), 63.1 (GP), 55.5 (AGP), 56 (GP-R) and (53.1) AGP-R. No statistically significant difference was found between groups. The Fisher's exact test indicated significant differences (P < 0.05) in the fracture mode amongst groups MP, GP and AGP, indicating 100%, 50% and 10% of catastrophic fractures, respectively. **Conclusions:** The use of accessory glass fibre posts affected the fracture mode favorably: 90% of fractures in group AGP were in the coronal third.

ZOGHEIB,L.V; PEREIRA,J.R., VALLE A.L; OLIVEIRA J.A PEGORARO,L.F;  
**Fracture Resistance of Weakened Roots Restored with Composite Resin  
and Glass Fiber Post Braz Dent J (2008) 19(4): 329-333**

This study evaluated the fracture resistance of weakened roots restored with glass fiber posts ( Reforpost – Angelus), composite resin cores and complete metal crowns. Thirty maxillary canines were randomly divided into 3 groups of 10 teeth each: teeth without weakened roots (control); teeth with partially weakened roots (PWR) and teeth with and largely weakened roots (LWR). The control group was restored with glass fiber posts and a composite resin core. Teeth in the PWR and LWR groups were flared internally to standardized dimensions in order to simulate root weakness. Thereafter, the roots were partially filled with composite resin and restored in the same way as in the control group. The specimens were exposed to 250,000 cycles in a controlled chewing simulator. All intact specimens were subjected to a static load (N) in a universal testing machine at 45 degrees to the long axis of the tooth until failure. Data were analyzed by one-way ANOVA and Dunnett's test for multiple comparisons ( $p=0.05$ ). There were statistically significant difference differences ( $p<0.01$ ) among the groups (control group = 566.73 N; PWR = 409.64 N; and LWR = 410.91 N), with significantly higher fracture strength for the control group. There was no statistically significant difference ( $p>0.05$ ) between the weakened groups. The results of this study showed that thicker root dentin walls significantly increase the fracture resistance of endodontically treated teeth.

**SOARES, C.J.; ET AL. The Influence of Cavity Design and Glass Fiber Posts on Biomechanical Behavior of Endodontically Treated Premolars, JOE – Volume 34, Number 8, August 2008**

**Abstract**

The aim of this study was to evaluate the effect of cavity design and glass fiber posts on stress distributions and fracture resistance of endodontically treated premolars. Fifty extracted intact mandibular premolars were divided into 5 groups (n = 10): ST, sound teeth (control); MOD, mesio-occlusal-distal preparation \_endodontic treatment (ET) \_ composite resin restoration (CR); MODP, mesio-occlusal-distal \_ ET \_ glass fiber post (Reforpost – Angelus) \_ CR; MOD2/3, mesio-occlusal-distal \_ two thirds occlusal-cervical cusp loss \_ ET \_ CR; and MODP2/3, mesio-occlusal-distal \_ two thirds cusp loss \_ ET \_ glass fiber post \_ CR. The specimens were loaded on a cusp slope until fracture. Fracture patterns were classified according to four failure types. Stress distributions were evaluated for each group in a twodimensional finite element analysis. The fracture resistance of the MODP, MOD2/3, and MODP2/3 groups was significantly lower than the ST and MOD groups (p < 0.05). The loss of dental structure and the presence of fiber post restoration reduced fracture resistance and created higher stress concentrations in the tooth-restoration complex. However, when there was a large loss of dental structure (MODP2/3), the post reduced the incidence of catastrophic fracture types.

MENEZES, M. S.; VERÍSSIMO, A.G.; FONSECA, R. B.; SILVA, A. L. F.; MARTINS, L. R. M.; SOARES, C. J. **Influence of root depth and the post type on Knoop hardness of a dual-cured resin cement** Braz. J. oral sci;6(21):1337-1343, Apr.-June 2007.

**Abstract**

Fiber posts are usually luted to the root canal with dual-cured resin cements. However, some of these cements require light-activation in order to reach optimal degree of cure. The aim of this study was to evaluate the effect of the fiber post (Reforpost - Angelus) type on microhardness of a dualcured resin cement used for luting these posts. After endodontic treatment, four fiber post types were luted to the root canal of bovine incisors with RelyX ARC. The samples were sectioned in order to obtain four slices, representing different depths (0.0; 2.5; 5.0; 7.5 and 10.0mm). Knoop microhardness testing was performed in each slice. The data were submitted to split-plot ANOVA and Tukey post-hoc tests. An additional sample per fiber post type was used to analyze bonding interface by SEM. At the depths of 0 and 2.5 mm, the resin cement presented the highest hardness values. The lowest values were observed at the 10 mm depth, and the resin cement presented intermediary hardness means at the depths of 5 mm and 7.5 mm. By means of scanning electronic microscopy, it was possible to see the more homogeneous hybrid layer in the cervical region of the root.

PESCE, A. L. C.; LÓPEZ, S. G.; RODRIGUES, P. Gonzalés. **Effect of post space preparation on apical seal: Influence of time interval and sealer.** Med, Oral Cir. Bucal v.12 n.6 Madrid oct. 2007

**Abstract Objective:** To assess the efficacy of two sealants to preserve the apical seal after root canal preparation and cementation of posts at 24 h or 72 h after endodontic treatment. **Study design:** Sixty human single-root teeth were instrumented and obturated using lateral compaction technique with EndoFill® [30] or AH-Plus® [30] and were prepared in one of three ways, leaving a 3 mm gutta percha remnant in all cases: without cast post preparation, with preparation after 24 h or after 72 h. After cementing the posts ( Reforpost – Angelus), the specimens were thermal cycled at 5 and 55°C in water baths, submerged in 2% methylene blue dye for 72 h, embedded in acrylic resin and cut transversally into three 1-mm apical sections. Dye leakage was quantitatively assessed as the percentage leaked area. **Results and conclusion:** Comparison of the apical sections showed significant differences in leakage with both sealers among the three preparation groups ( $p < 0.001$ ). No significant differences between sealers were found in any preparation group or in the same sections.

ANDRADE , A.P.A.; Et al. **Influence of topography and surface treatment in fiber glass posts retention when cemented with a dual cure resin cement.** Revista de Odontologia da Universidade Cidade de São Paulo 2006 maio-ago; 18(2)117-22

Introduction: This study aimed to evaluate two types of fiberglass aesthetic posts regarding its retention, in accordance with its surface characteristics when cemented with a dual resin cement. Thirty single rooted teeth had been used. Methods: The roots had been endodontically treated and then gutta-percha had been removed from the canals in a 10 mm depth from the cervical limit. The roots had been randomly divided in three groups of 10 specimens. The 10 serrated posts (Reforpost® - Angelus) and 10 smooth posts (Fibiocore® posts-Anthogyr) had received as surface treatment acid etching and silanization. Another 10 smooth posts (Fibiocore® posts-Anthogyr) had received aluminum oxide sandblasting, acid etching and silane. The aesthetic posts were cemented with dual cure resin cement Variolink II and Excite®DSC adhesive system – Ivoclar Vivadent inside the reprepared (post's kit drill) and cleaned canals. Towards the samples could be submitted to tensile bond strength test by Universal Tests Machine Instron were confectioned inverted acrylic resin truncated-cone on the post suitable to the machine rabbit. A prefabricated matrix of Teflon with 3 mm<sup>2</sup> of area was used and the dentine surface was isolated by an adhesive ribbon, preventing resin-tooth adhesion. The samples stored in 37°C distilled water were to 24 hours and then submitted to the tensile bond test. Results: Data were statistically analyzed using Kruskal-Wallis test's at a significance level of 1%. They demonstrate that the post surface intervenes with its adhesion, being the smooth sandblasted and serrated statistically more retentive than the smooth ones. Conclusion: Statistically significant difference between the serrated posts and the sandblasted ones was not found.

**FONTANA, E, Estudo comparativo dos níveis de cinza de pinos intrarradiculares de fibra de vidro, carbono e quartzo, por meio de imagens digitais;** Tese apresentada como parte dos requisitos para obtenção do título de Doutor em Odontologia, concentração em Prótese Dentária. 2005

The study aimed at comparing and correlating gray levels in intraradicular post Reforpost Fibra of Carbono® (Angelus), Reforpost Fibra of Vidro® (Angelus) with diameter of 1,5 mm and the posts of quartz Light Post® (Bisco) with diameter of 2,18 mm (coronary portion) and 1,2 mm (portion apical) with adjacent radicular dentin with the duct without post, using the Digora® (Soredex) and DenOptix® (Gendex) digital systems. The disposition of the fibers and the compact of the epóxi resin of the posts non metallic intraradiculares were evaluated by means of the microscopy scanning electron (MEV) and its chemical composition for the spectroscopy for detector of rays X (EDS). Twenty-two incisive central superiors were selected, tends the crowns sectioned in the cervical limit and, the radicular conduits obturated for the conventional technique. The prepare it of the ducts it was performed with the drills indication for each intraradicular post. The X-ray of each specimen was taken with and without the different posts inside the radicular duct with the photo-activated match plates of each system. The analogical images were digitalized, being written down the largest and the smallest gray level in the center of the radicular duct with and without the posts and of the dentins adjacent (mesial and distal) for only one operator. The medium values of the obtained gray levels were submitted to the test statistical t-Student for a statistical significance of 1% and to the Freedman test. It was verified that the mean values of gray of the posts of fiber of carbon went inferior to the posts of fiberglass of quartz and of the duct without post in the DenOptix® system. In the Digora® system the posts of carbon had the mean ones of inferior gray to the posts of quartz and fiberglass, but superior value to the duct without post. By means of EDS it was observed the presence carbon and oxygen in all the posts and, even so in the posts of fiber of quartz and fiberglass was still verified, magnesium, silicium, aluminum and calcium. The adjacent dentins had superior mean values to the duct with posts of fiber of carbon, quartz and the duct without post in the Digora® digital system; already in DenOptix® its values went superior to the posts of fiber of carbon and the duct without post. It is concluded that the posts of fiber of carbon presented radiograph image radiolucent and that the posts of fiberglass and quartz presented radiopaque image in the two systems, what can be justified by the chemical composition of the posts observed in EDS and, also for the disposition of the fibers and compact of epóxi resin observed in MEV. It was also concluded that the presence of the posts inside the radiculars ducts interfered in the gray levels of the adjacent dentins.

**MARQUES, S.M.L. Resistência adesiva na cimentação de pinos de fibras de vidro utilizando diferentes sistemas adesivos e agentes cimentantes.** Dissertação apresentada ao Curso de Mestrado da Faculdade de Odontologia da Universidade Federal de Minas Gerais. 2003

The idea of using root canals for the retention of restorations of endodontically treated teeth is not new. The post function is to provide retention and support for the restoration material. The present work assessed the adhesive resistance of one dual adhesive system (Excite DSC), one chemical adhesive system (Alloybond), one dual resin cement (Variolink II) and one chemical resin cement (C&B Cement) in fiberglass post cementation (Reforpost). Forty sound human canines, extracted due to periodontal problems, were used. The anatomic crowns of the teeth were cut at the cemento-enamel junction. Fiberglass posts Reforpost (Angelus) were cemented, and 4 groups were formed with 10 samples each. The samples were stored in distilled water at 37°C for 24 hours. After this period, the teeth were fixed in stainless steel tubes with self-curing acrylic resin using a parallelometer. Subsequently, a same size new tube was positioned upside down on the first one in order to hold the fiberglass post up after its setting. A guide tube with positioning posts at both ends was used to standardize all the samples. The samples were positioned in an universal testing machine (Instron) for the traction tests. The comparison of the adhesive systems showed that Alloybond presented higher adhesive resistances, regardless of the resin cement used. There was no statistically significant difference between the resin cements Variolink II and C&B Cement.

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