BIBLIOGRAFIA COMPLETA SOBRE PINOS DE FIBRA

Por objeto da pesquisa (Janeiro, 2010)

Adições mais recentes estão em azul

SUMÁRIO

I. Adaptação e Ajuste dos Pinos

*Baldissara, P., Zicari, F., Ciocca, L., Zamboni, S. C. ,Valandro, L. F. **Effect of fiber post emerging diameter on composite core stabilization.** *J Dent Res. Vol 86 (Spec. Iss. A) Abstract #2623, 2007 (www.dentalresearch.org)*

Objectives: The relatively low elastic modulus of fiber posts reduce the risk of root fracture, but also decrease the composite core stabilization. To compensate for the lack of rigidity, larger post sizes are needed when restoring crownless teeth. The aim of this study was to evaluate the effect of the post emerging diameter on the composite core stabilization of restored flat root

human teeth. **Methods:** Forty single rooted, crownless human teeth were divided in 8 groups and randomly restored with quartz (Endolightpost and DT Light - Post, RTD, St Egreve, France) and glass (Premier Anatomic and Compaq, Innotech, Italy) fiber posts, each type represented with #1 and #2 sizes. Single tapered and double tapered post shapes were used. The posts were inserted 10mm deep in the root canal and cemented using Duo-Link and One-Step adhesive (Bisco, USA). The emerging diameter ranged from 1.00 to 1.50mm. The core was realized using Light-Core (Bisco) placed in transparent standardized shells. The specimens were stored in 100% humidity until the Instron loading tests, carried out at a 45° angle. The force required to detach the core from the dentin flat surface was considered as the fracture strength (FS). Data obtained were statistically analyzed with ANOVA and linear regression. **Results**: FSs ranged from 264±95N (Endolightpost #1) to 425.1 +/- 55N (DT Light-Post #2: RTD; St Egreve, France) ($P<0.05$). Single tapered posts were weaker than double tapered ones. FS was directly correlated to post emerging diameter ($P=0.017$). Notwithstanding the loss of dentin required to place larger posts, the root fracture rate was not significantly correlated to the post diameter ($P=0.8$). **Conclusion:** The emerging diameter of fiber post is extremely important to stabilize the core. When restoring crownless teeth, it is advisable to use fiber posts having large emerging diameters. Data obtained suggest that diameters of 1.5mm do not jeopardize the root dependability.

*Baldissara, P., Filonzi, C., Zicari, F., Ciocca, L. **Establishing an improved fiber post shape using a 3-D analysis.** *J Dent Res. Vol 84 (Spec. Iss. A) Abstract #0535, 2005. (www.dentalresearch.org)*

Objectives: When restoring endodontically treated teeth with fiber post, the coronal third of the root canal is often much more larger than both medium and apical portion. Fiber posts are frequently too small in diameter at this level, particularly in teeth previously treated, and a large amount of cement is required to fill the post/dentin gap. The aim of this study was to determine the root canal shape immediately prior the post space preparation, to obtain data for an improved post design**. Methods**: After gutta-percha removal, 40 poly-vinyl polysiloxane impressions of the root canal of endodontically treated teeth scheduled for fiber post restorations were taken by a single operator. Molars and lower incisors were excluded. Stone casts were obtained from the impressions. The casts were progressively grinded, taking a standardized microphotograph every 1mm. The canal length and both bucco-lingual and mesio-distal diameters were measured, obtaining a mean computer-designed 3-D canal profile. The canal shapes were compared to different fiber posts using graphics software. **Results:** the coronal and central thirds of the incisors, canines and 2nd bicuspids were found significantly larger than standard fiber posts. In these teeth, DT Light-Post (RTD, St Egreve, France) showed the best fit (although not ideal) when compared to single tapered or parallel sided posts. The mean canal length was 8.9„b1.4mm. When graphically superimposed on the 3-D images, extremely good adaptation was found with a post having a tapered root portion of 6¢X, 12mm in length, and parallel-sided coronal head 5mm in length. The head diameters should vary from 1.8 to 2.4mm to match the different tooth sizes. **Conclusions:** The canals of endodontically treated teeth are larger than available fiber posts, particularly at the coronal segment. An increased tapering and a larger coronal diameter have been introduced in a new post design obtaining a better post/dentin adaptation.

*Boudrias, P, Sakkal, S, Yulian, **Anatomical post design applied to quartz fiber/epoxy technology: A conservative approach**. *Oral Health, Nov., 2001:9-16*

Abstract/conclusions: A wide variety of prefabricated posts systems are manufactured with different materials and offered with different shapes. Post and core adaptation presents an important element in the biomechanical performance of the prosthetic restoration. The double taper post system was designed with the purpose of providing close canal adaptation with minimal tooth structure removal. The association of a quartz fiber/epoxy material with a more anatomical double taper shape provides a conservative and esthetic approach for the restoration of endodontically-treated teeth. The double taper post (D.T. Light-Post; RTD, St Egreve, France/Bisco Dental) allows one to rebuild the missing tooth structure using adhesive technology without obstructing the esthetics of the all-ceramic restorative systems. The double taper post closely imitates the post-endodontic shape of a radicular canal, and leaves a thin and uniform thickness of cement at the post/canal interface. This improved adaptation of the post promotes the mechanical properties of the quartz fiber/epoxy material, instead of the weaker composite resin cement. In as much as in vitro and early clinical follow-up are encouraging, long-term clinical study is needed to evaluate the behavior of this post system and the prosthetic prognosis of teeth with extensive coronal destruction. PDF

*Boudrias, P., Sakkal, S., and Petrova, Y. **Anatomical post design meets quartz fiber technology: Rationale and case report**. *Compendium. 22: 337-348, 2001.*

Abstract/conclusions: Endodontically treated teeth frequently require a post and core to serve as a foundation for the coronal restoration. Remaining tooth structure, physical properties of the post material, post shape, and cement type all contribute to the success of the restoration. Post adaptation to the canal walls also represents an important element in the biomechanical performance of the prosthetic restoration. A double taper post system made of quartz fiber and epoxy was developed to conform more precisely to the shape of endodontically treated canals. Immediate benefits of this post system include minimal tooth structure removal during canal reshaping, greater post-to-canal adaptation in the apical and coronal half of the canal, and good post retention. The use of a quartz fiber/epoxy material with a lower modulus of elasticity also reduces the incidence of root fracture. Furthermore, the esthetic nature of the colors offered with this post system (D.T. Light-Post; RTD, St Egreve,

France)) provide a favorable foundation for eliminating discoloration caused by a metallic post placed under all-ceramic crown systems. PDF

Dietschi, D., Romelli, M., and Goretti, A. **Adaptation of adhesive posts and cores to dentin after fatigue testing.** *International Journal of Prosthodontics. 10: 498-507, 1997.*

Abstract/conclusions: An in vitro nondestructive fatigue test was applied to adhesive posts and cores made on endodontically treated human teeth. Five post-and-core systems were evaluated: one Zirconia oxide post, two Titanium posts (with resinous or ceramic coating), and two resin-fiber posts. Each test specimen was intermittenly loaded and thermocycled. The scanning electron microscope observation of sample sections showed that only the interfaces between restorative materials and dentin exhibited substantial deficiencies. The Komet ER (Brasseler) exhibited the greatest percentages of continuity at the coronal (83.88%) or the radicular (78.12%) dentin levels, while the Zircon experimental post presented insufficient adaptation to the radicular 21.25% continuity) and to the coronal (53.25% continuity) dentin. Seven of eight samples in the Komet group showed root fractures. The carbon-fiber post (Composipost) behaved satisfactorily (67.38% radicular continuity), in spite of the use of an older bonding agent formulation. PDF

*Medioni, E., Griva, J. **Fiber post adaptation when using root canal shaping NiTi files** *J Dent Res. Vol 87 (Spec. Iss. A) Abstract #1503, 2008. (www.dentalresearch.org)*

One of the most difficult steps when restoring endodontic treated teeth is the post space preparation: a bad post space preparation can occur and induce irreversible damage to the tooth. **Objectives:** evaluation of adaptation of two different fibre posts after shaping the root canal by two different NiTi rotary files.**M ethods**: 40 healthy teeth, freshly extracted were selected. Twenty root canals were shaped using RaCe System (FKG, La Chaud de Fond, Switzerland) and twenty using Protaper system (Dentsply-Maillefer, Ballaigues, Switzerland). Peerless post System (Sybron Endo, USA) and D.T. post system (VDW Dentsply/ RTD, St Egreve, France) were fixed into the root canal using an impression paste, without post space preparation. After embedding roots into an epoxy resin and longitudinal cutting, the adaptation of posts was assessed by measuring the length of penetration and the thickness of "sealer". Statistical analyses to compare post adaptation were made using non parametric tests. **Results:** Regarding the length of post penetration, there is a statistical significant difference between the different posts when different root canal shaping instruments are used (p=0,013). When using RaCe rotary files, penetration length of Peerless posts is greater than with DT posts. There is no statistical significant difference for the thickness "sealer" at the tip (p=0,972) and at 3mm from the tip of the post (p=0,2344), but at the ECJ, there is a statistical significant difference (p=0,011). The "sealer" is less thick (p=0,0073) with Peerless Posts than with DT posts when root canal is shaped by Protaper system, and thicker (p=0,0008), when using Peerless posts comparing RaCe shaping and Protaper shaping. **Conclusion**: In the conditions of this experimentation, the post space preparation with specific drills is not necessary if root canal shaping is preformed with RaCe or Protaper NiTi rotary files and when Peerless posts or D.T. Posts are used.

*Iglesia-Puig MA, Arellano-Cabornero A **Fiber-reinforced post and core adapted to a previous metal ceramic crown.** *J Prosthet Dent 2004 Feb;91(2):191-4.*

A technique to create a fiber-reinforced anatomic post and core adapted to an existing crown is described. This technique is performed with a quartz post adapted to root canal anatomy, using a core composite material. With this technique, a well-adapted anatomic post and core may be achieved in a clinical session. PDF

II. Propriedades Físicas; dos pinos

A. RESISTÊNCIA FLEXURAL

*Beck, P., Ghuman, T., Cakir, D. Ramp, L. Burgess, J. **Evaluation of flexural strength and elastic modulus of endodontic posts.** *J Dent Res. Vol 88 (Spec. Iss. A) Abstract # 3065, 2009. (www.dentalresearch.org)*

Post fracture is a frequently reported failure for restored endodontically treated teeth. Current reports suggest that the rigidity of the post should be equal or close to that of the tooth structure in order to distribute the occlusal forces along the length of the root. **Objective:** To determine and compare modulus of elasticity and flexural strength of endodontic posts. **Methods:** Five fiber posts (Unicore/Ultradent, DT Post/BISCO, RelyX/3M ESPE, Snowlight/Danville, Parapost Fibre White/Coltene Whaledent) and 1 metal post (Parapost XT/Coltene/Whaledent) were used for this study (n=10). They were measured for length and diameter and placed on a 3- point bending test fixture. The posts were loaded in a universal testing device,

(Instron, Model 5565) using flexural test method until failure having a 1 mm/min crosshead speed. The fracture data was compared using a one-way ANOVA and Tukey post-hoc tests to examine for intergroup differences (p=0.05). Two samples were randomly selected from each group and evaluated using a scanning electron microscope (SEM) to determine the adaptation & orientation of the glass fibers. **Results:**

Table: Flexural strength results are displayed in (MPa±SD) and modulus of elasticity results are displayed in (GPa±SD)

	UNICORE	DT LIGHT-POST	RelyX FIBRE POST	ICE LIGHT	PARAPOST FIBRE WHITE	PARAPOST XT
Flexural Strength	1305.9±81	1191.6±157	1133.1±67	1234.3±300	1077.5±172	1897.9±151
Elastic Modulus	30.4±3	32.1±2	26.4±3	31.8±10	34.3±8	60.9±7

Unicore fiber post had significantly ($p<0.05$) higher flexural strength compared to the Parapost Fibre White post. Parapost XT titanium alloy post had a significantly higher flexural strength and modulus ($p<0.05$) compared to the fiber posts. **Conclusion:** Posts should be selected in part for their mechanical properties. Supported in part by a grant from Ultradent.

*Galhano, GA, Valandro, LP, deMelo, R., Scotti, R., Bottino, MA. **Evaluation of the flexural strength of carbon fiber, quartz fiber and glass fiber – based posts.** *JOE Vol. 31. No. 3, March 2005, 209-211*

This study investigated the flexural strength of 8 fiber posts (one carbon fiber, one carbon/quartz fiber, one opaque quartz fiber, two translucent quartz fiber and three glass fiber posts). Eighty fiber posts were used and divided into 8 groups (n=10): G1- Composipost / C-Post (RTD), G2-Aestheti-Post (RTD), G3-Aestheti-Plus (RTD), G4- Light-Post (RTD), G5- D. T. Light-Post (RTD), G6- ParaPost White (Coltene/Whaledent), G7-FibreKor (Pentron) and G8-Reforpost (Angelus). All of the samples were tested using a three-point bending test. Statistical analysis of the outcomes was conducted by means of analysis of variance and the post factor was significant ($p<0.001$). The critical value for comparison revealed that G2 (677.4 MPa +/18.3) and G3 (666.2 +/- 18.1) presented the highest flexural strength values. G1 (616.3 +/- 24.8) and G3 presented similar strengths. G1, G4 (607.2 +/- 19.5), G5 (608.7 +/-69.5), G6 (585.2 +/- 24.2) and G7 (562 +/- 59.6) were statistically similar. Reforpost-G8 (433.8 +/- 46.4) revealed the lowest flexural strength value compared to the other groups. PDF

Plotino, G, Grande, NM, Bedini, R, Pameijer, CH, Somma, F. **Flexural properties of endodontic posts and human root dentin**. *Dent Mater J. 2006 Vol 231129-1135*

Objectives: To evaluate the flexural modulus and flexural strength of different types of endodontic post in comparison with human root dentin. **Methods:** Three different types of fiber-reinforced composite (FRC) posts and three metal posts each comprising 10 specimens (n=10) and 20 dentin bars were loaded to failure in a three-point bending test to determine the flexural modulus (GPa) and the flexural strength (MPa). Three randomly selected fiber posts of each group were evaluated using a scanning electron microscope (SEM) to illustrate the differences in mode of fracture. Data were subjected to a one-way ANOVA to determine significant differences between groups and the Bonferroni t-test multiple comparison was applied to investigate which mean values differed from one another with significance levels of $P<0.05$. **Results:** The flexural modulus recorded for the dentin bars was 17.5+/-3.8GPa. The values for posts ranged from 24.4+/-3.8GPa for silica fiber posts to 108.6+/-10.7GPa for stainless steel posts. The flexural strength for dentin was 212.9+/-41.9MPa, while the posts ranged from 879.1+/-66.2MPa for silica fiber posts to 1545.3+/-135.9MPa for cast gold posts. The ANOVA test analysis revealed significant differences between groups ($P<0.05$) for flexural modulus and flexural strength mean values. **Significance:** FRC posts have an elastic modulus that more closely approaches that of dentin while that for metal posts was much higher. The flexural strength of fiber and metal posts was respectively four and seven times higher than root dentin. PDF

*Seefeld, F, Wenz, HJ, Ludwig, K, Kern, M. **Resistance to fracture and structural characteristics of different fiber reinforced post systems.** *Dent Mater. 2007 Mar;23(3):265-71*

Results: The aim of this study was to investigate the ultrastructure and resistance to fracture of eight different types of fiber post, and to verify the existence of a correlation between structural characteristics and flexural strength. **Results:**: Eight types of fiber post were selected for this study. Fiber Kor (Jeneric-Pentron), Para Post Fiber White (Coltene), Luscent Anchor (Dentatus), Twin-Luscent Anchor (Dentatus), Style Post (Metalor), DT White-Post (VDW), DT Light-Post (VDW / RTD, St Egreve, France) and ER Dentin Post (Brasseler). Ten posts of each experimental group were selected for a three-point

bending test, and one was processed for SEM evaluation. A universal testing machine loading at an angle of 90 degrees was employed for the three-point bending test. The test was carried out until fracturing of the post. After fracture testing, the posts with the highest and the lowest values of flexural strength of each system were additionally processed for SEM analysis. SEM evaluation was performed using a PC-measurement program to assess the fiber/matrix ratio and fiber dimensions. **Results:** The fracture load of the tested systems ranged from 60 to 96 N and the flexural strength from 565 to 898 MPa. DT White-Post and **D.T. Light-Post** (898 and 842 MPa, respectively) had significantly higher flexural strengths than the other posts. Style Post (565 MPa) showed a significantly lower flexural strength than all other posts. The differences in fiber diameter ranged from 8.2 to 21 micron and for the fiber/matrix ratio from 41 to 76%. Of the various structural characteristics investigated, only the fiber/matrix ratio showed a significant correlation to the flexural strength (r=0.922, p=0.003). **Significance:** The FRC-posts investigated displayed significant differences with regard to fracture load and flexural strength. A strong and significant linear correlation between the fiber/matrix ratio and the flexural strength was found. **PDF**

Vichi, A, Vano, M, Ferrari, M. **The effect of different storage conditions and duration on the fracture strength of three types of translucent fiber posts.** *Dent Mater. 2008 Jun;24(6):832-8. Epub 2007 Dec 3*

Objectives: (a) To evaluate the effects of storage duration, storage condition and type of fiber post on post fracture strength. (b) To morphologically evaluate the post structure before and after storage. **Methods:** Three types of fiber posts were divided in different groups (n=14) according to the storage duration (1, 6, 12 months), and storage condition (dry at 37 degrees C; saline water at 37 degrees C; mineral oil at 37 degrees C and storage inside the roots of extracted human teeth immersed in saline water at 37 degrees C). Specimens were loaded in a universal testing machine with a compressive load until fracture. A 3-way ANOVA and Tukey's test (alpha=.05) were used to compare the effect of the experimental factors on the fracture strength. Two posts of each group were observed before and after the storage using a scanning electron microscope. **Results:** Storage conditions and post type, had a significant effect on post fracture strength ($p<0.05$). The interaction between these factors was significant ($p<0.05$). Water storage significantly decreased the fracture strength, regardless of the post type and the storage duration. Storage inside roots, in oil, and at dry conditions did not significantly affect post fracture strength. SEM micrographs revealed voids between fibers and resin matrix for posts stored in water. Posts stored under the other conditions showed a compact matrix without porosities. **Significance:** Fiber posts placed inside human root canals immersed in water are not affected by the detrimental effect of water.

Cheleux, N., Sharrock, P.J., **Mechanical properties of glass fiber-reinforced endodontic posts.** *Acta Biomater. 2009 Oct;5(8):3224-30. Epub 2009 Apr* 24.

Five types of posts from three different manufacturers (RTD, France, Carbotech, France and Ivoclar-Vivadent, Liechenstein) were subjected to three-point bending tests in order to obtain fatigue results, flexural strength and modulus. Transverse and longitudinal polished sections were examined by scanning electron microscopy and evaluated by computer-assisted image analysis. Physical parameters, including volume % of fibers, their dispersion index and coordination number, were calculated and correlated with mechanical properties. The weaker posts showed more fiber dispersion, higher resin contents, larger numbers of visible defects and reduced fatigue resistance. The flexural strength was inversely correlated with fiber diameter and the flexural modulus was weakly related to coordination number, volume % of fibers and dispersion index. The interfacial adhesion between the silica fibers and the resin matrix was observed to be of paramount importance. **PDF**

Novais, V.R., Quagliatto, P.S., Bona, A.D., Correr-Sobrinho, L, Soares, C.J.. **Flexural modulus, flexural strength, and stiffness of fiber-reinforced posts.** *Indian J Dent Res. 2009 Jul-Sep;20(3):277-81.*

Background: The radiopacity degree of posts is not enough for adequate visualization during radiographic analyses. Glass fiber post with stainless steel reinforcement has been fabricated in an attempt to overcome this limitation. AIM: This study was designed to determine the influence of this metal reinforcement on the post mechanical properties. **Methods:** This study evaluated flexural modulus (E), flexural strength (sigma), and stiffness (S) of five different fiber post systems (n = 5): RfX (Reforpost Glass Fiber RX; Angelus, Londrina, PR, Brazil); RG (Reforpost Glass Fiber, Angelus); RC (Reforpost Carbon Fiber, Angelus); FP (Fibrekor Post; Jeneric Pentron Inc., Wallingford, CT, USA); and CP (C-Post; Bisco Dental Products, Schaumburg, IL, USA), testing the hypothesis that the insertion of a metal reinforcement (RfX) jeopardizes the mechanical properties of a glass fiber post. Posts were loaded in three-point bending using a testing machine with a crosshead speed of 0.5 mm/min. **Results:** The results were statistically analyzed using one-way ANOVA and Tukey's multiple range tests (a = 0.05). Mean and standard deviation values of E (GPa), s (MPa), and S (N/mm) were as follows: RfX: 10.8 +/- 1.6, 598.0 +/- 52.0, 132.0 +/- 21.9; RG: 10.6 +/- 1.0, 562.0 +/- 24.9, 137.8 +/- 5.5; RC: 15.9 +/- 2.4, 680.5 +/- 34.8, 190.9 +/- 12.9; FP: 10.9 +/- 1.4, 586.8 +/- 21.9, 122.4 +/- 17.3; CP: 6.3 +/- 1.7, 678.1 +/- 54.2, 246.0 +/- 41.7. Carbon fiber posts showed the highest mean s values ($P < 0.05$). In addition, RC showed the highest mean E value and CP showed the highest mean S value

(P < 0.05). **Conclusion:** The hypothesis was rejected since the metal reinforcement in the glass fiber post (RfX) does not decrease the mechanical property values. Posts reinforced with carbon fibers have a higher flexural strength than glass fiber posts, although all posts showed similar mechanical property values with dentin. PDF

Flexural Properties of Fiber Reinforced Root Canal Posts

Friday, July 16, 2010: 4:45 p.m. - 6 p.m.
Location: Exhibit Hall (CCIB)
F.S.F. TOMAZINHO, S. ZAITTER, S.R.C. SILVA, E. ALFREDO, and Y.T.C. SILVA-SOUSA, University de Ribeirao Preto - Unaerp, Ribeirão Preto, Brazil
Objectives: Fiber-reinforced composite (FRC) root canal posts have been introduced to be used instead of metal alloys and ceramics. The aim of this study was to investigate the fracture resistence of five different types of fiber post. Methods: The fiber posts selected for this study were DT Light Post (Bisco), White Post DC (FGM), Exacto (Angelus), ReforPost (Angelus), Everstick (Sticktech). Five posts of each experimental group were subjected to three-point bending test in a universal testing machine an angle of 90◦. The test was carried out until fracturing of the post. Mean flexural strength and SDs were calculated and data statistically analyzed by ANOVA and Tukey's test. Results: Means and SDs of flexural strength (N) were: DT Light Post: 99.88 (3.92), White Post DC: 108.56 (9.99), Exacto: 113.18 (2.26), ReforPost: 58.7 (5.24), Everstick: 84.6 (1.81). ANOVA indicated significant differences among de groups (p<0,05). The fracture load of the tested systems ranged from 51 to 116N and the flexural strength from 869 to 1414MPa. DT Light-Post (1345MPa) showed significantly higher flexural strengths than the other posts. ReforPost (988MPa) showed a significantly lower flexural strength than all other posts. Conclusion: The FRC-posts investigated showed significant differences regarding to fracture load and flexural strength

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Flexural Properties of Fiber Reinforced Root Canal Posts. **F.S.F. TOMAZINHO**, S. ZAITTER, S.R.C. SILVA, E. ALFREDO, and Y.T.C. SILVA-SOUSA. J Dent Res, Iss#89, Spec Iss B:3115, 2010. WWW.dentalresearch.org

B. RESISTÊNCIA A FADIGA

*Grandini, S., Goracci, C., Monticelli, F., Borracchini, A., Ferrari, M. **An evaluation, using a three-point bending test, of the fatigue resistance of certain fiber posts.** *II Dentista Moderno, March, 2004, 70-74*

Aim: The aim of the present study was to assess the fatigue resistance of several types of fiber posts by using a 3-point bending test and to observe their ultrastructure through Scanning Electron Microscopy (SEM) before and after undergoing the fatigue test. **Methods:** Six types of fiber posts were selected for this study, EasyPost (Group 1), ParaPost Fiber White (Group 2), FibreKor (Group 3), D. T. Light-Post (Group 4), Lucent Anchors (Group 5), and SnowPost (Group 6). Each group contained 15 posts; 5 posts in each group were observed with SEM, the other ten were used for the fatigue test. A three-point bending machine, loading at an angle of 90 degrees and a frequency of 3 Hz, was employed for fatigue testing. The test was carried out until 2 million cycles were completed or until the post fractured. After the fatigue test had been completed, further evaluations were carried out with SEM on the fractured posts and the posts that went to the end of the fatigue cycles. **Results:** The fatigue test showed statistically significant differences among the different posts. Group 4 (D.T. Light-Post; RTD, St Egreve, France)) performed better than all the other groups, withstanding the entire load cycles without fractures. **Conclusions:** There are great variations in the responses of different kinds of fiber posts to a fatigue resistance test. Structural integrity is already very different even before undergoing the fatigue test, and this proves that many of the performance differences noted are due to the differences in the manufacturing processes of the fiber posts. PDF

*Grandini, S., Goracci, C., Monticelli, F., Tay, F., Ferrari, M. **Fatigue resistance and structural characteristics of fiber posts: three-point bending test and SEM evaluation.** *Dental Materials (2005) 21,75-82*

Objective: This study evaluated the fatigue resistance of different types of fiber posts subjected to a fatiguing procedure with a 3-point bending machine. **Methods:** Eight types of fiber posts were selected for this study: Group 1 Easypost (Krugg, Milano, Italy), Group 2 ParaPost Fiber White (Coltene/Whaledent, Mahwah, NJ, USA), Group 3 FibreKor Post (Pentron Technologies, Wallingford, CT, USA), Group 4 Ghimas White (Ghimas, Casalecchio, Bologna, Italy), Group 5 D.T. Light-Post (RTD, St Egreve, France), Group 6 FRC Postec (Ivoclar/Vivadent, Schaan, Liechtenstein), Group 7 Lucent Anchor (Dentatus, New, York, USA), and Group 8 Fototech (Isasan Carbotech, Caronno Petrucella, Italy). Each group included 10 posts. A three-point bending machine, loading at an angle of 90^0 and a frequency of 3 Hz was employed. The test was carried out until 2,000,000 cycles were completed or the post fractured. One-way ANOVA, followed by the Bonferroni test for multiple comparisons was performed to evaluate the 8 groups. The level of significance was set at $p<0.05$. **Results:** The fatigue test showed statistically significant differences among the different posts. Groups 5 (D.T. Light-Post) and 6 (FRC Postec) performed significantly better than all the other groups; withstanding the entire cycle of loads. All of the other posts fractured before the end of the test. **Conclusions:** the statistical analysis is highly significant: different kinds of posts give different results when they undergo a fatigue resistance test. PDF

*Grandini, S., Chieffi, N., Cagidiaco, M.C., Goracci, C., Ferrari, M. **Fatigue resistance and structural integrity of different types of fiber posts.** *Dent Mater J. 2008 Sep;27(5):687-94.*

The study aimed at assessing and estimating the fatigue resistance of different fiber posts and to observe their ultrastructures through SEM. Six types of fiber posts were used: GC Fiber Post (Group 1), ParaPost Fiber White (Group 2), FibreKor (Group 3), DT Light-Post radiopaque (Group 4), FRC Postec (Group 5), and Luscent Anchors (Group 6). Ten out of 15 posts within each group were used for the fatigue test, and the other five were processed for SEM evaluation. The fatigue test revealed that Groups 1, 4, and 5 performed better than all the other groups, and that their performance differed significantly from the other tested groups from a statistical standpoint. For SEM analysis, Groups 1, 4, and 5 also obtained better results. Through correlation analysis, an absence of correlation between fatigue resistance and structural characteristics suggested that the latter reflected more of the divergence inherent in the manufacturing process of fiber posts.

Ma, P.S., Nicholls, J.I., Junge T, Phillips KM. **Load fatigue of teeth with different ferrule lengths, restored with fiber posts, composite resin cores, and all-ceramic crowns.** *J Prosthet Dent. 2009 Oct;102(4):229-34*

Statement of problem: There is no evidence to suggest that the ferrule length needed for an all-ceramic crown is different from that needed for a cast metal or metal ceramic crown**. Purpose:** The purpose of this study was to relate different ferrule lengths with the number of fatigue cycles needed for failure of the crown cement for an all-ceramic crown cemented with a resin cement. **Methods:** Fifteen maxillary central incisors were divided into 3 groups (n=5), with ferrules of 0.0 mm (no-ferrule group), 0.5 mm (0.5-mm ferrule group), and 1.0 mm (1.0-mm ferrule group), respectively. Each tooth was restored with a 0.050-inch glass-filled composite post (ParaPost FiberWhite) and a composite resin core (ParaCore). The posts were cemented with resin cement (ParaPost Cement), and the composite resin cores were bonded to dentin using a dentin bonding agent (ParaPost Cement, Conditioner A & B). Each specimen was prepared with a 7-mm total preparation height, a 1.5-mm lingual axial wall, and a 1.0-mm shoulder around the tooth. The crowns for all specimens were pressed with a pressable ceramic material (IPS Empress 2) and cemented with resin cement (Variolink II). A 6-kg cyclic test load was applied to each specimen at 135 degrees to the long axis of the tooth. The independent variable measured was the number of load fatigue cycles required for failure of the crown cement. The data were subjected to the Kruskal-Wallis test to detect overall significance and the Mann-Whitney U test for pairwise comparisons with Bonferroni correction (alpha=.017). **Results:** The mean (SD) number of cycles to failure for each group was: no-ferrule group, 213 (317); 0.5-mm ferrule group, 155,137 (68,991); and 1.0-mm ferrule group, 262,872 (21,432). None of the specimens in the 1.0-mm ferrule group failed. Significant differences were found between the no-ferrule group and the 0.5-mm ferrule group, and the no-ferrule group and the 1.0-mm ferrule group ($P<.017$), but not between the 0.5-mm ferrule group and the 1.0-mm ferrule group ($P>.017$). **Conclusions:** Specimens with a 0.0-mm ferrule survived few fatigue cycles despite the fact that both the post and crown were bonded with resin cement. Teeth with a 0.5-mm ferrule showed a significant increase in the number of fatigue cycles over the 0.0-mm group, whereas teeth with the 1.0-mm ferrule exhibited a significantly higher fatigue cycle count over the 0.0-mm but not the 0.5-mm group. PDF

C. RADIOPACIDADE

*Denny, D., Heaven, T., Broome, J., Weems, R. **Radiopacity of luting cements and endodontic posts .** *J Dent Res. Vol 84 (Spec. Iss. A) Abstract #0675, 2005* (www.dentalresearch.org)

The lack of radiopacity found with some nonmetallic prefabricated radicular posts in combination with the luting cement can make radiographic interpretation difficult. Objective: This study evaluated the radiographic density of nine cements and eleven posts. Methods: Cements tested were: ZnPO4 (Z) Mizzy; Duolink (DL), Hi-X (HX) Bisco; Ketac Cem (KC); Rely X

ARC (RA), Rely X Luting (RL), Rely X Unicem (RU) 3M ESPE; Panavia F (PF) Kuraray; Variolink (V) Ivoclar. Posts tested were: D.T. Light Post (DT) RTD, St Egreve, France; Twin Luscent Anchor (TLA) Dentatus; Parapost XP steel (XP); Parapost XT titanium, (XT); Fiber White (FW), Whaledent; Achromat (A) Axis; Fibrekor (FK) Pentron,; FRC Postec (FRC) Ivoclar. Individual radiographs of each specimen and a continuous aluminum ramp were made using D-speed film (Kodak). These films were scanned and analyzed with NIH Image software. Data were analyzed with a one-way ANOVA and Tukey-Kramer at α=0.05. Results: The mean (sd) density of the cements in terms of equivalent thickness of aluminum were: Z 4.50 (0.45)a, V 3.82 (0.19)b, HX 3.42 (0.27)c, RU 1.57 (0.23)d, RA 1.07 (0.10)e, KC 1.06 (0.17)e, RL 1.02 (0.21)e, DL 0.64 (0.14)f, PF 0.60 (0.24)f. The density of the posts were: XP 11.12 (0.15)a, XT 5.56 (0.18)b, **A 1.74** (0.07)c, DT 1.65 (0.12)c, FRC 1.34 (0.12)d, FK 1.05 (0.14)e, FW 0.61 (0.10)f, TLA 0.38 (0.10)g, Means of groups with the same superscript were not significantly different. Conclusion: ISO 4049 (2000) for polymer-based materials stipulates that a material must exhibit the radiopacity of an equivalent thickness of aluminum to be deemed radiopaque. Seven of the nine cements and six of the eight posts were found to meet the criteria.

D. CONDUTIVIDADE DE LUZ

Bassi, F. Cerutti, F., Poletti, N., Gagliani, M., Re, D., Cerutti, A. **Endocanalar glass-fibre-post luting: Micro-raman analysis of dual-curing composites conversion degree.** *J Dent Res. Vol 88 (Spec. Iss. A) Abstract # 1911, 2009. (www.dentalresearch.org)*

Objective: Aim of this study was to evaluate the degree of conversion (DC) of composites cured throughout glass-fibre post, comparing different curing methods at increasing depths. **Methods:** Forty-five freshly extracted mono-radicular teeth were sectioned at the CEJ with a diamond-coated saw, endodontically treated and filled with warm gutta-percha. Samples were randomly divided into three groups (n=15), post spaces were prepared and glass-fibre posts (FRC Postec Plus, Ivoclar-Vivadent) were luted with three dual-curing composite materials, respectively: Calibra (Dentsply), Multilink Automix and Variolink II (Ivoclar – Vivadent). Light-curing was performed with the same halogen lamp (Swiss Master Light, EMS) employed with three different programs (400 mW/cm2 for 120s; 800 mW/cm2 for 60s; 1200 mW/cm2 for 40s), providing a constant amount of energy (48J). Samples were stored in physiological saline in a sealed box for 24 hours at 37°C, then 1 mm-thick slices were cut. Slices corresponding at 1, 3, 5 and 7mm of depth from the CEJ were analysed with MicroRaman HR Spectrometry at 0° and 180°. The data were statistically analysed by ANOVA (p<0,05), then compared to data collected in a previous in vitro study based on the same protocol. **Results:** DC was considered as a function of depth: from this point of view, no significant difference was found between the composites DC. Considering DC as a function of the curing modality for each material, at the depth of 7 mm Variolink II acquires the best results when cured at 400mW/cm2 for 40s. Conversion mean values and SD are shown in Tab.1. **Conclusion:** Materials with a dual component are recommended in post luting to ensure adequate monomer conversion at high depths. The features of each luting composite are exalted from different curing conditions that should be calibrated.

Material		Calibra			Multilink Automix			Variolink II		
Curing Mod		400x120	800x60	1200x40	400x120	800x60	1200x40	400x120	800x60	1200x40
Depth	1 mm	71 (10,2)	66 (13,6)	67 (15,1)	72 (12,4)	77 (10,4)	75 (6,8)	82 (5,8)	80 (9)	78 (4,3)
	3 mm	65 (5,8)	59 (11,6)	67 (7)	78 (10)	78 (9,7)	81 (6,3)	82 (3,5)	79 (13,7)	81 (4,9)
	5 mm	66 (17,3)	60 (10,4)	63 (11,7)	76 (13,1)	80 (4,7)	76 (9,1)	84 (6,5)	81 (6,4)	79 (7,8)
	7 mm	67 (9,3)	62 (13,6)	65 (7,5)	71 (15,5)	76 (13,8)	72 (8,7)	86 (5,2)	82 (4,5)	79 (5,7)

Dos Santos, A., Morgan , LF, Peixoto, RT, de Castro Albuquerque, R, Santos Corrêa, MF, de Abreu Poletto, LT, Pinotti ,MB. **Light transmission through a translucent fiber post**. *J Endod. 2008 Mar;34(3):299-302.*

This study is a quantitative assessment of the luminous energy transmitted through different translucent fiber posts. After embedding the posts in black resin, the blocks were submitted to sequential cuts in a precision machine, and depths of 16 mm, 12 mm, 8 mm, and 4 mm were assessed for light transmission with a digital photometer. The quantitative analysis showed significant differences between different posts and depths. Furthermore, the values obtained revealed that the

quantity of luminous energy transmitted depends on the type of post and that for all of them there was a significant reduction of the quantity of light transmitted as the depth increased. Even without the post, the luminous intensity inside the canal seems to decrease to levels that are insufficient for polymerization, especially in the apical third.

Faria, E. Silva, AL, Arias, V.G, Soares, LE, Martin, AA, Martins, LR .**Influence of fiber-post translucency on the degree of conversion of a dual-cured resin cement**. *J Endod. 2007 Mar;33(3):303-5.*

This study evaluated the degree of conversion of one dual-cured resin cement when used to lute fiber posts with different translucencies. To measure the degree of conversion, polyvinylsiloxane molds were prepared to simulate root canals. The posts, Aestheti-Post or Light-Post, were cemented in these molds and, after photoactivation, were removed to obtain the resin cement spectrum by FT-Raman spectroscopy. Spectra were acquired at three depths: superficial, medium, and deep. For Light-Post, the resin cement at deep depth showed the lowest degree of conversion and no significant difference in degree of conversion was found between the other depths. For Aestheti-Post, the superficial depth presented a higher degree of conversion values than those in the medium and deep depths, which were not significantly different from each other. Light-Post exhibited a higher degree of conversion than that of Aestheti-Post only at medium depth. Light-Post effectiveness regarding the degree of conversion is dependent on the depth. **PDF**

*Goracci, C., Corciolani, G., Visci, A., Ferrari, M. **Light- transmitting ability of marketed fiber posts**. *J Dent Res87 (12):1122 -1126, 2008.*

If proper polymerization of resin-based cements is to be achieved for fiber post luting, light activation is needed for photo-curing agents, recommended for self-curing materials. The study was aimed at verifying whether the light-transmitting ability of marketed fiber posts reflected the manufacturers' claims for translucency. Ten posts per type were light-irradiated with a curing unit. Spectrophotometric measurements of the amount of photons reaching different post levels were taken. Data were statistically analyzed (linear regression, two-way ANOVA; alpha = 0.05). No light transmission was recorded through FibreKleer and Tech21 X-OP. For the other posts, light intensity decreased from coronal to apical and rose again at the apical tip, where it peaked for GC Fiber Post, Macro-Lock Illusion Post, and Radix Fiber Post. Light transmission was significantly higher at the coronal level. A statistically significant difference in translucency was found for Dentin Post X and FRC Postec Plus in comparison with Reforpost, FibreKleer, Tech21 X-OP, and Composipost. **PDF**

Lassilla, L. Vallittu, P. **Photopolymerization of fiber reinforced root canal post.** *J Dent. Res 81 (Spec Issue A) Abstract 3479, 2002. (www.dentalresearch.org)*

Objectives: During the last few years fiber reinforced composite (FRC) root canal post has been introduced to market. However, there still remains question of possible problem with the adhesion between highly crosslinked polymer matrix of FRC-posts and filler-composite. An alternative to resolve this problem FRC post simultaneously with the surrounding filler composite. The aim of this study was to determine the degree of conversion (DC) of resin matrix of FRC post polymerzed by light initiation in a simulated root canal. **Methods:** Four different lengths (7,12,18,24 mm) of cylinders were used as a model of root canal. Two groups of cylinders where used: cylinders in Groups 1 were filled only with dimethacrylate resin (StickResin, StickTech, Finland) only. Cylinders in Groups 2 were filled with continuous unidirectional E-glass fibers (StickClassics) that have been further impregnated with resin. Specimens were light-cured (Elipar, ESPE, Germany) for 40 sec from the top of the cylinders. The bottom of the cylinder was fixed on FTIR/ATR (Fourier Transform Infrared spectroscopy/Attenuated Total Reflectance) (Spectrum One, Perkin Elmer) sample accessory and polymerisation process was analysed. Degree of conversion (DC%) was calculated from the aliphatic C=C peak at 1638 cm^{-1}, normalised against the aromatic C=C peak at 1582 cm^{-1}: DC% = (1-C/U)x100%, where C=absorption peak of the cured specimen, where U=absorption peak of the uncured specimen. Spectra of the sample was recorded every 2.5 min up to 5 min. Each IR-spectra was recorded with 8 scans using a resolution of 4 cm^{-1}. **Results:**

	DC%/Length of cylinder(mm)			
Group	7	12	18	24
1. Resin	69.2	67.3	63.9	57.0
2. Resin+glass fibers	66.8	66.0	59.0	56.1

Regression line was fitted into both models with regression coefficients of 0.946 (resin, p=0.027) and 0.938 (fibers+resin, p=0.031). **Conclusions:** This in vitro study showed that sufficient degree of conversion could be achieved by exposing light from other end of glass fiber post.

Patyk, A., . Friedrich, M. **Translucency of glass-fiber-reinforced resin posts.** *J Dent. Res 83 (Spec Issue A) Abstract 1784, 2004. (www.dentalresearch.org)*

Objectives: In addition to their dentinoid biomechanical properties, glass-fiber-reinforced resin posts offer advantageous optical properties because of their translucency. The study aims at comparing the translucency of four different factory-made glass-fiber-reinforced posts for visible light at a wavelength of 420 mm. **Methods:** In a first step, the transfer of light through the post was documented fotographically. The following three post systems were compared: - FRC Postec® (Ivoclar Vivadent, Schaan/Liechtenstein) - Twin Luscent Anchors® (Dentatus, Hägersten/Sweden) - Para Post® Fiber White (Coltène Whaledent, Konstanz, Germany) In a second step, the degree of light polymerisation was qualified by measuring the hardness of the surrounding composite cement in dependence of the exposure time with the Knoop hardness test (14.000 measurements). The horizontal and vertical distances between the measuring points were 0,2 mm. The reference value was the hardness of composite cement having directly been exposed to light. **Results:** Whereas the photographs of the light transfer in the FRC Postec® and the Twin Luscent Anchors® system show a slightly decreasing intensity of the emitted light from the head of the post to its apex, in the Para Post® system an emission of light is found only in the head region. The results of the Knoop hardness test show that under 60 sec. of light exposure, the reference value of hardness is reached up to an apical depth of 5 mm. Under 120 sec. of light exposure, the reference value is reached up to a depth of 7,8 mm (Twin Luscent Anchors®) respectively 7,4 mm (FRC Postec). **Conclusion:** The results show, that the different geometrical shapes of the post systems have no significant influence on the polymerisation process. The crucial factor for the polymerisation depth is the duration of exposure to light, which should be at least 100 seconds.

Sawada, N, Hikage, S, Sakaguchi, K, **Shape of composite resins photopolymerized by the translucent post**. *J Dent Res.81 IADR Abstract #2569; 2002 (www.dentalresearch.org)*

Objectives: The purpose of this study was to investigate light transmission of a glass fiber post (GFP Light-Post #3; RTD St Egreve, France/Bisco) from the shape of polymerized dental resins. **Methods**: The GFP was inserted into composite resins (Lite-Fil II A Shade E1 and Lite-Fil II P Shade A3 (Shofu) in a 1.5ml microtube. The upper end of the post was irradiated with a visible light generator (Griplight II, Shofu) for 20, 40 or 60 seconds. After polymerization, the unpolymerized resin around the GFP was measured. The length (A) of the polymerized resin, the diameter (B) of the upper surface and the diameter (C) of the resin 10mm below (B) were measured. Three samples were measured for each set of conditions. The data were statistically analyzed by Student's t-test. **Results**: Results showed that irradiation for 20 seconds was insufficient for polymerization, and the measurements of the samples were not possible. In the E1 resin, the value for (A) after irradiation for 60 seconds (15.5 +/- 0.3mm) was significantly larger than after 40 seconds (13.7 +/- 1.1mm) ($p<0.05$). In addition, the diameters of (B) were 3.7 +/-0.3 (40 seconds) and 5.3 +/- 0.3 (60 seconds), and the diameters of (C) were 6.7 +/- 0.7 (40 seconds) and 8.8 +/- 0.2 (60 sec). In the A3 resin, the extent of the resin polymerization was smaller than that in E1, although the value for (A) in the A3 resin was not significantly different from that in E1. **Conclusions**: Consequently, it was concluded that the composite resins were photopolymerized using the GFP. These results suggest that irradiation of a GFP (Light-Post #3) for over 40 seconds can effectively polymerize a highly translucent resin in clinical practice.

*Kim, Y.K., Kim, S. K. , Kim, K.H. Kwon, T.Y.. **Degree of conversion of dual-cured resin cement light-cured through three fibre posts within human root canals: an *ex vivo* study.** *International Endodontic Journal Volume 42 Issue 8, Pages 667 – 674*

Aim To evaluate the degree of conversion of one dual-cured resin cement light-cured through three fibre posts within extracted human teeth. **Method:** Fifteen mandibular premolars were root filled and then divided into three groups. Variolink II was light-cured through the posts (LP, **D.T. Light-Post;** PP, FRC Postec Plus; SP, Snowpost) within the root canal. The degree of conversion was obtained at 1 mm intervals in 9 mm-deep longitudinally sectioned root canals using an optical microscope connected to an FTIR spectrophotometer ($n = 10$). The light transmission of each post tested was also examined using UV–Vis spectroscopy. Data were analysed using ANOVA and Tukey's test ($\alpha = 0.05$). **Results:** The LP and PP posts revealed a light transmission of 10.2% and 7.7%, respectively, whereas the SP post exhibited a significantly lower value of 0.5%. The degree of conversion mean value ranged from 32.78% to 69.73% depending on the depth and type of post. For all the groups, there were significant decreases in the degree of conversion values for the middle region when compared with those for the cervical region ($P < 0.05$). Except at a depth of 1 mm, the SP group consistently exhibited significantly lower degree of conversion values than the other groups ($P < 0.05$). The linear regression analysis revealed a strong correlation between the light transmission of the posts and the overall degree of conversion value for each group ($R^2 = 0.9888$). **Conclusions:** The decrease in the degree of conversion for Variolink II relative to the depth was dependent on the light transmission capacity of the posts tested. PDF

III. PROPRIEDADES MECÂNICAS; interação com o dente

A. Resistência a Fratura do Dente Restaurado

Abo El-Ela, OA, Atta, OA, El-Mowafy, O. **Fracture resistance of anterior teeth restored with a novel nonmetallic post.** *J Can Dent Assoc Jun;74(5):441 2008*

Objective: To determine the fracture resistance of endodontically treated anterior teeth restored with a novel nonmetallic post in combination with self-etching adhesives. **Methods:** Extracted maxillary anterior teeth were sterilized with gamma irradiation, and each crown was severed 2 mm above the cementoenamel junction. Endodontic treatment was performed, and the teeth were divided into 7 test groups according to the post-adhesive combination used (n = 8 in each group). The following combinations of posts and adhesives were used: group 1, ParaPost stainless steel post with glass ionomer cement (control group); group 2, Light Post post with Clearfil SE Bond bonding agent and Panavia-F adhesive; group 3, Light Post post with Xeno-III bonding agent and Panavia-F adhesive; group 4, ParaPost Fiber White post with Clearfil SE Bond bonding agent and Panavia-F adhesive; group 5, ParaPost Fiber White post with Xeno-III bonding agent and Panavia-F adhesive; group 6, everStick post with Clearfil SE Bond bonding agent and Panavia-F adhesive; and group 7, everStick post with Xeno-III bonding agent and Panavia-F adhesive. Core build-ups to restore anatomic form were made from light-cured composite (TPH3). Specimens were stored in water at 37 degrees C. The roots of each tooth were embedded in an acrylic base, and the teeth were mounted at 135 degrees to the horizontal. The teeth were loaded in an Instron machine, and loading was applied to the point of fracture. Fracture loads were recorded, means and standard deviations (SDs) were calculated, and the data were analyzed with analysis of variance (ANOVA) and Tukey"s tests. **Results:** The mean fracture load (and SD) for each group was as follows: for group 1, 536.8 (75.1) N; for group 2, 1,000.1 (190.9) N; for group 3, 1,049.9 (231.5) N; for group 4, 1,548.5 (290.0) N; for group 5, 1,171.3 (296.9) N; for group 6, 1,711.7 (516.7) N; and for group 7, 1,825.7 (527.3) N. ANOVA revealed significant differences among the groups ($p < 0.001$). In addition, the mean fracture value for group 7 was significantly higher than those of the other groups $p < 0.05$) except for groups 4 and 6. **Conclusions:** Use of a novel glass fibre post (the everStick post) was associated with the highest mean fracture force for maxillary anterior teeth, regardless of the bonding agent used, whereas the stainless steel post was associated with the lowest mean fracture force.
PDF

Adanir, N., Belli, S. **Evaluation of different post lengths' effect on fracture resistance of a glass fiber post system.** *Eur J Dent. 2008 Jan;2(1):23-8.*

Objectives: The purpose of this in vitro study was to evaluate the influence of different post lengths upon root fracture resistance. **Methods:** 78 maxillary central teeth with similar dimensions were mounted in acrylic blocks with artificial silicone periodontal ligaments. Combinations of post lengths of 6 mm (shorter than 1/1 clinical crown length), 9 mm (1/1 clinical crown length), and 12 mm (longer than 1/1 clinical crown length) made up 6 different groups consisting of 13 teeth each. The glass fiber posts (Snowpost) were cemented with Super-Bond C&B and Panavia F luting cement. Composite-resin cores were made with Clearfil PhotoCore. The specimens were tested in a universal test machine. The testing machine applied controlled loads to the core, 2 mm from its incisal edge, on the palatal side at an angle 135 degrees to the long axis of the root. The testing machine was set at a crosshead speed of 5mm per minute. All samples were loaded until failure. **Results:** There was no statistically significant difference between cements (P>.05). Posts shorter than clinical crown length demonstrated root fracture under significantly lower loading forces (P<.05). **Conclusion:** Usage of posts shorter than clinical crowns should be avoided to eliminate clinical failure.

*Akkayan, B., Gulmez, T.: **Resistance to fracture of endodontically treated teeth restored with different post systems.** *J Prosthet Dent 2002; 87:431-7*

Statement of problem: Very little is known about the resistance to fracture of endodontically treated teeth restored with newly developed esthetic post systems. **Purpose:** This in vitro study compared the effect of 1 Titanium and 3 esthetic post systems on the fracture resistance and fracture patterns of crowned, endodontically treated teeth. **Methods:** A total of 40 recently extracted human maxillary canines with their crowns removed were endodontically treated. Four groups of 10 specimens were formed. Teeth were restored with Titanium (Filpost), quartz fiber (D.T. Light-Post), glass fiber (ParaPost White) and Zicronia (Cosmopost) posts and numbered as groups 1, 2, 3 &4, respectively. All posts were cemented with Single Bond dental adhesive system and dual-polymerizing RelyX ARC adhesive resin cement. All teeth were restored with composite cores, and metal crowns were fabricated and cemented with glass ionomer cement. Each specimen was imbedded in acrylic resin and then secured in a universal load testing machine. A compressive load was applied at a 130-degree angle to the long axis of the tooth until fracture, at a crosshead speed of 1mm / min. One-way analysis of variance and a Tukey test were used to determine the significance of the failure loads between groups (P<.001). A non-parametric $\mathbf{X}^2$ test was conducted for evaluation of the mode of failure (P<.001). **Results:** The mean failure loads (kg) were 66.95, 91.20, 75.90, and 78.91 for groups 1 – 4, respectively. Teeth restored with quartz fiber posts (group 2) exhibited significantly higher resistance to fracture (P<.001) than the other 3 groups. Teeth restored with glass fiber and zirconia posts (groups 3 and 4) were statistically similar (P<.05). Fractures that would allow repair of the tooth were observed in groups 2 and 3, whereas

unrestorable, catastrophic fractures were observed in groups 1 and 4 (P<.001). **Conclusion:** Within the limitations of this study, significantly higher failure loads were recorded for root canal treated teeth restored with quartz fiber posts (D.T. Light-Post: RTD, St Egreve, France). Fractures that would allow repeated repair were observed in teeth restored with quartz fiber and glass fiber posts. **PDF**

*Akkayan, B. **An in vitro study evaluating the effect of ferrule length on fracture resistance of endodontically treated teeth restored with fiber-reinforced and zirconia dowel systems.** *J Prosthet Dent. 2004 Aug;92(2):155-62*

Statement of problem: There are few published studies analyzing the effects of different ferrule lengths of endodontically treated teeth in relationship to newly developed fiber-reinforced and zirconia dowel systems. **Purpose:** This in vitro study compared the effect of 3 different ferrule lengths on the fracture resistance and fracture patterns of crowned endodontically treated teeth restored with 4 different esthetic dowel systems. **Methods:** The crowns of 123 human maxillary canines were removed at the cementoenamel junction and the roots were endodontically treated. Three master tooth models were prepared to ferrule lengths of 1.0 mm, 1.5 mm, and 2.0 mm to produce 3 master analogs. Each root was embedded in autopolymerizing resin with a 0.2-mm layer of silicone impression material to simulate the periodontal ligament. Forty analogs of each master tooth, with ferrule lengths of 1.0 mm, 1.5 mm, and 2.0 mm were produced with copy-milling (Celay system). Each group was further subdivided into 4 groups of 10 specimens each and restored with 4 different esthetic dowel systems: quartz fiber (D.T. Light-Post- RTD St Egreve, France), glass fiber ER DentinPost/Brasseler-Komet, Germany), glass fiber plus zirconia (EasyPost, Dentsply-Maillefer, Switz.), and zirconia (CosmoPost, Ivoclar-Vivadent, Liechtenstein). All dowels were luted with adhesive resin cement (RelyX ARC), restored with composite cores (Valux Plus), and Ni-Cr alloy (Wiron 99) complete crowns. All specimens were loaded at 130 degrees to the long axes in a universal testing machine at a crosshead speed of 1 mm/min until fracture. Fracture patterns were classified as failures above or below the incisal third of the roots. The data were analyzed with 2-way ANOVA and Tukey HSD tests (alpha=.05). A Fisher exact test was conducted for evaluation of the mode of failure (alpha=.05). **Results:** Mean failure loads (kg) for quartz fiber, glass fiber, glass fiber plus zirconia, and zirconia groups, respectively, with the 3 ferrule lengths were: 1.0-mm ferrule specimens: 98.09 +/- 2.90, 85.36 +/- 2.82, 80.24 +/- 1.88, 70.11 +/- 2.48; 1.5-mm ferrule specimens: 101.0 +/- 2.88, 87.58 +/- 2.83, 89.8 +/- 2.09, 82.71 +/- 2.14; 2.0-mm ferrule specimens: 119.5+/-1.78, 99.84+/-1.23, 98.6 +/- 1.64, 95.42 +/- 1.02. Teeth prepared with 2.0-mm ferrules demonstrated significantly higher fracture thresholds (P<.001). There were no significant differences in fracture patterns. **Conclusions:** Increasing the ferrule length of the endodontically treated teeth from 1 mm to 1.5 mm in specimens restored with quartz-fiber and glass-fiber dowels did not produce significant increases in the failure loads (P=.084, P=.119, respectively). No significant difference was detected between glass-fiber and glass-fiber plus zirconia dowels with 1.5-mm and 2.0-mm ferrules (P=.218, P=.244, respectively). However, fracture thresholds were higher for all 4 dowel systems when the specimens were prepared with a 2.0-mm ferrule length (P<.001). **PDF**

Al-Wahadni, AM, Hamdan, S, Al-Omiri, M, Hammad, MM, Hatamleh, MM. **Fracture resistance of teeth restored with different post systems: in vitro study.** *Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2008 Aug;106(2):e77-83. Epub 2008 Jun 13.*

Objective: The objective of this study was to investigate fracture resistance and mode of failure of teeth restored with different prefabricated post systems. **Study design:** Thirty teeth were collected, sectioned 15 mm from the apex, root canal prepared, and randomly allocated into 3 groups as follows: glass fiber posts (group 1), carbon fiber posts (group 2), and Radix-Anchor titanium posts (group 3). Teeth were then restored with a composite core and tested using a universal testing machine at 10 mm/min cross-head speed. Mode of failure was identified as either reparable or irreparable (catastrophic). **Results:** Mean values of fracture forces (N) for teeth restored with Radix posts (571.6) were statistically significantly higher than teeth restored with either carbon fiber (420.6) or glass fiber posts (393.9). There were 86.67% of fractures that were catastrophic in nature. **Conclusions:** Teeth restored with Radix-titanium posts were more resistant to fracture than those restored with either carbon or glass fiber posts. Most of the fracture modes were catastrophic in nature. **PDF**

Aminsalehi, E., **Strength of incisors restored by metallic, fiber and ceramic posts.** *J Dent. Res 84 (Spec Issue B), African and Middle East Section 2005 (www.dentalresearch.org).*

Objectives: In endodontically treated teeth, because of extensive structural defects, the risk of fracture is increased. For reconstruction of coronal structure posts provide retention. Composite fiber posts were recently introduced to dentistry. This study compared the fracture strength of maxillary central incisors restored by metalic, fiber-reinforced composite and ceramic posts. **Methods:** 30 human maxillary central incisors were used. The crown of each incisor was cut off 1 mm coronally to C.E.J. perpendicular to long axis of the tooth by metal disc. Root canals of teeth were prepared for posts after RCT. Specimens were embedded in autopolymerizing acrylic resin 4 mm below the CEJ and then tested in a universal testing machine (Zwick-Germany). A compressive load was applied at 130 degrees to the long axis until fracture, at a cross-head speed of 0.5 mm/min. Fracture loads were recorded. All data collected were analyzed statistically using the ANOVA

and LSD tests. **Results:** The mean and standard deviation (S.D.) of failure loads (in Newtons) were 765 +/- 113/265 N, 790+/- 95/34 N, 614+/- 105/32 N for glass-fiber, ceramic and metallic groups, respectively. ANOVA test detected statistically significant differences between all groups. Teeth restored with fiber and ceramic posts exhibited significantly higher resistance to fracture than with titanium posts. Teeth restored by fiber and ceramic posts were statistically similar by LSD test. The highest proportion of undesirable fractures was seen with titanium posts. **Conclusion:** Usage of fiber and ceramic posts are preferable to titanium posts. Because of more undesirable fractures in the ceramic group than fiber group, use of the latter posts are recommended overall.

*Antonson, S.A., Yilmaz, Z., Kilinc, E., Antonson, D.E,, Hardigan, P. **Fracture resistance of endodontically treated lower incisors with fiber posts.** *J Dent Res. Vol 88 (Spec. Iss. A) Abstract # 1912, 2009. (www.dentalresearch.org)*

Objectives: To compare the effects of four fiber post systems with three luting cements on the fracture strength of endodontically treated and crowned lower anterior teeth. **Methods:** The root canals of 104 lower incisors were prepared to a #40 size. Roots covered in adhesive-tape to simulate PDL were mounted in acrylic-resin. Post spaces were prepared at 9mm leaving 5mm apical gutta-percha. Samples were divided into 12 study groups including four fiber post systems(Parapost Taperlux/ColteneWhaledent; D.T.Light-Post/RTD, St Egreve, France / Bisco; PeerlessPost/SybronEndo; SpirapostPFS/ZenithDental) and three cements(RelyX-Unicem/3MESPE; Nexus2-Dual-cure/Kerr; DualSyringe/Bisco). Control group included gutta-percha without posts. All teeth were restored(Parapost Paracore dual-cure-corematerial) and prepared in standard manner(4mm core-height, 1.2mm chamfer-finishline, 2mm ferrule). Base-metal full crowns including labial-step design(1x1mm) were fabricated and cemented with respective cements. Samples were statically loaded(Instron, 0.5mm crosshead-speed,18°angle on labial-step) until failure. Failure load(N) was statistically analyzed using One-way ANOVA with Tukey'sHSD. Samples were ranked by $\chi 2$ test for independence for the type of failure(catastrophic/favorable). Results: No differences were found between post or cement groups ($p>0.05$). Type of failure was not significant in any particular group.

Groups	Load at failure (N)	Confidence Intervals	
		Lower 95%	Upper 95%
Spirapost-DualSyringe	560.82^{AB}	32.43	56.83
Peerless-RelyX	542.27^{AB}	33.51	52.79
Spirapost-RelyX	492.2^{AB}	29.53	48.81
Peerless-DualSyringe	476.10^{AB}	28.25	47.53
Spirapost-Nexus 2	459.74^{AB}	25.45	47.72
Parapost-DualSyringe	407.73^{B}	22.80	42.09
Parapost-Nexus 2	402.40^{B}	21.71	42.33
D.T.Light-RelyX	400.67^{B}	21.58	42.19
D.T.Light-DualSyringe	393.57^{B}	20.19	42.45
D.T.Light-Nexus 2	377.46^{B}	19.73	40.35
Peerless-Nexus 2	351.03^{B}	17.63	38.24
Parapost-RelyX	335.86^{B}	16.42	37.03
Control	792.38^{A}	50.86	75.25

*Levels not connected by same letter are significantly different.

Conclusions: The different fiber posts with various cements performed similarly both in fracture toughness and failure mode, having the control group performing the best. Inclusion of ferrule may have an effect on the comparable results. Materials were supplied by respective companies.

*Ayad, MF, Bahannan, SA, Rosenstiel, SF. **Fracture resistance of structurally compromised roots with aesthetic dowel systems** *J Dent Res.87 (Special Issue A) AADR Abstract #1036; 2008 (www.dentalresearch.org)*

Objectives: This study evaluated the validity of composite resin and glass ionomer cement for reinforcement of flared root canals before aesthetic dowel system application. **Methods:** To simulate weakness, the entire surfaces of 140 extracted human single-rooted teeth were enlarged to reduce the thickness of dentin wall to 0.5 mm. The teeth were equally divided into 7 test groups (n=20) according to the canal irrigant used: no irrigant (control), 5% hydrogen peroxide, 5% sodium hypochlorite, a combination of 5% hydrogen peroxide and sodium hypochlorite, 15% ethylenediaminotetraacetic acid (EDTA), 10% lactic acid, or 20% lactic acid. Within each group, half of treated root canals (n=10) were filled with composite resin (PermaFlo, Kerr) and the other half were filled with glass ionomer (Fuji One, GC America). A light-

transmitting plastic post (Luminex, Dentatus) was used to create space for the fiber-reinforced posts (D.T. Light-Post, RTD, St Egreve, France/ Bisco) and (Aestheti-Post, (RTD, St Egreve, France/ Bisco) (n=5) and to cure the restorative materials All posts were cemented with adhesive resin cement (Panavia 21, Kurrary). Compressive load was applied at 130¨¬ on lingual surface of the composite core (Corestore 2, Kerr) to obtain the fracture resistance on an Instron universal testing machine. The data were analyzed with 1-way ANOVA followed by Ryan-Einot-Gabriel-Welsch Multiple Range Test (□=.05). **Results:** Lactic acid solutions and EDTA created micromechanical retention in the dentin with composite resin. Moreover, a hybrid layer was detected along the dentin wall and fracture resistance was significantly higher than other groups (p<.001). **Conclusions:** Composite resin bonding systems are an efficient method to reinforce structurally compromised roots with a lactic acid irrigant. Moreover, aesthetics can be enhanced with aesthetic dowel rehabilitation.

Bandeca, M.C., El-Mowafy, O, Lima, J.P.M., Nadalin, M.R., Saade, E., Boaventura, J.M.C. Rastelli, A.N.S., Porto-Neto, S.T. **Fracture resistance of endodontically treated teeth after using intracoronal bleaching**. *J Dent Res. Vol 88 (Spec. Iss. A) Abstract # 610, 2009. (www.dentalresearch.org)*

Objectives: The aim of this study was to evaluate the fracture resistance and failure pattern of endodontically treated teeth after intracoronal bleaching with 35% hydrogen peroxide for 3 weeks with application of different restorative procedures. **Methods:** This study was performed on 80 mandibular incisors (n=80) and divided in 10 groups: G1: non-bleached teeth and restored with composite resin; G2: non-bleached teeth and luting of fiber-reinforced composite post (Everstick¨ Post, Sticktech) with Panavia¨ F 2.0 (Kuraray); G3: non-bleached teeth and luting of fiber-reinforced composite post with Breeze¨ (Pentral Clinical); G4: non-bleached teeth and luting of fiber glass post (Exacto¨, Angelus) with Panavia¨ F 2.0; G5: non-bleached teeth and luting of fiber glass post with Breeze; The groups G6 to G10 were the same materials of the anterior groups respectively, however the teeth were bleached. After 7 days storage in artificial saliva, the specimens were submitted to the fracture resistance test (kN) by a universal testing machine (Instron 4444) set at a speed of 0.5 mm/min and the data were submitted to the Tukey-Kramer multiple comparisons test. **Results:** No significant difference (p<0.05) was found between groups G1 to G10. The results suggest that intracoronal bleaching with 35% hydrogen peroxide did not significantly weaken the teeth. **Conclusion:** Among the application of different restorative procedures, the teeth restored with composite resin showed same values of resistance with those restored with non-metallic posts, however the failure pattern were predominately favorable to teeth restored with non-metallic posts.

Braz, R, Conceição, AAB, Conceição, E.N., Loretto, S.C., Lyra, A.M.V.C., Silva, .A.K.S. **Evaluation of reinforcement materials used on filling of weakened roots.** *J Dent Res. Vol 84 (Spec. Iss. A) Abstract #1733, (www.dentalresearch.org)*

Objectives: The purpose was to evaluate flexural strength of glass fiber posts associated with filling materials used for root reinforcement, and fracture resistance of flared roots reinforced with the same materials. **Methods:** For flexural test, 10 cylinders, 3.5mm (diameter) and 14mm (length), were made for each group, according to the reinforcement material used: G1 - Reforpost (Angelus)+dual resin cement Variolink II (Ivoclar/VIvadent); G2 - Reforpost+dual composite core BisCore (Bisco); G3 - Reforpost+three accessory posts Reforpin(Angelus)+Variolink II. Cylinders were dry stored (24h) and tested in a universal testing machine (0.5mm/min). For fracture resistance test, 30 human maxillary canines were used and their crowns removed at the cement-enamel junction (CEJ). The canals were endodontically treated, after which the fillings were removed and the canals widened by 3.5mm, simulating flared canals. The dual adhesive system Excite DSC (Ivoclar/Vivadent) was applied to the roots, which were randomly divided into 3 groups as performed for flexural strength test. After the cementation, coronal complements were made with composite-resin and the roots were assembled in metallic cylinders filled with self-curing acrylic-resin 2mm below the CEJ. After storage (24h), the samples were fixed at a 45º angle to a metal funneled tip that applied a force on the lingual surface (0.5mm/min). Statistics were performed using analysis of variance and Tukey`s test (5%). **Results:** The flexural mean values (MPa) were: G1 - 206.52, G2 - 224.39 and G3 – 272.64, showing a statistically difference between the reinforcement materials used, with G3 presenting statistically higher flexural strength compared to other groups. For fracture resistance, mean values (Kgf) were: G1 – 47.45, G2 – 66.57 and G3 – 74.11, showing that G1 presented a statistically lower mean value than the other groups. **Conclusion:** Therefore, it was possible to conclude that glass fiber post, associated with accessory posts, is the method of choice for reinforcing structurally weakened roots.

Burmann, P, Cardoso, P., Santos, J, Soares, L. **Post Systems: compressive strength of roots prepared at 2/3 and ½ length restored with post systems**. *J Dent Res.81 IADR Abstract #1933; 2002 (www.dentalresearch.org)*

Objectives: Evaluate the mechanical resistance of roots restored with prefabricated posts. **Methods:** 40 sound upper human central incisors had the crown removed and the roots were endodontically treated. After 24 hours, the root canals were prepared using low rotation, going 2/3 or ½ down the depth of the root, and were divided into 4 groups (n=10). Group A: 10

roots were prepared on 2/3 of the depth for the cementation of the Unimetric Post (Dentsply/Maillifer) (**UNI**) using Clearfil LinerBond 2V and Panavia F (Kuraray Co. Japan), according to manufacturers instructions; Group B: 10 roots were prepared ½ down into the root canal for cementation with the same system as Group A; Group C: 10 roots were prepared on 2/3 of the depth for the cementation of the Aestheti-Post (**AES**: RTD, St Egreve, France) /Bisco) using ALL-BOND 2 (Bisco) and Post Cement HI-X (Bisco); Group D: 10 roots were prepared ½ down into the root canal for cementation with the same system as Group C. Three mm of the post were left outside of the root canal, on the cervical portion, to allow the fixation of the core restoration with composite resin (Z250-3M/ESPE, USA). Simulating preparation for a crown. The specimens underwent compression at 45^0 on a universal testing machine, at a speed of 0.5 mm/min. until fracture. **Results:** The mean values of load obtained at fracture (Group A=93.4 Kgf, Group B=88.4 Kgf, Group C=95.7 Kgf, Group D=96.3 Kgf) were statistically tested using ANOVA two-way test. **Conclusions:** All groups showed statistically similar results ($p>0.05$).Tthe different preparation depths of the root canals did not influence the results of the strength tests.

Cardoso, P.C., Burmann, P.A., Silveira, B., Albers, A, Soares, L.F. **Fracture strength of bovine pulpless teeth restored by post systems**. *J Dent Res. 80; AADR Abstract # 227; 2001 (www.dentalresearch.org)*

The development of adhesive cements and prefabricated post system (PPS) provides us a conservative alternative to the traditional cast post –core in the reconstruction of endodontically treated teeth. However, the fracture strength of the core/tooth structures continues to be an object of doubts and discussions. The study aimed at evaluating the "in vitro" fracture strength of roots of restored inferior incisor bovine teeth. Thirty bovine teeth and ten human teeth were selected to constitute 4 groups (n=10); group 1) PPS Cosmopost (Ivoclar) + Syntac + Variolink II (Vivadent); group 2) PPS C-Post + All Bond 2 + Post Cement HI-X (Bisco, Inc., USA); group 3) PPS Aestheti-Post +All Bond 2 + Post Cement HI-X (Bisco, Inc., USA); and the group 4) (control group) human incisor teeth prepared for metal ceramic crown. The roots all the same length (15 mm), were embedded into acrylic resin blocks with a film (0.2 mm) of vinyl polysiloxane to simulate the periodontal ligament. The core was build up with composite (7.250 – 3M USA) through a custom transplant matrix. After 24 hours storage (H_20/37ºC) the specimens were submitted to the comprehensive test in Richie universal testing machine.

Group	***Average***	***SD***
Cosmopost \ Variolink	87.30 MPa	±13.5814
C-Post – AB2 \ HI-X	67.35 MPa	±18.5305
ÆsthetP + AB2 \ HI-X	80.30 MPa	±19.1038
Human Teeth	97.63 MPa	±37.4461

The statistical analysis of the data (ANOVA) revealed no significant difference ($p>0.05$) among the fracture strength averages of the four groups. The values obtained from the pre-fabricated post systems gave us results are similar to those obtained with natural teeth.

Chuang, S-F, Yaman, P., Dennison, J., et al, **Fracture resistance of devitalized teeth restored with different prefabricated posts.** *J Dent Res. Vol 84 (Spec. Iss. A) Abstract #2926, 2005 (www.dentalresearch.org).*

Objectives: To investigate the fracture characteristics of devitalized teeth restored with posts of different materials and length. **Methods:** Sixty intact extracted incisors of similar size were chosen and sectioned 2mm coronal to the CEJ. The root canals were instrumented and obturated. Three different post systems were tested: stainless steel post (SB), glass-fiber post (GF), and carbon-fiber post (CF). The teeth were prepared to post lengths of 5 and 10 mm with the appropriate reamers for each post system. Composite cores of a standardized size were constructed over the cemented posts and Ni-Cr ceramic crowns were fabricated with a 1.5 mm ferrule length. The teeth were stored for 24 hours, thermocycled 1500 times (5-55¢XC). The tooth-crown assembly was mounted with a jig in a universal Instron testing machine and loaded at a crosshead speed of 0.5 mm/minute until failure. The teeth were then inspected under a stereoscope and SEM for fracture patterns. **Results:** The 10 mm/SB group had the lowest failure load (930 N), and was significantly different from the 5 mm/SB (1339 N) and 10 mm/GF group (1271 N). There was no significant difference in the failure loads among the fiber post groups, and in the failure toughness among six groups. Oblique fracture was the dominant pattern in all groups. Teeth restored with posts of the same material demonstrated similar fracture location and directions. Under SEM observation, cracked dentinal tubules were found in the lingual aspects of the SB posts. Over half of the specimens in the metal post groups exhibited fracture planes passing through the apex of the post.. **Conclusions:** Use of a 10 mm metal post did not improve the fracture strength of the restored devitalized teeth. Fiber posts provide more uniform stress distribution, which may prevent fracture at the apical end of the post. The fracture patterns of the teeth were associated with the post materials, while the post length had little influence on either the fracture strength or patterns of the teeth.

D'Arcangelo, C, De Angelis, F, Vadini, M, Zazzeroni, S, Ciampoli, C, D'Amario, M. **In vitro fracture resistance and deflection of pulpless teeth restored with fiber posts and prepared for veneers.** *J Endod. 2008 Jul;34(7):838-41. Epub 2008 May 16.*

The aim of this in vitro study was to evaluate the influence of endodontic therapy, veneer preparation, and their association on fracture resistance and deflection of pulpless anterior teeth and assess whether restoration with quartz fiber-reinforced post can influence these properties. Seventy-five freshly extracted human maxillary central incisors were selected. Teeth were randomly divided into 4 experimental groups (veneer preparation/endodontic therapy/endodontic therapy and veneer preparation/endodontic therapy, veneer preparation, and fiber post placement) and a control group (n = 15). Specimens were loaded to fracture recording crown deflection under load, and data were statistically analyzed. Veneer preparations and endodontic treatment did not significantly influence fracture resistance of maxillary incisors. On the contrary, preparation for veneer significantly increased the deflection values of the specimens. Fiber post restorations seemed to significantly increase mean maximum load values for specimens prepared for veneers. A fiber-reinforced post restoration can be suggested when endodontic treatment is associated with veneer preparation. **PDF**

de Oliveira, JA, Pereira, JR, Lins do Valle, A, Zogheib, LV. **Fracture resistance of endodontically treated teeth with different heights of crown ferrule restored with prefabricated carbon fiber post and composite resin core by intermittent loading.** *Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2008 Nov;106(5):e52-7. Epub 2008 Aug 20.*

This study evaluated the fracture resistance of endodontically treated teeth restored with prefabricated carbon fiber posts and varying quantities of coronal dentin. Sixty freshly extracted upper canines were randomly divided into groups of 10 teeth each. 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. Data were analyzed by 1-way analysis of variance and Tukey test (alpha = .05). Significant differences ($P < .001$) were found among the mean fracture forces of the test groups (positive control, 0 mm,1 mm, 2 mm, 3 mm, and negative control groups: 1022.82 N, 1008.22 N, 1292.52 N, 1289.19 N, 1255.38 N, and 1582.11, respectively). These results suggested that the amount of coronal dentin did not significantly increase the fracture resistance of endodontically treated teeth restored with prefabricated carbon fiber post and composite resin core. **PDF**

Dean, J. P., Jeansonne, B. G., and Sarkar, N. **In Vitro Evaluation of a Carbon Fiber Post.** *Journal of Endodontics. 24: 807-810, 1998.*

Abstract/conclusions: The purpose of this study was to evaluate the influence of endodontic and restorative procedures on fracture resistance of teeth, and to compare the incidence of root fracture in teeth with clinical crowns removed that were restored with three different types of post and a composite core build-up. Seven groups of 10 extracted maxillary canines were used. A control group had only a crown preparation, but no endodontic treatment. Three groups had endodontic treatment, crown preparation, and the access restored. Three groups had endodontic treatment, the crown totally removed, a tapered, parallel, or carbon post (Composipost) placed, and a composite build-up. All specimens were subjected to a 45-degree load at 0.5 mm/min until failure occurred. The force at failure and the location of fracture were recorded. The groups with post and composite build-ups failed at significantly lower force than the teeth in which the crowns had not been removed. There were no significant differences in the amount of force required to produce failure among the three groups with different posts and a composite build-up. The group restored with the Composipost had no root fractures, whereas there were five fractures (50%) in each of the parallel and tapered post groups. **PDF**

Dietschi, D, Ardu, S, Rossier-Gerber, A, Krejci, I. **Adaptation of adhesive post and cores to dentin after in vitro occlusal loading: evaluation of post material influence.** *J Adhes Dent. 2006 Dec;8(6):409-19*

Purpose: Fatigue resistance of post and cores is critical to the long term behavior of restored nonvital teeth. The purpose of this in vitro trial was to evaluate the influence of the post material's physical properties on the adaptation of adhesive post and core restorations after cyclic mechanical loading. **Methods:** Composite post and cores were made on endodontically treated deciduous bovine teeth using 3 anisotropic posts (made of carbon, quartz, or quartz-and-carbon fibers) and 3 isotropic posts (zirconium, stainless steel, titanium). Specimens were submitted to 3 successive loading phases--250,000 cycles at 50 N, 250,000 at 75 N, and 500,000 at 100 N--at a rate of 1.5 Hz. Restoration adaptation was evaluated under SEM, before and during loading (margins) and after test completion (margins and internal interfaces). Six additional samples were fabricated for the characterization of interface micromorphology using confocal microscopy. **Results:** Mechanical loading increased the proportion of marginal gaps in all groups; carbon fiber posts presented the lowest final gap proportion (7.11%) compared to other stiffer metal-ceramic or softer fiber posts (11.0% to 19.1%). For internal adaptation, proportions of debonding between dentin and core or cement varied from 21.69% (carbon post) to 47.37% (stainless steel post). Debonding at the post-cement interface occurred only with isotropic materials. Confocal microscopy observation revealed that gaps were generally associated with an incomplete hybrid layer and reduced resin tags. **Conclusions:** Regardless of their rigidity, metal and

ceramic isotropic posts proved less effective than fiber posts at stabilizing the post and core structure in the absence of the ferrule effect, due to the development of more interfacial defects with either composite or dentin. **PDF**

Dikbas, I, Tanalp, J, Ozel, E, Koksal, T, Ersoy, M. **Evaluation of the effect of different ferrule designs on the fracture resistance of endodontically treated maxillary central incisors incorporating fiber posts, composite cores and crown restorations.** *J Contemp Dent Pract. 2007 Nov 1;8(7):62-9.*

Aim: The purpose of this study was to evaluate the fracture resistance of endodontically treated maxillary central incisors restored with quartz fiber posts, composite cores, and crowns when different types of ferrule designs were incorporated. **Methods:** Sixty maxillary incisors were divided into six groups: Group 1 (control): teeth with root canal treatments having a full crown prosthesis; Group 2: teeth with a 2 mm circumferential ferrule; Group 3: teeth with a 2 mm ferrule only in the vestibular region; Group 4: teeth with a 2 mm ferrule only in the palatal region; Group 5: teeth with a 2 mm ferrule in the vestibular and palatal region, having cavities in both proximal areas; and Group 6: teeth with no ferrule. The teeth in the experimental groups were restored with quartz fiber posts-composite cores and full metallic crowns. All experimental teeth were subjected to an increasing compressive force with a crosshead speed of 1 mm/min, until fracture occurred. **Results:** The median fracture values of groups were as follows: Group 1: 574.4 N, Group 2: 472.4 N, Group 3: 474.3 N, Group 4: 480.7 N, Group 5: 463.1 N, and Group 6: 297.9 N. A statistically significant difference was found between Group 1 and Group 6 ($p < 0.01$). **Conclusions:** It was concluded different ferrule designs did not have any influence on the fracture resistance of teeth with fiber posts. The results of this study indicate fiber posts can safely be used for their reinforcing properties. Furthermore, there is no significant change in the resistance of teeth with fiber posts regardless of which ferrule design is incorporated. The property of these types of posts is an additional advantage in clinical practice. **PDF**

*Fathi, M., Mortazavi, MV, Katiraie, N. **Fracture resistance of endodontically treated teeth restored with esthetic posts.** *J Dent Res.Vol 87 (Spec Iss A) Abstract #1857, 2008 (www.dentalresearch.org)*

Objectives: This study compared the effect of three esthetic post systems with different modulus of elasticity on the fracture resistance and fracture patterns of endodontically treated teeth with structurally compromised and normal roots. **Methods**: Forty five extracted and root canal treated central incisors were assigned to 2 main experimental groups called "narrow" and "flared" canals. Narrow-canal group divided into 2 and flared-canal group, divided into 3 experimental subgroups (n=9). For narrow-canal subgroups, post spaces were prepared with the corresponding drills to restore with quartz fiber double taper light posts (D.T. Light-Post; RTD St Egreve, France) [subgroup A] and zirconia posts (CosmoPost;Ivoclar) [subgroup B]. For the flared-canal subgroups, thin–walled canals were simulated, and restored with quartz fiber double taper light posts[subgroup C], quartz fiber double taper light posts inserted within the polyethylene woven fibers (Ribbond; Ribbond,Inc) [subgroup D] and zirconia posts[subgroup E]. All posts were cemented with dual–polymerizing adhesive resin cement (Panavia F; Kuraray).After restoration of access cavity with composite and thermocycling, compressive load was applied to the palatal surface of tooth until fracture. Mean failure load values were analyzed using One-way ANOVA and Tukey test ($P<0.05$).Mode of failure was evaluated with Fisher exact test ($P<0.05$). **Results:** The mean failure loads ± SD were 678.55±90.86, 603.44±68.66, 638.22±93.71, 732.44±81.78, and 573.66±91.340 N for subgroups A to E, respectively. Subgroup D exhibited significantly higher resistance to fracture compared to subgroups B, C and E ($P<0.05$). Subgroup E showed significantly less fracture resistance compared to subgroups A and D ($P<0.05$). Subgroups B and E showed more root fracture compared to subgroups A, C, and D (P=0,004). **Conclusion:** Significantly higher fracture resistance was observed in flared root canal treated teeth restored with quartz fiber double taper light posts + polyethylene woven fibers. Zirconia posts showed lower fracture resistance and significantly more root fracture compared to fiber posts.

Fellippe, L. A., Monteiro, S. et al**. Influence of the use and type of endo posts used in the cervical stress level of central incisors submitted to the fatigue test; an in vitro study.** *J Dent Res. Vol 81 (Spec. Iss. A) Abstract #0057, 2002***.** *(www.dentalresearch.org)*

Objectives: The objective of this study was to observe the biomimetic behavior of the fiber resin post and cast post in the cervical stress level of central incisors submitted to the fatigue test. A group of non-posted tooth was also evaluated. **Methods:** Thirty six recently extracted upper central incisors were selected. The teeth were divided in three groups. G1 – Cast post and core. G2 – Fiber resin post and composite core G3 – without post and core. Post was introduced 2/3 of the root. All groups were endodontically treated and received a full cast crown. G1 e G2 were cut 1mm to the cervical limit. G3 was just restored with composite resin. For the fatigue test, the teeth were mounted in epoxy supports with a simulation of the periodontal ligament. The angle of test was 45º . An Instron 4444 (Universal Test Machine) was used for the compressive fatigue test. The maximum load was 60N. After the fatigue test, the groups were thermocycled and immersed in ethylene blue die for 24 hrs. **Results:** were obtained after teeth sectioning. The Kruskal-Wallis test was used. The average for each group was G1-3.0, G2-1.7, G3-4.6. A significant difference was observed ($p<0,05$) ($T=16.25$ and $p=0,0003$.) G2

had the best result. **Conclusion:** the study suggests that teeth with fiber resin post better resists the fatigue test than teeth with cast post or without post, under the specific conditions of the study.

Forberger N, Göhring TN. **Influence of the type of post and core on in vitro marginal continuity, fracture resistance, and fracture mode of lithia disilicate-based all-ceramic crowns.** *J Prosthet Dent. 2008 Oct;100(4):264-73*

Statement of problem: The influence of different crown foundations on marginal seal and fracture resistance of ceramic crowns placed on endodontically treated teeth has not been clearly established. PURPOSE: The purpose of this study was to evaluate the marginal continuity and fracture behavior of high-strength all-ceramic crowns with different substructures in endodontically treated premolars. **Methods:** Forty-eight human mandibular premolars were assigned to 6 groups, including a no-treatment group (Untreated) and a group for which the access cavity was restored with composite resin (Tetric Ceram) (COMP). In the remaining 4 groups, teeth were prepared to receive all-ceramic crowns with 0.8-mm-wide shoulders and axial dentin heights of 2 mm. No posts were used in the Endocrown group. Glass fiber posts (FRC Postec) were used in group FRC-POST. Group ZRO-POST received zirconia ceramic posts (CosmoPost), and group GOLD-POST received cast gold posts (CM). Experimental lithia disilicate ceramic crowns were made and adhesively cemented (Variolink). All teeth were subjected to thermal cycling and mechanical loading (TCML) in a masticatory simulator (1,200,000 loads, 49 N, 1.7 Hz, 3000 temperature cycles of 5 degrees C-50 degrees C-5 degrees C). Marginal continuity was evaluated with scanning electron microscopy at x200. All specimens were loaded to failure in a universal testing machine at 0.5 mm/min after TCML. Data were analyzed using 1-way ANOVA and post hoc t tests with Bonferroni correction (alpha=.05). **Results:** Initially, mean values (SD) between 72.4 (15.8)% (Endocrown) and 94.8 (3)% (FRC-POST) for continuous margins were found. With TCML, marginal continuity decreased significantly only in FRC-POST, to 75.5 (8.4)%, and in Endocrown, to 44.7 (14.5)%. Mechanical load testing measured mean loads to failure between 1092.4 (307.8) N (FRC-POST) and 1253.7 (226.5) N (ZRO-POST) without significant differences between groups. Deep root fractures were observed in half of the specimens, irrespective of their groups. **Conclusions:** Marginal continuity of the crowns studied was better and more stress resistant when posts and cores were included in the restoration of endodontically treated teeth with complete ceramic crowns. The placement of a post-and-core foundation did not influence the pattern of failure.

Giovani, A.R., Pasqualin, F.H., Rodrigues, L.M., Souza-Filho, C.B., Sousa-Neto, M.D., Silva-Sousa, Y.T.C., Paulino, S.M., Vansan, L.P. **Fracture resistance of posts with different geometric configuration**. *J Dent Res. Vol 88 (Spec. Iss. A) Abstract # 608, 2009. (www.dentalresearch.org)*

Objectives: This study evaluated in vitro the fracture resistance of roots with metallic and glass-fiber intraradicular retainers, varying the geometric configuration and using the compression test. **Methods:** The sample had 50 central superior incisives: 10 received only the coronary preparation (control) and 40 had their crowns sectioned and radicular canals endodontically treated (experimental group). The roots were embedded in acrylic resin, except for the 4 mm of cervical area. The prosthetic space was performed with cylindrical bur in low speed attached to a parallelometer. Groups were then randomly divided: teeth only coronary prepared (I), metallic cast posts with cylindrical (II) and conical (III) shape, glass-fiber posts with cylindrical (IV) and conical (V) shape, which were luted with Panavia F. Metallic cast crowns made done and cemented with zinc phosphate. The resin/dentin blocks were positioned in the Instron 4444 Universal Machine, using a rectangular tip with round edge, in an angle of 135 in relation to the root long axis. **Results:** Means in KN were: I (0.87±0.23), II (0.44±0.24), III (0.57±0.19), IV (0.71±0.35), V (0.45±0.11). The Tukey test showed no significant difference ($p>0.05$) between the cylindrical and conical metallic posts. The cylindrical glass-fiber posts were statistically similar ($p>0.05$) to the control group, which presented the higher fracture resistance values. **Conclusions:** It was concluded that the geometric configuration influenced on the fracture resistance of glass-fiber posts.

Hajizadeh, H., Namazikhah, MS, Moghaddas, MJ., Ghavmnasiri, M., Majidinia, S. **Effect of posts on the fracture resistance of load cycled endodontically treated premolars restored with direct composite resin.** *J Contemp Dent Pract Vol 10, No. 3, 2009 1-10*

Aim: The aim of this study was to investigate the fracture resistance and failure mode of premolars restored with composite resin using various prefabricated posts. **Methods:** Sixty sound maxillary premolars were divided into four equal sized groups. All but the control group reveived endodontic treatment followed by placement of MOD composite restorations (Tetric Ceram; Ivoclar, Leichtenstein) as follows: Group T = no post, Group DT= fiber reinforced composite post (DT Light-Post, RTD, Grenoble, France), Group FL= prefabricated metal post (Filpost). The control group (C) had no cavity preparation. After thermal and load cycling, static load was applied at 30 degrees' angle until fracture. Failure modes were categorized as restorable and non-restorable. Data were analyzed using the analysis of variance (ANOVA) and Duncan tests ($\alpha = 0.06$). **Results:** The mean value s of fracture loads (N) for all groups were: C (880 +/-258); T (691+/- 239); DT (865+/-269); and FL(388+/-167). Statistically significant differences ($P<0.05$) were observed for all groups except between groups

C and DT. The Chi square test showed failure modesin Groups C and DT were mostly restorable. The most non-restorable fractures were observed in Group FT. **Clinical singnificance:** The results of this study suggest that a quartz fiber post used in conjunction with an MOD composite resin restoration inproves fracture resistance in an endodontically treated pre-molar.

Hayashi, M., Takahashi, Y., Imazato, S., Ebisu, S. **Fracture resistance of pulpless teeth restored with post-cores and crowns**. *Dent Mater. 2005 Sep 16*

Objectives: The present study was designed to test the null hypothesis that there is no difference in the fracture resistance of pulpless teeth restored with different types of post-core systems and full coverage crowns. **Methods:** Extracted human upper premolars were restored with a fiber post, prefabricated metallic post or cast metallic post-core. Teeth with full crown preparations without post-core restorations served as a control. All teeth were restored with full coverage crowns. A 90-degree vertical or 45-degree oblique load was applied to the restored teeth with a crosshead speed of 0.5mm/min, and the fracture loads and mode of fracture were recorded. **Results:** Under the condition of vertical loading, the fracture load of teeth restored with the cast metallic post-cores was greatest among the groups (two-factor factorial ANOVA and Scheffe's F test, $P<0.05$). All fractures in teeth restored with all types of post-core systems propagated in the middle portions of roots, including the apices of the posts. Under the condition of oblique loading, the fracture load of teeth restored with pre-fabricated metallic posts was significantly smaller than that in other groups. Two-thirds of fractures in the fiber post group propagated within the cervical area, while most fractures in other groups extended beyond the middle of the roots. **Significance:** From the results of the present investigations, it was concluded that under the conditions of vertical and oblique loadings, the combination of a fiber post and composite resin core with a full cast crown is most protective of the remaining tooth structure.

Hayashi, M, Sugeta, A, Takahashi, Y, Imazato, S, Ebisu, S. **Static and fatigue fracture resistances of pulpless teeth restored with post-cores.** *Dent Mater. 2008 Sep;24(9):1178-86. Epub 2008 Mar 28*

Objective: Superior restorative methods for effectively strengthening pulpless teeth need to be identified, since vertical root fractures of pulpless teeth are still a major problem in everyday clinical practice. The present study tested the null hypothesis that there were no differences in static and fatigue fracture resistances of pulpless teeth restored with different types of post-core systems. **Methods:** Extracted human premolars were restored with a combination of either a fiber post or metallic post and a composite resin core. Teeth with full crown preparations without post-core restorations served as a control. A 90 degrees vertical or 45 degrees oblique static compressive load was applied to restored teeth, and fracture loads and modes of fracture were recorded. Fatigue fracture tests were conducted by applying sinusoidal cyclic loads to restored teeth from vertical or oblique directions. Fatigue limits for each restoration were calculated using the staircase approach. **Results:** In both static and fatigue fracture testing under vertical or oblique loadings, the fracture loads of teeth restored with fiber posts were significantly greater than those of teeth restored with metallic posts. The fatigue limits of teeth restored with fiber and metallic posts were 112 kgf and 82 kgf respectively under vertical loadings and 26 kgf and 20 kgf under oblique loadings. **Significance:** The combination of a fiber post and a composite resin core showed superior fracture resistance against both static and fatigue loadings compared to restorations using a metallic post, and is therefore recommended in restoring pulpless teeth. **PDF**

Isidor, F., Odman, P., and Brondum, K. **Intermittent loading of teeth restored using prefabricated carbon fiber posts.** *International Journal of Prosthodontics. 9: 131-136, 1996.*

Abstract/conclusions: This in vitro study evaluated the fracture resistance of bovine teeth with prefabricated carbon fiber posts (Composipost). Fourteen bovine teeth having similar lengths and dimensions were mounted in an acrylic resin block having a simulated periodontal ligament. The post space was prepared using two calibrated drills that provided an 8.5-mm post length. The prefabricated carbon fiber post was luted with a resin luting agent, and the core was made using the system's autopolymerizing resin core material. A crown was luted to each prepared tooth. Each test specimen was intermittently loaded (250 N) at an angulation of 45 degrees to the long axis of the tooth at a frequency of 2 loads per second. Four of the roots had an incomplete longitudinal fracture after loading. The results of this study were compared to a previous study by the authors that had been conducted under similar conditions. The failure rates of the two types of posts from the previous study (prefabricated parallel-sided posts (Para-Post) and tapered, individually cast posts) were significantly higher (Logrank test; $P<.02$) than those of the carbon fiber posts. **PDF**

Jimenez, M. P., Yaman, P., Dennison, J.D., et al **Fracture resistance of endodontically treated teeth restored with composite posts.** *J Dent Res. Vol 81 (Spec. Iss. A) Abstract #0323, 2002 (www.dentalresearch.org).*

The most recent application of fiber-reinforced composites involves their use as post and core systems to restore endodontically treated teeth. Even though this last application has been advertised and been used clinically by many dentists, there is very little information regarding the physical properties of these posts. **Objectives:** The purpose of this study was to compare the fracture resistance and mode of failure of endodontically treated teeth restored with fiber-reinforced composite posts. **Methods:** Ninety maxillary central incisors were divided into eight experimental groups and one control group of 10 samples each. Teeth from the two experimental groups called "Narrow" and "Flared" canals were restored with Fibre-Kor, Lucent Anchors and Ribbond posts using two different cementation techniques. Specimens were loaded to failure using an Instron machine. **Results:** Statistical analysis using two-way ANOVA revealed no significant difference between flared and narrow canals in mean load to failure between the post systems except for the Ribbond posts. For the narrow canal, the mean load ranged from a low of 4.55 (±1.49) Kg for the Ribbond Standard to a high of 12.9 (±1.64) Kg for the Lucent Anchors while for the flared canal the low mean was 9.04 (±1.76) for Fibre-Kor and the high of 12.87 Kg was equal for both Lucent Anchors and Ribbond Standard. Overall, the ParaPost control group had the highest load value (18.33 ±3.27 Kg). No root fractures occurred in any of the experimental groups. **Conclusions:** Results from the study suggest that the mode of failure or deflection of the fiber reinforced composite posts is protective to the remaining tooth structure**.** Considering the high risk of fracture and the possibility of re-treatment of endodontically treated teeth, the use of these new post systems seems to represent a conservative option when restoring debilitated root canals.

Kivanc, B., Gorgul, G. **Fracture resistance of teeth restored with different post systems using new generation adhesives.** *Jnl of Contemporary Dental Practice, Vol. 9, No.7., November 1, 2008.*

Aim: The aim of this study was to investigate the fracture strength of three post systems cemented with a dual cure composite resin luting cement by using different adhesive systems. **Methods:** In this study 63 extracted anterior teeth with single roots were endodontically prepared and filled. Teeth were randomly assigned to one of three post systems placed into the prepared canals: Group I - titanium posts (n=21) (Filpost); Group II - glass fiber posts (n=21) (Mirafit White); and Group III zirconia posts (n=21) (CosmoPost). Each group was again randomly divided into three subgroups according to the bonding materials used [Single Bond (n=7), Clearfil SE Bond (n=7), and Prompt L Pop (n=7)]. A dual cured resin cement (Rely X ARC) was used for bonding the posts into the root canals. Standard cores were made by a composite resin (Clearfil Photocore) using core build-ups. The samples were tested in the compression test machine for 1 mm/min and fracture resistance of the teeth were recorded. The data was analyzed by using two-way analysis of variance (ANOVA) and Duncan's New Multiple Range Tests. A significance level of $p<.05$ was used for all comparisons. **Results:** There was a significant difference in fracture resistance between the post systems ($p<0.05$) and the interaction of adhesive resins and post systems ($p<0.05$). Mirafit White was more resistant to fracture than other groups; Filpost showed the least resistance to fracture. CosmoPost post system bonded with Single Bond recorded the lowest fracture resistance ($p<0.05$). **Conclusion:** Endodontically treated anterior teeth restored with glass fiber posts exhibited higher failure loads than teeth restored with zirconia and titanium posts. Self-etching adhesives are better alternatives to etch-and-rinse adhesive systems for luting post systems. **Clinical Significance:** Under the condition of this study, glass fiber posts are preferable to restore endodontically treated anterior teeth. **PDF**

*Maccari, PC, Cosme, DC, Oshima, HM, Burnett, LH Jr, Shinkai, RS **Fracture strength of endodontically treated teeth with flared root canals and restored with different post systems.** *J Esthet Restor Dent. 2007;19(1):30-6;*

Background: Many post systems are available to clinicians, yet no consensus exists about which one is better in restoring endodontically treated teeth. **Purpose:** This study evaluated the fracture strength of teeth with flared canals and restored with two fiber-reinforced resin systems (glass fiber: FRC Postec [Ivoclar Vivadent, Schaan, Liechtenstein]; quartz fiber: D.T. Light-Post (RTD, St Egreve, France/ Bisco Dental Products), and one custom cast base metal (Ni-Cr) post and core system. **Methods:** Thirty anterior teeth had their crowns removed below the cemento-enamel junction and were endodontically treated. The canals were prepared for post fixation, and the canal walls were flared using a taper diamond bur. The prepared roots were randomly divided into three groups according to the post system. All posts were cemented with an adhesive resin cement. For the fiber-reinforced resin posts, cores were built up using microhybrid composite. Metallic crowns were luted using zinc phosphate cement. Specimens were loaded at 45 degrees in a universal testing machine at a crosshead speed of 0.5 mm/min until failure. The mode of failure was classified as repairable or nonrepairable. **Results:** Teeth restored with cast posts had fracture strength twice that of teeth restored with resin posts. Fiber-reinforced resin posts failed at a compressive force comparable to clinical conditions, but all failures were repairable. **Conclusions:** Fracture strength and mode of failure in anterior teeth with flared canals varied according to the type of post used to support a crown. **PDF**

Martinez-Insua, A., DaSilva, L., Rilo, B., and Santana, U. **Comparison of the fracture resistances of pulpless teeth restored with a cast post and core or carbon-fiber post with a composite core.** *Journal of Prosthetic Dentistry. 80: 527-532, 1998.*

Statement of problem: The survival of pulpless teeth restored with a post and core system is a controversial issue.

Purpose: This study compared the fracture resistance of 2 types of restorations: teeth restored with prefabricated carbon-fiber (Composipost) posts and composite cores to cast dowel-core restored teeth. **Methods:** A total of 44 recently extracted sound premolars were randomly distributed into 2 equal groups: group I, restored with prefabricated carbon-fiber post and a composite core; and group II, with custom-cast type III gold alloy post and cores. The size and shape of the posts were identical in the 2 groups. All teeth were fully covered with a nonprecious cast crown. Fracture resistance was measured by applying a point force at 45 degrees to the long angle of the tooth. **Results:** Mean fracture threshold was 103.7 ± 53.1 kg for group I versus 202.7 ± 125.0 kg for group II (differences significant with $P = .003$). In group II, however, fracture nearly always affected the tooth itself, whereas in group I, the post-core nearly always failed first. **Conclusions:** Significantly higher fracture thresholds were recorded for the cast post and core group. Teeth restored with cast posts typically showed fracture of the tooth, although at loads rarely occurring clinically. **PDF**

Meng, QF, Chen, YM, Guang, HB, et al. **Effect of a ferrule and increased clinical crown length on the in vitro fracture resistance of premolars restored using two dowel and core systems**. *Oper Dent, 2007 32-6, 595-601*

Summary: This study investigated the effect of a crown-lengthening ferrule on the fracture resistance of endodontically-treated teeth restored with two dowel-core systems. Thirty-two extracted mandibular first premolars were sectioned perpendicular to the long axis at a point 1.0 mm occlusal to the buccal cementoenamel junction. Following endodontic treatment, the teeth were randomly assigned to four groups: cast Ni-Cr alloy dowel-core with no ferrule (Group A1), cast Ni-Cr alloy dowel-core with 2.0 mm ferrule (Group A2), prefabricated carbon fiber-reinforced dowel-resin core with no ferrule (Group B1) and carbon fiber-reinforced dowel-resin core with 2.0 mm ferrule (Group B2). Each specimen was embedded in a self-cured acrylic resin block from 2.0 mm apical to the margins of a cast Ni-Cr alloy crown, then loaded at 150 degrees from the long axis in a universal testing machine at a crosshead speed of 1.0 mm/minute until fracture. The data were recorded and analyzed using ANOVA and Fisher's exact tests, with alpha = 0.05. Mean failure loads (kN) for the A1, A2, B1 and B2 Groups (ComposiPost-RTD, St Egreve, France / C-POST/ Bisco Dental) were: 1.46 (S.D. 0.45), 1.07 (0.21), 1.13 (0.30) and 1.02 (0.27). The teeth restored with cast Ni-Cr dowel-cores and 2.0 mm ferrules demonstrated significantly lower fracture strengths, $p = 0.04$. There were significant differences in the root fracture patterns between the two dowel systems, with the carbon fiber-reinforced dowel-resin core system, being the less severe $p < 0.05$. Crown lengthening with a 2.0 mm apical extended ferrule resulted in reduced fracture strengths for endodontically-treated teeth restored using two dowel-core systems and cast metal crowns. The carbon fiber-reinforced dowel-resin core system reduced the severity of the root fractures. **PDF**

*Mortazavi, V. Fathi, M., Katiraie, N. **Fracture resistance of endodontically treated teeth restored with esthetic posts.** *J Dent Res. Vol 88 (Spec. Iss. A) Abstract # 605, 2009. (www.dentalresearch.org)*

Objectives: This study compared the effect of three esthetic post systems with different modulus of elasticity on the fracture resistance and fracture patterns of endodontically treated teeth with structurally compromised and normal root walls. **Methods:** Forty five extracted and root canal treated central incisors were assigned to 2 main experimental groups called "narrow" and "flared" canals. Narrow canal group divided into 2 and wide canal group, divided into 3 experimental subgroups (n=9). For narrow canal subgroups, post spaces were prepared with the corresponding drill to restore with quartz fiber double taper light posts (D.T. Light-Post; RTD)[subgroup A] and zirconia posts (CosmoPost;Ivoclar)[subgroup B]. For the flared canals subgroups, thin – walled canals were simulated, and restored with double taper light posts[subgroup C], double taper light posts inserted within the polyethylene woven fibers (Ribbond; Ribbond,Inc)[subgroup D] and zirconia posts[subgroup E]. All posts were cemented with dual – polymerizing adhesive resin cement (Panavia F; Kuraray).After restoration of access cavity with composite (Clearfil; Kuraray) and thermocycling, compressive load was applied at a 130-degree angle to the long axis of the tooth on the equal area in the palatal surface until fracture. Mean failure load values were analyzed using One-way ANOVA and T-test($P<0.05$).Mode of failure was evaluated by Fisher exact test . **Results:** The mean failure loads± SD in Newtons were 678.55±90.86, 603.44±68.66, 638.22±93.71, 732.44±81.78, and 573.66±91.340 for subgroups A to E, respectively. Subgroup D exhibited significantly higher resistance to fracture compared to subgroups B, C and E ($P<0.05$).Subgroup E showed significantly less fracture resistance compared to subgroups A and D.

*Nothdruft, FP, et al **The fracture behavior of premolar teeth with class II cavities restored by both direct composite restorations and endodontic post systems**. *Journal of dentistry (2008) doi:10 1016/j.jdent.2008.03.004*

Purpose: The aim of this study was to evaluate the influence of different posts on the fracture load and fracture resistance of endodontically treated premolars with class II cavities and direct composite restorations in an ex vivo setting. **Methods:** Forthy eight single rooted premolars were endodontically treated and prepared with standardized M-O (mesio-occlusal) cavities. Eight teeth each received either no posts or were restored with Titanium Screws (BKS), glass fiber posts (DentinPost), quartz fiber posts (DT Light-Post SL). Sixteen teeth were restored with Zirconium Dioxide posts (CeraPost). BKS screws and eight Zirconium Dioxide posts were cemented conventionally with glass ionomer cement; Panavia F resin cement was used for all others. The specimens were restored with direct composite restorations. Eight sound premolars served as the controls. After thermomechanical fatigue testing, the samples were loaded until fracture occurred at an angle of 45^0. All specimens were evaluated for fracture lines. **Results:** The sound (control group) teeth showed the significan highest

fracture load (792.5 +/- 210.1), but the group restored with quartz fiber posts differed not significantly from the control group. In the groups restored with the glass fiber posts and titanium screws significant higher fracture load values occurred as in the group with direct composite restorations without posts. The groups with the fiber posts did not show a more favorable fracture mode than the other groups. **Clinical significance**: The use of an intraradicular post in premolars with class II cavities can significantly increase the resistance towards extra-axial forces. **PDF**

*Nothdurft,, FP , Schmitt, T., Motter, PJ, Pospiech, PR. **Fatigue testing of crowned incisors restored with FRC-posts** *J Dent Res.Vol 87 (Spec Iss A) Abstract #1864, 2008 (www.dentalresearch.org)*

Objectives: The aim of the study was to evaluate the influence of fatigue and cementation mode on the fracture behaviour of endodontically-treated bovine incisors restored with crowns and fiber reincorced composite (FRC) posts. **Methods:** Forty-eight endodontically-treated bovine incisors were restored with FRC-posts (D.T. Light-Post, VDW/RTD, St Egreve, France), composite build-ups, and full-cast crowns. In 16 teeth, each of the posts were cemented conventionally with KetacCem (3M Espe) or adhesively with Panavia F (Kuraray) or RelyXUniCem (3M Espe). One-half of the specimens in each group were subjected to thermocycling (5–55°C, x10,000) and mechanical aging (50 N, x1,200,000). Fracture resistance was determined by loading the specimens until fracture at an angle of 45 ° to the long axis of the teeth. The mean fracture loads were analysed applying the non-parametric Kruskal-Wallis test. All samples were assessed for failure modes by visual inspection in combination with ink staining. “Favorable failures” were defined as repairable failures as fractures of the root on or above the level of bone simulation. The results were reported as descriptive. **Results:** Specimens fractured at failure loads of 371 N (Panavia F, Fatigue Testing) to 494 N (KetacCem, Fatique Testing). Comparing the different modes of cementation similar values for fracture load could be found, before fatigue testing as well as afterwards. The roots restored with conventionally-cemented posts revealed no decrease in fracture resistance after fatigue loading; but the difference between fracture loads before and after artificial aging was not statistically significant for any group. Most specimens fractured in a favorable way; only the groups with KetacCem and RelyX UniCem showed an even distribution of fracture modes after simulated aging. **Conclusions:** The loading test showed that neither cementation mode nor fatigue testing had an influence on the load bearing capability of crowned endodontically-treated incisors with FRC posts.

Osada, T., Warota, S. Hu. K., Kawawa, T. **Determining the effect of the post on corono-radicular reconstruction** *J Dent Res. 80 IADR Abstract # 1432; 2002 (www.dentalresearch.org)*

Adhesion between the resin composite and the radicular dentin structure serves an important role by supporting both the core and the superstructure. The aim of this in-vitro study was to investigate the efficacy of two dentin bonding systems and two resin composites on the fracture resistance of pulpless teeth and to determine the effect of the post. Root canal instrumentation was performed for twenty mandibular first premolars and divided into four groups: 1. experimental dentin bonding system (EXP) self-cured resin composite (Clearfil Fll, Kuraray: Fllk; 2. EXP/dual-cured resin composite (Clearfil DC CORE, Kuraray: DC); 3. commercial dentin bonding system (ED primer and Clearfil Photo Bond, Kuraray: ED)(Fll:4 ED/DC. Slowly increasing forces were applied perpendicular to the longitudinal tooth axis in an Instron testing machine with a crosshead speed of 0.5 mm/min. until the root fractured. Results [mean SD (Kgl)] were compared with those previously obtained for with and without the C-POST) (Osada et al. JDR 79: 628.2000) using two-way ANOVA and Scheffe test.There was no significant difference in the dentin bonding system/resin composite combinations. When the post was present, the fracture resistance was significantly improved ($p<0.01$), probably due to reinforcing and supporting of the resin composite core.

*Porciani, P., Vano, M., Radovic, I, Goracci, C., Garcia-Godoy, F., Ferarri, M. **Fracture resistance of fiber posts: Combinations of several small posts vs standardized single post.** *Am J Dent 2008; 21: 373-376*

Purpose: To determine the fracture resistance of different sizes of standardized single fiber posts and the combinations of multiple small experimental posts. **Methods:** Single posts in 3 different sizes (1, 2 and 3 DT Light-Posts; RTD St Egreve, France) as control, and seven combinations of experimental small posts, reproducing the the sizes of several endodontic files were cemented in endodontic resin blocks. The combination of small posts were made combining 2-4 small posts so as to reach the the sizes of the standardized DT posts. The posts were loaded at an angle of 45degrees to the long axis of the block using a crosshead speed of 1 mm/min. until specimen failure. Ten posts/combinations were tested using one – way ANOVA., followed by Tamhane test for the *post hoc* comparison ($p<0.05$). **Results:** For the single posts, fracture resistance increased when increasing the diameter of the post. The use of multiple posts resulted in fracture resistance comparable to that of the single post in 2 of the 3 post diameters studied (DT1 and DT2). For the largest diameter studied (DT3), the use of multiple posts resulted in lower fracture resistances than did the single (DT3) post. **PDF**

Rodriguez-Cervantes, F., Sancho-bru, J., Barjau-Escribano, A., Forner-Navarro, L., et al. **Influence of prefabricated post dimensions on restored maxillary incisors.** *Journal of Oral Rehabilitation 2007, 34; 141-152.*

Summary: The aim of this study was to test the following hypothesis: biomechanical performance (fracture strength and stress distribution) of restored teeth is less sensitive to post diameter and post length when using fibre posts than when using stainless steel posts. First, an experimental fracture strength test was performed on 80 extracted human maxillary central incisors. Teeth were decoronated, treated endodontically and restored (40 with glass fiber posts and 40 with stainless steel posts), and the length and diameter of the posts varied uniformly. Failure loads were recorded and results were compared using an ANOVA analysis. Secondly, the finite element technique was used to develop a model of the restored tooth. The post diameter had a significant effect on the biomechanical performance of teeth restored with stainless steel posts; LOWER failure loads were found as post diameter increased. However, the post diameter in those teeth restored with fibre posts, and the post length for both systems under consideration did not affect the biomechanical performance of restored teeth to a significant degree. The stress distributions predicted by the developed model confirmed these findings, confirmed the assumed hypothesis, and permitted the the proposal of the use of fiber posts to achieve a restorative technique that is less sensitive to post dimensions, and thus more robust. **PDF**

Rosentritt, M., Sikora, M., Behr, M., Handel, G**. In vitro fracture resistance and marginal adaptation of metallic and tooth-colored post systems.** *J Oral Rehabil, 2004 Jul;31(7):675-81.*

Summary: The aim of this *in vitro* study was to compare the fracture resistance and marginal adaptation of all-ceramic incisor crowns with all-ceramic posts, glass–fibre-reinforced posts and titanium posts as well as a control without any post. Three groups of eight maxillary incisors were restored with an all-ceramic post, a fibre-reinforced composite (FRC) post, a titanium post and a further group was restored without posts. Composite cores were provided and all-ceramic crowns were adhesively luted. After artificial ageing, the fracture resistance of the restored teeth was determined. The marginal adaptation of the restorations at the interfaces between cement-tooth and cement-crown was evaluated with scanning electron microscopy using replica specimen before and after ageing. The restored teeth without posts [270N (235/335)] showed no significantly different fracture strength compared with teeth with the titanium system [340N (310/445)]. The all-ceramic posts [580N (425/820)] and the FRC posts [505N (500/610)] both provided a significant higher fracture resistance than the teeth without posts. Prior to ageing, all materials showed <5% separation at the margins cement-tooth or cement-crown ('marginal gap'). After ageing, the interfaces of all systems deteriorated to values between 6 and 14% marginal gap. The greatest marginal gap was found with the titanium system (14%) at the interface cement-crown and with the all-ceramic posts (12%) at the transition between cement-tooth. Regarding fracture resistance and the marginal adaptation, the all-ceramic and FRC posts may be considered as an alternative to the commonly used titanium post restorations.

Salameh, Z, Sorrentino, R, Papacchini, F., Ounsi, HF, Tashkandi, E, Goracci, C, Ferrari, M**. Fracture resistance and failure patterns of endodontically treated mandibular molars restored using resin composite with or without translucent glass fiber posts.** *J Endod. 2006 Aug;32(8):752-5.*

The elastic modulus of the restorative material is important in restoring endodontically treated teeth. This study aimed to compare the fracture resistance and failure patterns of 90 mandibular molars restored using resin composites with or without fiber posts, with respect to the number of residual cavity walls. Five restoration types were performed corresponding to different wall defects (groups 1-5). Groups were divided in two subgroups corresponding to the use or absence of fiber posts. Teeth were loaded and resistance of specimens was measured as the axial compressive load to cause fracture and macroscopic fracture patterns were observed. One way ANOVA revealed a significant difference in fracture resistance ($p < 0.001$). Tukey post hoc test also revealed significant differences between groups as samples restored with fiber posts exhibited mostly restorable fractures. It was concluded that the resistance of endodontically treated mandibular molars restored with composite resins is mainly affected by the number of residual walls. Using fiber-reinforced posts optimized fracture patterns. **PDF**

Salameh, Z, Sorrentino, R,. Ounsi, H, Goracci, C,, Tashkandi, E, Tay, F, Ferrari, M. **Effect of different all-ceramic crown system on fracture resistance and failure pattern of endodontically treated maxillary premolars restored with and without glass fiber posts**. *J Endod 2007 July Volume 33, Issue 7, 848-851*

Abstract: Endodontically treated teeth are traditionally restored with a crown to prevent fracture. The aim of this study was to compare the fracture resistance and failure modes of endodontically treated maxillary premolars treated with or without a fiber post and restored with different types of crowns. Eighty human maxillary premolars were selected. After root canal treatment, the teeth were embedded in resin blocks and divided into four groups. Samples received MOD cavity preparations and were divided into two subgroups: with and without fiber posts and restored using porcelain fused to metal, lithium disilicate, fiber-reinforced composite, or zirconia crowns. The specimens were vertically loaded in the central fossa using a universal loading machine until failure, and the maximum breaking loads were recorded. Samples were perfused with Indian

ink to highlight the fracture lines and the mode of failure that was classified as restorable or non-restorable. Even without post, all crown designs resisted vertically applied forces beyond those that may be encountered in the mouth. Two-way analysis of variance revealed the use of a fiber post ($p = 0.007$) and the type of crown ($p < 0.001$) significantly affected the restorability of fractured teeth. The relationship between placing or not placing the post and the type of failure (restorable/non-restorable) was found to be significant ($\chi 2$ test, $p = 0.002$). Although post placement resulted in higher fracture resistance values, these were significant for Empress II crowns only. The results suggest that the posts could contribute to the reinforcement and strengthening of pulpless maxillary premolars. With respect to failure modes, placement of fiber posts improved the fracture from non-restorable to restorable patterns. This study suggests that the placement of fiber posts is necessary to improve fracture resistance even under full-coverage crowns. **PDF**

Salameh, Z, Ounsi, HF, Aboushelib, MN, Sadig, W, Ferrari, M. **Fracture resistance and failure patterns of endodontically treated mandibular molars with and without glass fiber post in combination with a zirconia-ceramic crown.** *J Dent. 2008 Jul;36(7):513-9. Epub 2008 May 13*

Objective: The aim of this study was to investigate the influence of a fiber post on the fracture mechanics of zirconia crowns inserted over endodontically treated teeth with different extent of coronal damage. **Methods:** Endodontically treated human molars with three types of coronal damage received fiber posts before cementation of zirconia-veneered crowns. Controls received composite resin cores without fiber posts. The specimens were loaded to failure and fractographically examined using a scanning electron microscope (SEM). **Results:** Statistical analysis revealed that specimens with fiber posts demonstrated significantly higher failure loads and favorable fracture pattern compared to the controls. At fractographic analysis, specimens with fiber posts demonstrated delamination of the veneer ceramic from intact zirconia under structure. Meanwhile, the specimens that were restored without a fiber post demonstrated micro-cracking of the composite core build-up resulting in loss of the support under the zirconia crowns which was responsible for the initiation of radial crack and catastrophic damage. **Conclusions:** Within the limitation of this study, the insertion of fiber post improved the support under zirconia crowns which resulted in higher fracture loads and favorable failure type compared to composite core build-up.

Salameh, Z., Sorrentino, R., Ounsi, H. et, al The **Effect of different full coverage crown systems on fracture resistance and failure pattern of endodontically treated maxillary incisors restored with and without glass fiber posts**. *J Endod 2008; 34:842-846.*

Abstract: The aim of this study was to compare the fracture resistance and failure pattern of endodontically treated maxillary incisors restored using composite resin with or without fiber-reinforced composite (FRC) posts under different types of full coverage crowns. The null hypothesis tested was that fracture resuistance and the failure pattern were not affected by thenuse of FRC posts or by the type of full coverage crown. One hundred twenty maxillary incisors were endodontically treated and divided into 4 groups of 30 each. Each group was divided into 2 sub-groups; restoration with or withoutfiber post. PFM crowns were placed in Group 1, Empress II crowns in Group 2, SR Adoro crowns in Group 3 and Cercon crowns in group 4. Fracture tests were performed by loading specimens to fracture. Data were analyzed with two-way analysis of variance ($\alpha = 0.05$). The type of crown was not a significant factor affecting fracture resistance ($\alpha = 0.04$). Both the presence of a post and the type of crown had a significant influence on the proportion of restorable versus UNrestorable fractures. Although prosthodontic textbooks do not generally advocate the placement of fiber posts in endodontically treated incisors, the results of this study indicate that the use of fiber posts in such teeth increases their resistance to fracture and improves the prognosis in the case of fracture. **PDF**

Santos Filho, PCF, Soares, PV., Martins, LRM., Silva, GR, Soares CJ **Biomechanical analysis of the restorative procedure of endodontically treated anterior-teeth** *Dent Res.Vol 87 (Spec Iss A) Abstract #1858, 2008 (www.dentalresearch.org)*

Objectives: To investigate in vitro the effects of different post systems and lengths on stress distribution, strain and fracture resistance of endodontically treated teeth. **Methods:** 135 bovine incisors were sectioned 15mm from apex and have root filled, embedded in polystyrene resin simulating periodontal ligament. Roots were divided into 3 groups (n=45): fiber-glass-post (Fgp); prefabricated-steel-post (Psp); cast-post and core (Cpc). Each group was divided into 3 subgroups (n=15) according to post length: L5- 5.0 mm; L7.5- 7.5 mm; L10- 10.0 mm. All teeth were restored with metal crowns. For strain-gauge test, 2 strain-gauges per sample were used. The fracture resistance was assessed by compressive loading in universal test machine. Data were analyzed with 2-way ANOVA and Tukey HSD test ($p<0.05$). Finite element analysis was realized by 2D-models and the stress distribution was analyzed by von Mises criterious. **Results:** Fracture resistance values (N) were: Fgp- L10:618.5 ± 177.5^{Aa}, L7.5:615.5 ± 127.7^{Aa}, L5:607.2 ± 139.7^{Aa}; Cpc- L10:769.9 ± 68.5^{Aa}, L7.5:540.0 ± 86.2^{Bab}, L5:399.2 ± 90.0^{Cb}; Psp- L10:698.8 ± 96.8^{Aab}, L7.5:502.8 ± 134.7^{Bb}, Pl5:390.2 ± 94.6^{Cb}. Strain values (μS) were: Fgp- L10: 78 ± 22^{Aa}, L7.5:80 ± 15^{Aa}, L5: 80 ± 15^{Aa}; Cpc- L10: 90 ± 25^{Aab}, L7.5: 130 ± 44^{Bb}, L5: 200 ± 93^{Cb}, Psp- L10:106 ± 44^{Ab}, L7.5:138 ± 44^{Bb}, L5: 216 ± 57^{Cb} (Capital letters represent analysis among length post for each post system and lower case letter

represent analysis among post systems for each length). Strain values were lowers in Fgp groups than Cpc and Psp groups. Fracture modes of Cpc and Psp groups were no reparable and all fracture modes of Fgp were reparable. Stress distribution of Cpc and Psp concentrated into root dentin- post interface. Fgp showed homogeneous stress distribution. **Conclusions:** The cast post and core with 10.0 mm showed the highest fracture resistance; however the fiber-glass-post was effective with the three post lengths, showing higher fracture resistance than metal posts when the length was 5.0 mm with lower strain levels and the best stress distribution.

*Shirani, F., Malekipour, M.**, Effects of non-metallic posts on fracture resistance of weakened teeth.** *J Dent Res. Vol 86 (Spec. Iss. A) Abstract #1619, 2007 (www.dentalresearch.org)*

Objectives: The restoration of severely damaged teeth that have lost support at the coronal portion of the root canal is very difficult. The aim of this study was the evaluation of different methods of root reinforcement by dual-cure composite and various types of non-metallic posts. **Methods:** We performed root canal therapy on 60 maxillary central incisors. The teeth were divided into five groups, and specimens from three groups were prepared to simulate the teeth with flared canals. In the 1st group, no weakening was done. In the 2nd group, the compromised area of the root canal was obturated with gutta percha. In the 3rd group, universal D.T. Light-Posts (RTD, St Egreve, France) were used in the root canal to 8 mm below the margin of the palatal wall, after which the height of the DT post was regulated in the canal pulp chamber space so that it would not be under direct load. The post was then cemented with dual-cure composite. In the 4th and 5th groups, the same procedures were done; however, clear and opaque posts, with shapes and dimensions similar to those of D.T. Light-Posts, were used. In all groups, the access cavity was restored with light-curing composite resin to 0.5 mm under the margins. After being mounted, all specimens were pressed in an Instron machine. At fracture, the amount of force was recorded. **Results:** The highest resistance to fracture belonged to group 1 and the lowest to group 2. The results showed that there was a significant statistical difference, and a Duncan analysis showed that the differences of resistance to fracture were significant in all groups except among groups 3, 4, and 5. **Conclusion:** The use of dual-cure composite resin and non-metallic D.T. Light-Posts can significantly increase the resistance-to-fracture of root-treated maxillary central incisors with thin root walls.

*Shirani, F., Malekipour, M**. In-vitro study of different reinforcement methods of anterior weakened teeth.** *J Dent Res. Vol 84 (Spec. Iss. A) Abstract #1732 2005 (www.dentalresearch.org)*

Objectives: The purpose of study was to evaluate the potential of intraradicular reinforcement of layered adhesion technique and two different types of post in structurally compromised roots. **Methods:** Root canal therapies were done on 48 extracted similar maxillary incisors. The samples were divided to 4 groups. In three groups for simulation of specimens to weakened teeth, instrumentation was done 5mm apical to CEJ from access cavity. In positive control group that weakening was not done, restoration of access cavity was done with composite resin (Z100, 3M dental product, USA) and dentin bonding agent (Single bond, 3M dental product, USA). In second group access cavity of the weakened teeth was restored only with composite resin and dentin bonding agent to the level of CEJ. In third group weakened cervical area were reinforced with a dual cure composite (Bis-Core, BISCO, INC, USA) and translucent quartz fiber post (**Light-Post,** RTD, St Egreve, France) In the fourth group, the weakened cervical area was reinforced with dual cure composite and cast post with similar morphologic properties. Access cavity in the last two groups were restored with composite resin, then all specimens were tested in an instron machine. **Results:** The mean fracture load for the 4 groups were 170.12, 71.40, 129.36, and 116.6 kgf respectively. The differences between first group and others (P value=0), second group and others (P value=0) were significant. There was no significant differences between third and forth group (P value =0.103), but the rate of restorable fractures (pattern of fracture) was significantly different between these two groups. **Conclusions:** It is concluded that the use of post, dentin bonding agent and a composite resin in a root with thin walls will reinforce the weakened tooth but the type of the post will influence on the final result.

Clavijo VG, Reis JM, Kabbach W, Silva AL, Oliveira Junior OB, Andrade MF.**Fracture strength of flared bovine roots restored with different intraradicular posts.** J Appl Oral Sci. 2009 Nov-Dec;17(6):574-8.

Objective: The aim of this study was to evaluate the fracture strength and failure mode of flared bovine roots restored with different intraradicular posts. **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 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 masculine 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 presented 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. **PDF**

D'Arcangelo C, De Angelis F, Vadini M, D'Amario M, Caputi S. **Fracture resistance and deflection of pulpless anterior teeth restored with composite or porcelain veneers.** *J Endod. 2010 Jan;36(1):153-6.*

Introduction: The aim of this in vitro study was to evaluate the influence that resin composite and porcelain veneer restorations, associated or not to fiber post placement, have on fracture resistance and deflection of pulpless anterior teeth. **Methods:** One hundred twenty freshly extracted human maxillary central incisors were selected. Teeth were randomly divided into 7 experimental groups (veneer preparation/resin composite veneer placement/endodontic therapy and resin composite veneer placement/endodontic therapy, fiber post and resin composite veneer placement/porcelain veneer placement/endodontic therapy and porcelain veneer placement/endodontic therapy, fiber post and porcelain veneer placement) and a control group (n = 15). Specimens were loaded to fracture recording crown deflection, and data were statistically analyzed. **Results:** Veneer preparations did not significantly influence fracture resistance of incisors. On the contrary, veneer preparation significantly increased specimen deflection values. Fiber posts seemed to significantly increase mean maximum load values for endodontically treated teeth restored with either composite or porcelain veneers. **Conclusions**: A fiber post restoration can be suggested when endodontic treatment is associated with veneer restoration. Veneer restorations seem to be an optimal choice also for endodontically treated teeth. **PDF**

Giovani, A.R., Vansan, L.P., de Sousa Neto, M.D., Paulino, S.M. **In vitro fracture resistance of glass-fiber and cast metal posts with different lengths.** *J Prosthet Dent. 2009 Mar;101(3):183-8.*

Statement of problem: Dental fractures can occur in endodontically treated teeth restored with posts. **Purpose:** The purpose of this study was to evaluate the in vitro fracture resistance of roots with glass-fiber and metal posts of different lengths. **Methods:** Sixty endodontically treated maxillary canines were embedded in acrylic resin, except for 4 mm of the cervical area, after removing the clinical crowns. The post spaces were opened with a cylindrical bur at low speed attached to a surveyor, resulting in preparations with lengths of 6 mm (group 6 mm), 8 mm (group 8 mm), or 10 mm (group 10 mm). Each group was divided into 2 subgroups according to the post material: cast post and core or glass-fiber post (n=30). The posts were luted with dual-polymerizing resin cement (Panavia F). Cast posts and cores of Co-Cr (Resilient Plus) crowns were made and cemented with zinc phosphate. Specimens were subjected to increasing compressive load (N) until fracture. Data were analyzed with 2-way ANOVA and the Tukey-Kramer test (alpha =.05). **Results:** The ANOVA analysis indicated significant differences (P<.05) among the groups, and the Tukey test revealed no significant difference among the metal posts of 6-mm length (26.5 N +/-13.4), 8-mm length (25.2 N +/-13.9), and 10-mm length (17.1 N +/-5.2). Also, in the glass-fiber post group, there was no significant difference when posts of 8-mm length (13.4 N +/-11.0) were compared with the 6-mm (6.9 N +/-4.6) and 10-mm (31.7 N +/-13.1) groups. The 10-mm-long post displayed superior fracture resistance, and the 6-mm-long post showed significantly lower mean values (P<.001). **Conclusions:** Within the limitations of this study, it was concluded that the glass-fiber post represents a viable alternative to the cast metal post, increasing the resistance to fracture of endodontically treated canines. **PDF**

*Mekayarajjananonth, T., Chitcharus, N., Winkler, S., Bogert, M.C. **The effect of fiber dowel heights in resin composite cores on restoration failures of endodontically treated teeth**. *J Oral Implantol. 2009;35(2):63-9.*

In vitro and in vivo testing suggest that fiber posts may reduce the incidence of root fractures of endodontically treated teeth. The purpose of this in vitro study was to compare the effect of fiber post height in resin composite cores on the **fracture resistance** of endodontically treated teeth. Forty maxillary central incisors were randomly divided into 2 control groups (Groups 1 and 2) of 5 teeth each, and 3 experimental groups (Groups 3, 4, and 5) of 10 teeth each. The teeth in Group 1 had their opening restored with composite resin, the teeth in Group 2 were restored with quartz fiber posts (D,T. Light-Post, RTD, St Egreve, France) without resin composite cores, and the teeth in Groups 3, 4, and 5 were restored with quartz fiber posts of 2, 4, and 6 mm high, respectively, in 6-mm resin composite cores. Ceramic crowns were fabricated for the specimens. Specimens were positioned in a mounting device and aligned at a 130-degree angle to the long axis of each tooth. A universal testing machine was used to apply constant load at a crosshead speed of 0.5 mm/min until failure occurred. The highest fracture load and mode of failure of each specimen was recorded. The highest fracture resistance force was observed in Group 2 (290.38 +/- 48.45 N) and decreased, respectively, in Group 1 (238.98 +/-26.26 N), Group 5 (228.35 +/-58.79 N), Group 4 (221.43 +/-38.74 N), and Group 3 (199.05 +/-58.00 N). According to one-way analysis of variance (ANOVA) and Duncan's test (P < or = .05), there was no statistically significant increase in the force from Group 3 to Group 5, and the force in Group 2 was significantly higher than that of the experimental groups. There was no statistical significance difference in force among the experimental groups, and the amount of residual tooth structure was found to be the critical

factor in fracture resistance. The results suggest that endodontically treated teeth should be restored with the longest possible post height while preserving maximum tooth structure. PDF

Torabi K, Fattahi F. **Fracture resistance of endodontically treated teeth restored by different FRC posts: an in vitro study.** Indian J Dent Res. 2009 Jul-Sep;20(3):282-7.

Background: Posts and cores are often required for restoration of pulpless teeth and to provide retention and resistance for a complete crown, but conventional posts may increase the root fracture. **Objective:** This study was performed to compare the root fracture resistance of extracted teeth treated with different fibers reinforced with composite posts and treated teeth with conventional post and core systems. **Methods:** Root canal therapy was performed for 50 mandibular first premolars. The coronal portion of each tooth was amputated, and five post and core systems (cast, polyethylene woven, glass, carbon, and quartz fiber posts) were compared. Acrylic resin blocks were used for mounting, using a layer of elastomeric impression material covering the roots. The load was applied axially and measured with a universal testing machine. **Conclusions**: Significantly, cast posts and cores had a higher failure threshold **including teeth fracture**; whereas, fiber posts failure was due to core fracture, with or without fractures in coronal portion of posts. Difference in FRC posts did not provide any significant difference in the load failure and the mode of fracture. PDF

B. Photoelastic measurements

*Cifuentes, I., Fernandez, A., Petrasic, L. et al **Photoelastic stress distribution for four endodontic post sytems.** *J Dent Res. Vol 84 (Spec. Iss. A) Abstract #2934, 2005 (www.dentalresearch.org)*

Objectives: Determine if the fabrication and technology of four post systems modify the stress distribution to canals. **Methods:** The stress distributing characteristics associated `with the installation and function of D. T. Light-Post (Quartz fiber, RTD, St Egreve, France)), EasyPost (Glass fiber, Dentsply), Reforpost (Angelus) and Unimetric Post (Steel post, Dentsply) as a control group were determined with a 2-dimensional photoelastic stress analysis using a circular polariscope. Standardized 11 mm in length canals were prepared in PSM-5 (Measurements Group, Raleigh ;N.C) photoelastic sheets material with increasing sizes acrylic drills. All the posts were cemented with resin cement (Bifix QM, Voco, Germany). Then the posts were loaded vertically and with a 26 degrees inclined load at 20, 30,40,50 and 60 kilograms. The posts were photographed (Olympus 5050 Digital Camera) by use of the circular polariscope in the loaded and unloaded state. Qualitative measurement of the number (magnitude) and the closeness (concentrate) of the fringes were made. **Results:** The steel preformed post showed the higher stress magnitudes at the vertical and lateral loading. It showed stress concentration at the apical and at each post thread. The pre-stressed fiber post at the vertical load showed the least magnitude and concentration of stress in the surrounding photoelastic material. At lateral loads fiber-glass EasyPost and pre-stressed quartz fiber post showed similar behaviors. **Conclusions:** Stress distribution surrounding post cemented in canals, done in photoelastic material, is related with the fabrication material and with the fabrication technology of the posts.

*Cifuentes, I., Fernandez, A., Sanchez, A. and Pavlov. P. **Stress distribution surrounding five endodontic posts** *J Dent Res, Vol 83 (Spec. Iss. A) Abstract #4084, 2004 (www.dentalresearch.org)*

Objectives: Determine if the cement interface thickness and fabrication material of five post system modify the stress distribution to flared canals. **Methods:** The stress distributing characteristics associated with installation and function of Cast Post (Ni-Cr), Para-Post (Steel post, Coltene-Whaladent), Integrapost (Titanium post, Premier), Mooser Post (Steel-post, Maillefer) and D.T. Light-Post (RTD, St Egreve, France) were determined with a two-dimentional photoelastic stress analysis using a circular polariscope (Photoelastic Inc).Standardized enlarged canals were prepared in PSM-5 (Measurements Group, Raleigh ;N.C) photoelastic sheets material with increasing sizes acrylic drills (Orico,Germany). All the posts were cemented with resin cement (Duo-Link, Bisco Inc).The cast post was made closely adapted to the canal walls and cemented with the same cement .Then the posts were loaded vertically and with a 35 degrees inclined load at 10,20 and 30 kilograms. Then the posts were photographed (Olympus 5050 Digital Camera) by use of the circular polariscope in the loaded and unloaded state. Qualitative measurement of the number (magnitude) and the closeness (concentrate) of the fringes were made. **Results:** The cast post with thinner cement interface showed the higher stress magnitudes at the vertical and lateral loading. All the metallic preformed post showed high stress concentration at the apical and cervical zones for the loads respectively .The fiber post at the vertical and lateral load showed the least magnitude and concentration of stress in the surrounding photoelastic material. **Conclusions:** The stress distribution surrounding posts cemented in flared canals, done in photoelastic material, is related with the fabrication material of the post and with the thickness of the cement interface.

Lopes, M.B., Bosso,K., Moura, S.K., Gonini-Júnior, A. **Photoelastic stress analysis of different endodontics posts.** *J Dent Res. Vol 88 (Spec. Iss. A) Abstract # 607, 2009. (www.dentalresearch.org)*

Objectives: This study analyze the stress distribution and severity produced by different endodontics posts (G1 – Metallic cast post, G2 – glass-fibre, G3 – carbon-fibre, G4 – metallic screw post, G5 - glass-fibre with resin reconstruction technique) at different loads (occlusal or 45-degrees). **Methods:** One human canine tooth has the canal prepared according to the glass-fibre and carbon-fibre manufacturers' instructions. The crown was removed and the reminiscent prepared for a total metallic-ceramic crown. The prepared tooth was moulded with polyvinyl-siloxane and duplicated in photoelastic resin (n=5 for each group). G1 was casted and cemented with zinc phosphate; G2 and G3 was cemented with resin cement and the core constructed in composite resin; G4 was inserted with an screwdriver and cemented with zinc phosphate; G5 have the glass-fibre post reconstructed in composite resin to copy the canal shape and then cemented with resin cement. A load of 10N was applied on the incisal, perpendicular to the core and at 45-degrees. The specimens were analysed with photoelastic equipment. A score of 0,25 was given to each colour of the fringe, totalling score 1 for a full fringe formation. A descriptive analysis was done. **Results:** At 45-degrees load, G1 showed score 1 at the first and middle third and 1.5 at the last third of the root; G2 and G3 score 0.75 at the last third; G4 score 1.5 around all the screws; G5 score 0,75 at the first third and score 1.5 at the last third. At occlusal load, G1 presents score 1 at the middle and last third of the root; G2 and G3 score 1 at the middle third; G4 score 1 around the screws; G5 score 1.5 at the first an last third. **Conclusions:** In general, glass-fibre and carbon-fibre groups showed less stress formation and a favourable stress location.

Yamamoto, M., Miura, H., Okada, D., Masuoka, D., Komada, W. and Suzuki, C. **Photoelastic stress analysis in different types of post and core**, *Dent Res. Vol 86 (Spec. Iss. A) Abstract #2617, 2007 (www.dentalresearch.org)*

Objectives: The aim of this study was to compare three types of post and core systems and analyze the stress magnitude within the root. **Methods:** Two-dimensional photoelastic simulation models of endodontic treated upper central incisors were fabricated with epoxy resin sheets (6 mm of thickness). Models were 10 times the life size. The post and core systems were divided in three different types, build-up method using only composite resin (R), build-up method using composite resin in combination with a glass fiber post (R+F), and a cast post and core (C). The equivalent ratio of elastic modulus for composite resin, dentin, glass fiber post, and metal were considered for all the parts (5:1). The models were observed in a transmission polariscope with the same loading force (400 N) on 45 degrees palatal direction. The measured points were the buccal margin area of the root and the surrounding area of the apex of the post, which used to present the higher stress concentration area. The isochromatic fringe patterns and the stress distribution in the tooth simulation models were analyzed. **Results:** In the buccal margin area of the root, R, R+F and C showed 3.1 fringe order, 1.4 fringe order, and 2.4 fringe order, respectively. For the surrounding area of the apex of the post, R, R+F and C showed 0.45 fringe order, 0.80 fringe order, and 1.0 fringe order, respectively. **Conclusion:** The stress concentration in the buccal margin area of the root had a higher distribution, compared with the surrounding area of the apex of the post. Resin + Fiber post model had the lowest stress concentration in the buccal margin area of the root.

Zhang, WY, Shi, CX, et al**. Three-dimensional photoelastic stress analysis of roots restored with FRC posts and Ni-Cr alloy posts.** *J Dent Res. Vol 83 (Spec. Iss. B China), 2004 (www.dentalresearch.org)*

Objectives: Post-and-core is a perfect restoration method for residual crown or root of pulpless teeth. More and more emphasis has been placed on how to avoid tooth fracture and maintain esthetic appearance without reducing strength and retention. This study shows that the new developed fiber-reinforced composite post (FRC) used successfully for several years, because of their strength and relative flexibility, ease of placement or ease of removal. The purpose of this study was to analyze the effect of two modulus elasticity material posts on root stress distribution by using three-dimensional photoelastic analysis. **Methods:** The photoelastic models were divided into four groups according to posts material and loading. The roots stress distribution, which restored with FRC posts and Ni-Cr alloy posts, was analyzed by three-dimensional photoelastic analysis. **Results**: The material of posts influenced the root stress distribution significantly. The greater stress concentration was found at apex of Ni-Cr alloy posts with high modulus, the stress was evenly in FRC posts groups. **Conclusions:** The study concluded that the modulus of posts material influenced the root stress distribution significantly. The FRC posts which modulus was closed to teeth could protect roots from fracture.

C. Distribuição de Esforços F. E. A.

Adanir, N., Belli, S. **Stress analysis of a maxillary central incisor restored with different posts.** *Eur J Dent 2007; 2:67-71*

Objectives: To evaluate the effects of different post materials on the stress distribution in an endodontically treated maxillary incisor. **Methods:** a pseudo 3-dimensional finite element model was created in a labiolingual cross-sectional view of a maxillary central incisor and modified according to five posts with different physical properties consisting of stainless steel, titanium, gold alloy, glass fiber (SnowPost/ Carbotech) and carbon fiber post (Composipost/RTD, St Egreve, France).

A 200 newton force was then applied from 2 different directions; a) a vertical load on the incisal edge, and b) 45 degreee diagonal load above the cingulum location. Stress distribution and values were then calculated by considering the pseudo 3 dimensional von Mises stress criteria. **Results:** Under the 2 loading conditions, post made of steel showed greatest stress concentration at the post/dentin interface, followed by titanium, gold alloy, SnowPost and Composipost. However, Composipost, which elastic modulus was closer to dentin, produced higher rate of stress values at the cervical 1/3. **Conclusions:** Within the limitations of this simulated mechanical analysis, we can conclude that the physical characteristics of posts were important on stress distributions in post and core applications. Fiber posts revealed more balanced stress under functional forces.

Albuquerque, R C, Polleto, LT, Fontana, RH, Cimini, CA. **Stress analysis of an upper central incisor restored with different posts**. *J Oral Rehabil. 2003 Sep;30 (9):936-43.*

Summary / conclusions: The effect of different anatomic shapes and materials of posts in the stress distribution on an endodontically treated incisor was evaluated in this work. This study compared three post shapes (tapered, cylindrical and two-stage cylindrical) made of three different materials (stainless steel, titanium and carbon fibre on Bisphenol A-Glycidyl Methacrylate (Bis-GMA) matrix).Two-dimensional stress analysis was performed using the Finite Element Method. A static load of 100N was applied at 45 degrees inclination with respect to the incisor's edge. The stress concentrations did not significantly affect the region adjacent to the alveolar bone crest at the palatine portion of the tooth,regardless of the post shape or material. However, stress concentrations on the post/dentin interface on the palatine side of the tooth root presented significant variations for different post shapes and materials. Post shapes had relatively small impact on the stress concentrations while post materials introduced higher variations on them. Stainless steel posts presented the highest level of stress concentration, followed by titanium and carbon/Bis-GMA posts.

Akoglu, B., Yildiz, B,. Cansiz, C., Ozkan, Y. , Kayabasi, O. **Effect of post material, cement and amount of coronal destruction**, *J Dent Res. Vol 88 (Spec. Iss. A) Abstract # 455, 2009. (www.dentalresearch.org)*

Objectives: Endodontically treated teeth are affected by a higher risk of biomechanical failure than vital teeth. A comparative study on the stress distribution of an endodontically treated maxillary incisor has been carried out by three dimensional stress analyses using the Finite Element Method. The role of post material and cement rigidity and amount of coronal destruction on reliability of endodontic restorations is discussed. **Methods:** A 3D FEM model of a central maxillary incisor was created. The following parameters were studied: 2 levels of coronal destruction (1- total loss of coronal dentin, 2-partial loss of coronal dentin with 2 mm surviving dentinal walls), 3 loading conditions(mastication, bruxism and impact), 3 different luting cements, 4 post materials (steel, titanium, glass fiber, zirconium posts) when present, and absence of post. In this study the validity of the FEM model was controlled by an in vitro test. Thirty recently extracted caries free, human maxillary central incisors with similar root sizes were divided into 6 groups. Endodontic treatment was subsequently performed and post core restorations were prepared and porcelain restorations were fabricated. Fracture strength and mode of failure was determined by universal testing machine. **Results:** As a result there were significant differences between post systems, cements ($p \leq 0.05$). The presence of 2 mm coronal dentin decreased the maximum stress values in all models. The stresses decreased with the post material in order of steel, zirconium, titanium, glass fiber. In functional loading, maximum equivalent stress mostly occurs at the vestibular side of the cement layer. There was correlation between the results of FEM and fracture test results. **Conclusion:** FE analysis is a powerful tool in calculating stress distributions in complex structures. Minimum stress values were obtained with the glass fiber post bonded with an adhesive resin cement with low elastic modulus .

Bolla, M., Laplanche,O., Leforestier, E., Muller-Bolla, M., **Influence of elastic modulus of posts on stress distribution** *J Dent Res. Vol 86 (Spec. Iss. A) Abstract #2609, 2007 (www.dentalresearch.org)*

Objectives: fractures of restored pulpless teeth can be influenced by many factors, including type or design of the post, or the occlusal load and its direction. The purpose of this study is to use finite element analysis to investigate the effect of different posts used for restoring endodontically treated teeth according to different elastic moduli and direction of the occlusal load. Method: a 3-dimensional finite element model, including the periodontal ligament, was constructed in a mesio-distal cross sectional view of a mandibulary premolar. Tooth was fully restored with a cast crown, as occurs in clinical practice. The standard model was composed of 80000 elements and 130000 nodes. Elastic modulus and Poisson's ratio of different components, along with the coordinate and geometry of each node and element were entred into a computer. Four different posts (length: 14 mm – diameter : 1.2 mm ; 3 metallic : stainless, titanium, gold – 1 non-metallic : carbon fiber) were investigated according to three different composite core materials. The effect of a 300 MPa load on vertical, 30 degrees and 45 degrees oblique direction was tested. Analysis program (IDEAS, version n°6) was used to solve the stress analysis problem. **Results:** stress distribution in the root depends on the elastic modulus and on the direction of the occlusal load. Elastic modulus of the core is less significant than elastic modulus of the post. **Conclusions**: the effect of the post on stress distribution varies according to the direction of the load : in a vertical load, gold and carbon fiber posts generate lower

stresses in the root than other metallic posts. In a 30 or 45 degrees oblique load, best results are obtained with a carbon-fiber post.

Bolla, M., Laplanche, O. et al. **Elastic modulus and stress distribution: finite element analysis.** *J Dent Res. Vol 84 (Spec. Iss. A) Abstract #2933, 2005 (www.dentalresearch.org)*

Objective: Fractures of restored pulpless teeth can be influenced by many factors, including type or design of the post, or the occlusal load and its direction. The purpose of this study is to use finite element analysis to investigate the effect of different posts used for restoring endodontically treated teeth, according to different elastic moduli and the direction of occlusal load. **Methods:** a 3-dimensional finite element model, including the periodontal ligament, was constructed in a mesio-distal cross sectional view of a mandibular premolar. The tooth was fully restored with a cast crown, as occurs in clinical practice. The standard model was composed of 80000 elements and 130000 nodes. Elastic modulus and Poisson's ratio of different the components, along with the coordinate and geometry of each node and element were entered into a computer. Four different posts (length: 14mm, diameter: 1.2mm) 3 metallic (stainless, titanium gold) and one non-metallic (carbon fiber) were investigated according to three different composite core materials. The effect of a 300MPa load on vertical, 30 degrees and 45 degrees oblique was tested. Analysis program (IDEAS, Version 6) was used to organize the stress analysis data. **Results:** Stress distribution in the root depends on the elastic modulus and the direction of the occlusal load. Elastic modulus of the core is less significant than the elastic modulus of the post. **Conclusions:** The effect of the post on stress distribution varies according to the direction of the load. In a vertical load, gold and carbon fiber posts generate lower stresses in the root than other metallic posts. In a 30 or 45 degree oblique load, the best results are obtained with a Carbon fiber post.

Borcic, J., Catic, A., Smojver, I., Antonic., R., Petricevic, N., and V. Reljic, **Stress distribution in glass fiber vs cast post and core.** *Dent Res. Vol 86 (Spec. Iss. A) Abstract #2621, 2007 (www.dentalresearch.org)*

Objectives: Endodontically treated teeth become brittle as a result of moisture loss and have a greater incidence of fracture than vital and healthy teeth. The difference between the elastic modulus of dentin and the post material may be a source of stress in the root structures. The aim of the study was to analyse the mechanical behaviour of a teeth restored with prefabricated glass fiber posts and composite core vs cast post and core through 3D finite element analysis. **Methods:** Models have more than 1,5 million elements and an average loading force of 200 N was used to simulate biting forces in the two different occlusal conditions. First condition represents so called normal occlusion with tripodal occlusal contact. Second condition represents malocclusion with single contact on the palatal cusp. The load vectors were applied in the direction normal to the surface in order to simulate the contact with antagonistic teeth. **Results:** Endodontic posts take some of the stresses on themselves and values are smaller on the surface of the tooth. In the case of normal occlusion stress distribution is the same for sound and restored tooth, dissimilarity exsists in the values od stresses. Significantly higher tensile stress values were recorded for the cast post and core restored tooth. At the root furcation, tensile stress appeared only in the restored tooth. In the case of normal occlusion, tensile stress at root furcation occurs only in the model with cast post and core. **Conclusions:** Cast posts resulted in significantly higher stress values. Tensile stresses are much harmful for the tooth tissue and this type of stress occurs at the root furcation only in the restored tooth, esspecially in the cast post and core.

Borcic, J. et al. **Finite element study of the glass fiber endodontic posts.** *J Dent Res. Vol 83 (Spec. Iss. A) Abstract #0530, 2004 (www.dentalresearch.org)*

Objectives: Post and core applications are generally used in the restoration of endodontically treated teeth. The stress distribution during masticatory function in a tooth restored with a post and core can cause root fracture. The different mechanical behavior of post and dentine is a critical parameter for the load transmission. In order to minimize the rigidity difference between the post and the dentine, a new kind of post was developed. The aim of this study was to analyze the mechanical behavior of a new polymeric composite post reinforced with glass fibers. A natural tooth was considered as a reference model. **Methods:** The 3D finite element method (FEM) was selected to perform the stress analysis of the two-rooted first maxillary premolar restored with glass fiber posts. Composite resin was used as the core material and full porcelain crowns covered the model. Four noded tetrahedral were applied in the description of the tooth morphology, resulting in 1,684,512 elements and 246,510 nodes with 739,539 degrees of freedom. A total force of 200N was applied. **Results:** The greatest stresses were observed in the palatal cervical region (-16.126MPa) and in the intraradicular parts of the post (-23.898MPa). In the cervical region, the mean high-intensity compressive stress areas were more extensive in the natural tooth (-175.222 MPa). **Conclusions:** The glass fiber composite post induces a stress field similar to that of the natural tooth, except in the cervical region, where the tooth has higher compressive stresses.

Chuang, S-F, Chang, C-H, Su, K-C, Yaman, P. **Effect of post length and material on periodontally involved teeth .** *J Dent Res. Vol 85 (Spec. Iss. B) Abstract #0006, 2006. (www.dentalresearch.org)*

Objective: To investigate the stress distribution of periodontally involved teeth restored with different posts using finite element analysis. **Methods:** 2-D models of a maxillary central incisor consisting of a PFM crown, composite core, parallel post, dentin, gutta percha, periodontal ligament, and cortical/trabecular bone were constructed using ANSYS v9.0 software. The posts tested were stainless steel (SS), carbon fiber (CF), and glass fiber (GF) at 10mm and 5mm lengths into the root canals. The alveolar bone level was set either as intact periodontium or with bone loss even with the apical end of short post. All materials were assumed to be linearly elastic and isotropic except CF and GF posts which were orthotropic. Teeth were subjected to two different loads: the first a 70N force on the incisal tip; the second a 100N force on the lingual surface of crown at a 145 degree angulation. **Results:** With the 70N load the stress distribution patterns were similar among the groups. For the 100N load at 145 degrees, the models representing periodontal bone loss showed higher von Mises stress over the middle part of root periphery and around the post ends compared to the intact periodontium groups. In the intact periodontium groups, the stress around the crown margins was higher than the middle of the root. The SS post exhibited higher stress levels than the other posts only around the apical end of the post. The SS/5mm group with periodontal bone loss exhibited the greatest stress (334 MPa) on the dentin around the ends of posts. **Conclusion:** Teeth with posts and periodontal bone loss generate higher stress concentrations with an increased risk of root fracture. The major difference in stress distribution between rigid and non-rigid posts is primarily around the apical ends of the posts.

Duret, B., Duret, F., and Reynaud, M. **Long-life physical property preservation and postendodontic rehabilitation with the Composipost.** *Compendium. 17: S50-S56, 1996.*

Abstract/conclusions: Most coronal radicular reconstructions are made of cast inlay core metals or prefabricated metal posts covered in composite. The differences in the mechanical properties of these elements create a heterogeneous mass with inconsistent mechanical behavior. Studies using the Finite Element Method have shown the biomechanical disturbances casued by the inclusion of materials with a modulus of elasticity that is superior to that of dentine (ie, nickel, chrome, zircon, etc). The use of materials with a modulus of elasticity close to that of dentine does not disturb the flow of stress inside the root. To our knowledge, only a composite material structured with programmable mechanical properties would be capable of producing both high mechanical performance and a modulus of elasticity adapted to dentine values. The C-POST, made of carbon epoxy, accommodates the demands of the dentine, as well as the in vitro stress linked to the prosthesis. The internal structure, consisting of long high-performance carbon fibers, unidirectionally and equally stretched, confers a totally original behavior that is adapted to clinical objectives. In addition, the C-POST/Composipost (RTD, St Egreve, France) has a fracture resistance superior to most metals. **PDF**

Eraslan, O, Aykent, F, Yücel, MT, Akman, S. **Finite element analysis of the effect of ferrule height on stress distribution at post-and-core-restored all-ceramic anterior crowns.** *Clin Oral Investig. 2008 Aug 12.*

The purpose of this study was to compare the effect of ferrule with different heights on the stress distribution of dentin and the restoration-tooth complex, using the finite element stress analysis method. Three-dimensional finite element models simulating an endodontically treated maxillary central incisor restored with an all-ceramic crown were prepared. Three-dimensional models were varied in their ferrule height (NF: no ferrule, 1F: 1-mm ferrule, and 2F: 2-mm ferrule). A 300-N static occlusal load was applied to the palatal surface of the crown with a 135 degrees angle to the long axis of the tooth. In addition, two post and core materials with different elastic modulus were evaluated. The differences in stress transfer characteristics of the models were analyzed. Maximum stresses were concentrated on force application areas (32.6-32.8 MPa). The stress values observed with the use of a 2-mm ferrule (14.1/16.8 MPa) were lower than the no-ferrule design (14.9/17.1 MPa) for both the glass fiber-reinforced and zirconium oxide ceramic post systems, respectively. The stress values observed with zirconium oxide ceramic were higher than that of glass fiber-reinforced post system. The use of a ferrule in endodontically treated teeth restored with an all-ceramic post-and-core reduces the values of von Mises stresses on tooth-restoration complex. At rigid zirconium oxide ceramic post system, stress levels, both at dentin wall and within the post, were higher than that of fiber posts. **PDF**

Ferrari, M, Sorrentino, R, Zarone, F, Apicella, D, Aversa, R, Apicella, A. **Non-linear viscoelastic finite element analysis of the effect of the length of glass fiber posts on the biomechanical behaviour of directly restored incisors and surrounding alveolar bone.** *Dent Mater J. 2008 Jul;27(4):485-98*

The study aimed at estimating the effect of insertion length of posts with composite restorations on stress and strain distributions in central incisors and surrounding bone. The typical, average geometries were generated in a FEA environment. Dentin was considered as an elastic orthotropic material, and periodontal ligament was coupled with nonlinear viscoelastic mechanical properties. The model was then validated with experimental data on displacement of incisors from published literature. Three post lengths were investigated in this study: root insertion of 5, 7, and 9 mm. For control, a sound incisor model was generated. Then, a tearing load of 50 N was applied to both sound tooth and simulation models. Post restorations did not seem to affect the strain distribution in bone when compared to the control. All simulated post restorations affected incisor biomechanics and reduced the root's deforming capability, while the composite crowns

underwent a higher degree of deformation than the sound crown. No differences could be noticed in incisor stress and strain. As for the influence of post length, it was not shown to affect the biomechanics of restored teeth. **PDF**

Lanza, A., Aversa, R., Rengo, S., Davide, Apicella, D., Apicella, A.. **3D FEA of cemented steel, glass and carbon posts in a maxillary incisor** *Dent Mater. 2005 Aug; 21(8):709-15*

Objectives: A comparative study on the stress distribution in the dentine and cement layer of an endodontically treated maxillary incisor has been carried out by using Finite Element Analysis (FEA). The role of post and cement rigidity on reliability of endodontic restorations is discussed. **Methods:** A 3D FEM model (13,272 elements and 15,152 nodes) of a central maxillary incisor is presented. A chewing static force of 10 N was applied at 125° angle with the tooth longitudinal axis at the palatal surface of the crown. Steel, carbon and glass fiber posts have been considered. The differences in occlusal load transfer ability when steel, carbon and glass posts, fixed to root canal using luting cements of different elastic moduli (7.0 and 18.7 GPa) are discussed. **Results and significance:** The more stiff systems (steel and carbon posts) have been evaluated to work against the natural function of the tooth. Maximum Von Mises equivalent stress values ranging from 7.5 (steel) to 5.4 and 3.6 MPa (respectively, for carbon posts fixed with high and low cement moduli) and to 2.2 MPa (either for glass posts fixed with high and low cement moduli) have been observed under a static masticatory load of 10 N. A very stiff post works against the natural function of the tooth creating zones of tension and shear both in the dentine and at the interfaces of the luting cement and the post. Stresses in static loading do not reach material (dentine and cement) failure limits, however, they significantly differ leading to different abilities of the restored systems to sustain fatigue loading. The influence of the cement layer elasticity in redistributing the stresses has been observed to be less relevant as the post flexibility is increased. **PDF**

Maceri, F, Martignoni, M, Vairo, G. **Optimal mechanical design of anatomical post-systems for endodontic restoration.** *Comput Methods Biomech Biomed Engin. 2008 Jul 16:1. [Epub ahead of print]*

This paper analyses the mechanical behaviour of a new reinforced anatomical post-systems (RAPS) for endodontic restoration. The composite restorative material (CRM) completely fills the root canal (as do the commonly used cast metal posts) and multiple prefabricated composite posts (PCPs) are employed as reinforcements. Numerical simulations based on 3D linearly elastic finite element models under parafunctional loads were performed in order to investigate the influence of the stiffness of the CRM and of the number of PCPs. Periodontal ligament effects were taken into account using a discretised anisotropic nonlinearly elastic spring system, and the full discrete model was validated by comparing the resulting stress fields with those obtained with conventional restorations (cast gold-alloy post, homogeneous anatomical post and cemented single PCP) and with the natural tooth. Analysis of the results shows that stresses at the cervical/middle region decrease as CRM stiffness increases and, for large and irregular root cavities that apical stress peaks disappear when multiple PCPs are used. Accordingly, from a mechanical point of view, an optimal RAPS will use multiple PCPs when CRM stiffness is equal to or at most twice that of the dentin. This restorative solution minimizes stress differences with respect to the natural tooth, mechanical inhomogeneities, stress concentrations on healthy tissues, volumes subject to shrinkage phenomena, fatigue effects and risks of both root fracture and adhesive/cohesive interfacial failure. **PDF**

Maceri, F, Martignoni, M, Vairo, G. **Mechanical behaviour of endodontic restorations with multiple prefabricated posts: a finite-element approach.** *J Biomech. 2007;40(11):2386-98. Epub 2007 Jan 24*

This paper investigates some mechanical aspects of a new endodontic restoration technique, based on the idea that the root cavity can be more efficiently filled if multiple prefabricated composite posts (PCP) are employed. Multi-post technique increases bearing capacity and durability of endodontically treated teeth, as shown by numerical simulations performed through three-dimensional elastic finite-element static analyses of a lower premolar, constrained by a non-linearly elastic spring system representing the periodontal ligament, under several parafunctional loads. The influence of PCPs' number, material and dimensions is investigated by comparison of the resulting stress fields with those obtained in cases of traditional restorations (cast metal post and cemented single-PCP) and natural tooth, highlighting the advantages of the proposed technique when standard restorative materials are considered. A risk-analysis of root-fracture and interface-failure shows that cast gold-alloy post produces high stress concentrations at post-dentin interface, whereas multi-post solution leads to a behaviour closer to the natural tooth's, exhibiting some advantages with respect to single-PCP restorations. As a matter of fact, whenever PCPs' overall cross-section area increases, multi-post solution induces a significant reduction of stress levels into the residual dentin (and therefore the root-fracture-risk decreases) as well as of the expected polymerization shrinkage effects. Moreover, interfacial stress values in multi-post restorations can be higher than the single-PCP ones when carbon-fibre posts are considered. Nevertheless, the interfacial adhesive/cohesive failure-risk is certainly acceptable if glass-fibre posts are employed. **PDF**

Nakamura, T, Ohyama, T, Waki, T, Kinuta, S, Wakabayashi, K, Mutobe, Y, Takano, N, Yatani, H. **Stress analysis of endodontically treated anterior teeth restored with different types of post material**. *Dent Mater J. 2006 Mar;25(1):145-50*

Finite element analysis was performed to evaluate stress distribution in maxillary central incisors treated endodontically and restored with a post and an all-ceramic crown. Tensile stress at tooth root was analyzed using two-dimensional finite element models with different post diameters and lengths. One post length was 1/3 of the root (short), while the other was 2/3 of the root (long); one post diameter was 1/3 of the root (narrow), while the other was 2/3 of the root (wide). The following combinations were used for posts and cores: gold alloy cast post and core, commercial stainless steel post and resin core, and fiber post and resin core. Results showed that the fiber post produced less stress on the root dentin around the post tip than did the metal posts. This finding thus suggested that to reduce the stresses that cause root fracture, a long, thin fiber post should be used.

*Nothdurft, FP, Seidel, E, Gebhart, F, Naumann, M, Motter, PJ, Pospiech, PR., **Influence of endodontic posts on the fracture behavior of crowned premolars with class II cavities**. *J Dent. 2008 Apr;36(4):287-93. Epub 2008 Feb 21.*

Aim: The aim of the study was to evaluate the influence of different posts and types of cementation on the fracture load and fracture mode of crowned, endodontically treated premolars with class II cavities in an ex vivo setting. **Methods:** Forty-eight single-rooted human premolars were endodontically treated and prepared with standardized MO (mesio-occlusal) cavities and a circular chamfer preparation. Eight teeth each received either no posts or were restored with screws (BKS), glass fiber posts (DentinPost), or quartz fiber posts (D.T. Light-Post SL; RTD, St Egreve, France). Sixteen teeth were restored with zirconium dioxide posts (CeraPost). BKS-screws and eight zirconium dioxide posts were cemented conventionally with glass ionomer cement; Panavia F was used for all others. The specimens were restored with composite cores and crowns cast from a non-precious metal. Eight sound premolars served as the controls. After thermomechanical fatigue testing, the samples were loaded until fracture occurred at an angle of 45 degrees. All specimens were evaluated for fracture lines. **Results:** The sound teeth showed the significant highest fracture load (792.50+/-210.01N). Conventionally cemented zirconium dioxide posts showed the lowest fracture load (327.00+/-45.84N); the highest fracture load occurred with quartz fiber posts (421.75+/-90.19N). Only the difference between these two groups was statistically significant. With glass fiber posts and conventionally cemented zirconia posts, restored teeth failed mostly in an "unfavourable" mode. **Conclusions:** With respect to the fracture load, there was no statistical difference between the restoration of non-vital premolars with class II cavities with crowns and posts or crowns alone.

Okamoto, K, Ino, T, Iwase, N, Shimizu, E, Suzuki, M, Satoh, G, Ohkawa, S, Fujisawa, M. **Three-dimensional finite element analysis of stress distribution in composite resin cores with fiber posts of varying diameters.** *Dent Mater J. 2008 Jan;27(1):49-55.*

Using three-dimensional finite element analysis (3D-FEA), stress distributions in the remaining radicular tooth structure were investigated under the condition of varying diameters of fiber post for fiber post-reinforced composite resin cores (fiber post and core) in maxillary central incisors. Four 3D-FEA models were constructed: (1) fiber post (ø1.2, ø1.4, and ø1.6 mm) and composite resin core; and (2) gold-cast post and core. Maximum stresses in the tooth structure for fiber post and core were higher than that for gold-cast post and core. In the former models, stresses in the tooth structure as well as in the composite resin were slightly reduced with increase in fiber post diameter. These results thus suggested that to reduce stress in the remaining radicular tooth with a large coronal defect, it is recommended to accompany a composite resin core with a fiber post of a large diameter.

Oliviera, L.C.A., Candido, M.S.M., Duarte, S., Oliviera, S.A.G., **Comparative study of stress distribution in upper incisors; biometric behavior of post systems**. *AADR Abstract #0548, 2003 (www.dentalresearch.org)*

Objective: this work proposes a study about the distribution of mechanical stresses in the radicular dentin restored with different post systems, by means of Photoelastic and Finite Element techniques. This analysis is conducted for the following post systems: carbon fiber, fiberglass, zirconium, stainless steel, titanium and cast metal (Cu-Al alloy) and the healthy tooth (control). The computer analysis and numerical results were validated by laboratory experimental data (Photoelastic). **Methods:** For this purpose, representative 2-dimensional models were of the upper central incisor were built for both methods. These models were subject to a 100N load applied at the tip of the crown, at 45^0 from the axis along the tooth. These results are expressed in terms of the Von Mises and Sy stresses and the fringe order, for the Finite Element and photoelastic methods, respectively. **Results:** Through the analysis of these results, it can be concluded that significant stress distributions arise between the 6 different post systems tested, so that those made of zirconium, stainless steel, titanium and cast metal produced high stress concentration at the post/dentin interface region. In the cases of carbon fiber and fiberglass, on the other hand, the stress distribution along the radicular surface is uniform, lacking stress concentration areas. **Conclusion:** The zirconium, stainless steel, titanium and cast metal posts present mechanical properties which are different from those of the tooth structure, resulting in significant alterations over the mechanical behavior of the dental structure. The non-metallic posts comply more satisfactorily with the requirements necessary to provide a mechanical behavior more similar to that of the dental structure, the compatibility among the mechanical properties found in these systems and the dentin providing a biometric behavior, reducing the risk of failure or fracture of the root.

Okada, D, Miura, H, Suzuki, C, Komada, W, Shin, C, Yamamoto, M, Masuoka, D. **Stress distribution in roots restored with different types of post systems with composite resin.** *Dent Mater J. 2008 Jul;27(4):605-11*

Although composite resin core is used with various types of prefabricated posts, it remains unclear which kind of material is most suitable for the post. The aim of this study was to evaluate the influence of prefabricated posts on the stress distribution within the root by finite element analysis. Posts and cores were built up with composite resin and four types of prefabricated posts: two types of glass fiber posts (GFP1, GFP2) with low and high Young's moduli, a titanium post (TIP), and a stainless steel post (SSP). In all models, stress distribution during function was calculated. There were differences in stress concentration at the root around the end of posts. The magnitudes of stress for GFP1, GFP2, TIP, and STP were 8.7, 9.3, 11.7, and 13.9 MPa respectively. Given the results obtained, GFP1 was the most suitable material for post fabrication since this model showed a lower stress value. It would therefore mean a lower possibility of root fracture. **PDF**

Okada, D., Miura, H., Suzuki, C., Komada, W., Yamamoto, M., Masouka, D., Shin, C. **Stress distribution in root restored with different post systems .** *J Dent Res 85, (Special Issue B) #0011, 2006 (www.dentalresearch.org)*

Objective: Composite resin core materials in conjunction with various kinds of prefabricated posts are gaining in popularity. However, it is not yet clear, which kind of material is most suitable for the post. The aim of this study was to evaluate the influence of the prefabricated post on stress distributions in an abutment tooth restored with composite resin by 3-dimensional finite element analysis. **Methods:** Four 3-dimensional finite element models of an endodonticaly treated premolar were made. In these four models, posts and cores were built up with composite resin and four types of prefabricated post; glass fiber post (GFP), Titanium post (TIP), Zirconia post (ZRP), and Stainless steel post (STP). In all the models, an occlusal force similar to chewing beef jerky, was applied to the center of occlusal surface (lingual direction: 24N,distal direction:29N, apical direction:164N), which was measured with a small 3-dimensional occlusal force meter. Then Von Mises stress distributions within the root were calculated. **Results:** In all models, there were similar distributions of stress concentration at the apical area. However, in the dentin of the root around the end of the prefabricated posts, there were differences in stress concentration. The magnitudes of stress in this area for GFR, TIP, ZRP and STP were 11.5 Mpa, 12.6 MPa, 12.0 MPa, and 14.9 MPa respectively. **Conclusion:** Within the limitations of this experiment, GFR was indicated to be most suitable since this model showed lower stress values, which means less possibility of root fracture.

Okada, D., Miura, H., Suzuki, C., Komada, W., Yamamoto, M., Masuoka, D., Shin, C. **Stress distribution in root with different post and core systems.** *J Dent Res 87, (Special Issue A) #0336, 2008 (www.dentalresearch.org)*

Objective: Root fracture is one of the most disturbing problems for dentists. Especially, sometime vertical or horizontal root fracture occurs in the abutment teeth with flared post hole. The aim of this study was to evaluate the influence of three kinds of post system on stress distributions in an abutment tooth had flared post hole by 3-dimensional finite element analysis. **Methods:** Three types of 3-dimensional finite element models of endodontically treated premolar with flared post hole were made. In each model, posts and cores were built up with composite resin with prefabricated stainless steel post (SSP), composite resin with glass fiber post (GFP), and cast post and core (CPC). In all models, same occlusal force, which were measured with a small 3-dimensional occlusal force meter during chewing beef jerky in vivo, were applied to the center of occlusal surface (lingual direction: 24N,distal direction:29N, apical direction:164N). Then Von Mises stress within the root dentin, composite resin around two kinds of prefabricated post and luting agent around the end of CPC were calculated. **Results:** The magnitude of stress at the root dentin around the end of post for SSP, GFP, and CPC were 12.8 MPa, 11.1 MPa, and 13.6 MPa, respectively. On the other hand, the magnitude of stress of composite resin around the two kinds of prefabricated post (SSP, GFP) and luting agent around the end of CPC were 36.9 Mpa, 11.7 MPa, and 26.3 MPa, respectively. **Conclusion:** Within the limitation of this experiment, GFP thought to be most suitable for endodonticall treated teeth with flared post hole, since this model showed lower stress value within the root dentin and composite resin around the end of prefabricated post, which means less possibility of root fracture.

Pegoretti A, Fambri L, Zappini G, Bianchetti M. **Finite element analysis of a glass fibre reinforced composite endodontic post.** *Biomaterials. 2002 Jul;23(13):2667-82*

In this work the mechanical response to external applied loads of a new glass fibre reinforced endodontic post is simulated by finite element (FE) analysis of a bidimensional model. The new post has a cylindrical shape with a smooth conical end in order to adequately fit the root cavity, and to avoid edges that could act as undesired stress concentrators. Mechanical data obtained by three-point bending tests on some prototypes fabricated in the laboratory are presented and used in the FE model. Under various loading conditions, the resulting stress component fields are hence compared with those obtained in the case of two commercial endodontic posts (i.e. a cast metal post and a carbon fibre post) and with the response of a natural tooth. The gold cast post-and-core produces the greatest stress concentration at the post-dentin interface. On the other hand, fibre-reinforced composite posts do present quite high stresses in the cervical region due to their flexibility and also to the

presence of a less stiff core material. The glass fibre composite shows the lowest peak stresses inside the root because its stiffness is much similar to dentin. Except for the force concentration at the cervical margin, the glass fibre composite post induces a stress field quite similar to that of the natural tooth. **PDF**

Samilee, P., Arunpraditkul, S., Dechaumphai, P. **Finite element analysis of various post and core restorations in teeth with flared root canal.** *J Dent Res. Vol 82 IADR Abstract #1936, 2003 (www.dentalresearch.org)*

Objectives: Endodontically treated teeth with flared root canal are frequently found for many reasons and the prognosis of post and core restoration are also unpredictable. Reinforcing techniques that weaken the tooth had been introduced, however, the suitable methods are still questioning. The aim of this study is to investigate the stress distribution in root dentin and restorative materials. **Methods:** The 2 –dimensional Finite Element models of flared root canals (Maxillary central incisors) with ten restorative techniques were performed, using MSC/Nastran for Windows. Three evaluated parameters: reinforcing or non-reinforcing the flared root canal, reinforcing materials (composite resin and reinforced glass ionomer) and the post materials (gold alloy type III, Ni-Cr alloy, stainless steel, and carbon fiber) were investigated. All materials were assumed to be homogeneous, isotropic, linearly elastic. The load (150N) was applied on the lingual surface of metal-ceramic crown; 130 degrees to the tooth axis. **Results:** The results showed that maximal tensile stress in dentin were reduced in the reinforcing models. Reinforcement with composite resin provided less maximum tensile strength than that with reinforced glass ionomer. Higher elastic modulus of posts, such as Ni-Cr alloy showed more maximum tensile stress at post apex, but less stress concentration at flared dentin compared with posts with lower elastic modulus. **Conclusions:** From this FEA study, reinforcement of flared root canal with composite resin and carbon fiber post showed favorable stress distribution in restoring the teeth with flared root canal.

Soares, CJ, Soares, PV, de Freitas Santos-Filho, PC, Castro, CG, Magalhaes, D, Versluis, A. **The influence of cavity design and glass fiber posts on biomechanical behavior of endodontically treated premolars.** *J Endod. 2008 Aug;34(8):*1015-9

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 + 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 two-dimensional 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. **PDF**

Uddanwadiker, RV, Padole, PM, Arya, H. **Effect of variation of root post in different layers of tooth: linear vs nonlinear finite element stress analysis.** *J Biosci Bioeng. 2007 Nov;104(5):363-70.*

The objective of this study was to obtain an accurate stress distribution pattern on different domains of a post- and core-treated tooth, taking into account the nonlinear properties of the periodontal ligament (PDL). Linear stress and deformation analysis was carried out using four posts, different in constitution and shape. Accurate three-dimensional models of a restored tooth with different layers were prepared using CAD modeling software. The study was carried out using a cast metal post and core assembly, a glass fiber, a carbon fiber, and a titanium post with a composite resin core. For each restoration, parallel, tapered and threaded posts were modeled. However, PDL exhibits nonlinear properties ensuring a uniform stress distribution in the tooth structure. Hence, accurate results could be expected by simulating the model for the nonlinear properties of PDL. Owing to computational difficulties, a simplified model was prepared in the ANSYS environment and nonlinear stress analysis was carried out. The results indicate that for optimum strength, rigidity and flexibility, tapered fiber posts with a composite resin core cemented to the root are desirable. Under similar loading conditions, in the case of nonlinear analysis, the stresses decreased by approximately 25% and the deformation increased by approximately 50% as compared with those in case of linear static analysis for an endodontically treated maxillary central incisor. Thus, stress distribution within the restored tooth and surrounding tissues can be better anticipated by a dentist. From the results of this study, the dimensions of a post could be modified, to further reduce stress in the oral cavity and thereby reduce the risk of root and post fractures.

Coelho CS, Biffi JC, Silva GR, Abrahão A, Campos RE, Soares CJ. **Finite element analysis of weakened roots restored with composite resin and posts.** *Dent Mater J. 2009 Nov;28(6):671-8.*

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 + 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 masculine 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. **PDF**

Silva, N.R., Castro, C.G., Santos-Filho, P.C., Silva, G.R., Campos, R.E., Soares PV, Soares CJ. **Influence of different post design and composition on stress distribution in maxillary central incisor: Finite element analysis**. *Indian J Dent Res. 2009 Apr-Jun;20(2):153-8.*

Background: Post design and material has very important effects on dentinal stress distribution since the post placement can create stresses that lead to root fracture. **Methods:** In this study we use finite element analysis (FEA) to evaluate stress distribution on endodontically treated maxillary central incisors that have been restored with different prefabricated posts. Six models were generated from the image of anatomical plate: Four metallic posts (ParaPost XH, ParaPost XT, ParaPost XP, and Flexi-Flange) and one fiberglass post (ParaPost Fiber Lux). The sixth model was a control-a sound maxillary central incisor. We used CAD software and exported the models to ANSYS 9.0. All the materials and structures were considered elastic, isotropic, homogeneous, and linear except the fiberglass post which was considered orthotropic. The values for the mechanical properties were obtained by a review of the literature and the model was meshed with 8-node tetrahedral elements. A load of 2N was applied to the lingual surface at an angle of 135 degrees. **Results**: The stress results were recorded by shear stress and von Mises criteria; it was observed that there was no difference for stress distribution among the titanium posts in the radicular portions and into posts. There was higher stress concentration on the coronary portion with the titanium posts than with the glass fiber post. It seems that the metallic posts' external configuration does not influence the stress distribution. **Conclusion:** Fiber posts show more homogeneous stress distribution than metallic posts. The post material seems to be more relevant for the stress distribution in endodontically treated teeth than the posts' external configuration. **PDF**

Spazzin, A.O., Galafassi, D., de Meira-Júnior, A.D., Braz, R., Garbin, C.A. **Influence of post and resin cement on stress distribution of maxillary central incisors restored with direct resin composite.** *Oper Dent. 2009 Mar-Apr;34(2):223-9.*

The current study evaluated the influence of two endodontic post systems and the elastic modulus and film thickness of resin cement on stress distribution in a maxillary central incisor (MCI) restored with direct resin composite using **finite element analysis** (FEA). A three-dimensional model of an MCI with a coronary fracture and supporting structures was performed. A static chewing pressure of 2.16 N/mm2 was applied to two areas on the palatal surface of the composite restoration. Zirconia ceramic (ZC) and glass fiber (GF) posts were considered. The stress distribution was analyzed in the post, dentin and cement layer when ZC and GF posts were fixed to the root canals using resin cements of different elastic moduli (7.0 and 18.6 GPa) and different layer thicknesses (70 and 200 microm). The different post materials presented a significant influence on stress distribution with lesser stress concentration when using the GF post. The higher elastic modulus cement created higher stress levels within itself. The cement thicknesses did not present significant changes. **PDF**

D. Micro-infiltração

Bae, S. , Kim, E-J, Chang, H-S. **Microleakage and fracture aspects of posts related with repeated loading**, *J Dent Res. 85 (Special Issue B) Abstract #1516, 2006 (www.dentalresearch.org)*

Objectives: The aim of this study was to compare the dye penetration under repeated loading using Cyclic Loading Machine, which stimulated masticatory system, and to evaluate the fracture aspects of different post systems. **Methods:** 25 single rooted incisors were divided into 5 groups; Cast posts, Para post, FRC Postec, CosmoPost, and endodontically treated

teeth. Each post was cemented with Duo-Link (Bisco, U.S.A.), and core build-up was done using Light-Core (Bisco,U.S.A). Nittoflon Tape (Nitto Co. Japan) was used to simulate the periodontal ligaments. The load of 9.8N at 1 Hz for 50,000 cycles was applied to the angle of 45 degrees to the long axis of the tooth in 0.5% Fuchsine Basic solution on the Cyclic Loading Machine. After the fracture aspects were observed, the ratio of dyed surface area to the total root surface area was evaluated by Image Analyzer(Image Pro 4.0, U.S.A.) and statistically analyzed with Kruskal-Wallis Test and Duncan's Multiple Range Test at P=0.05. **Results:** The cast post showed the largest microleakage, while those of FRC Postec, Para post, CosmoPost were significantly lower(P<0.05). The fracture lines of FRC Postec and CosmoPost were limited to the upper 1/3 of the root, while those of cast post and Para post were extended to middle 1/3 of the root. **Conclusions:** In view point of microleakage, FRC Postec, CosmoPost, and Para post showed less value. However, considering the fracture aspects together, the results indicate that FRC Postec and CosmoPost were meaningful clinically.

*Dasch, W., El-aryan, M., Roggendorf, MJ., Ebert, JA. Petschelt, Frankenberger, R **Leakage of different luting cements for quartz-fiber post cementation**., *J Dent Res.Vol 87 (Spec Iss A) Abstract #3141, 2008 (www.dentalresearch.org)*

Objectives: Assessment of coronal leakage after quartz-fiber post cementation using adhesive and non-adhesive luting cements. **Methods:** Fourty root canals were prepared to apical size .02/#70 with K-reamers (Dentsply-Maillefer, Ballaigues/Switzerland). Root canals were obturated with AH-Plus sealer (DeTrey-Dentsply, Konstanz/Germany) and gutta-percha (Coltene-Whaledent, Langenau/Germany) and stored for 1 week under moist conditions at 37°C. Post preparation was performed with DT Post burs #3 (VDW-Dentsply, Munich/Germany). Teeth were randomly assigned to 5 groups (grp1-5, n=8) and DT White Posts (VDW-Dentsply) were luted with adhesive resp. non-adhesive cement: grp1: Harvard Cement (Richter & Hoffmann, Berlin/Germany); grp2: Ketac-Cem Aplicap (3M Espe, Seefeld/Germany); grp3: RelyX Unicem (3M Espe); grp4: Panavia-F 2.0/ED-Primer II (Kuraray-Dental, Kurashiki/Japan); grp5: Variolink II/Excite DSC (Ivoclar Vivadent, Schaan/Liechtenstein). Teeth were stored for 1 week under moist condition (100% rel. humidity) at 37°C. Leakage analysis was performed by a dye penetration test (5% aqueous methylene-blue solution/3min centrifugation time at 30g). Serial cross sections were investigated for dye penetration by means of a stereo microscope (magnification: x40). **Results:** The following mean leakage values were found (in mm+S.D.): grp1: 8.3+2.2; grp2: 6.9+2.6; grp3: 3.4+1.9; grp4: 5.6+3.2; grp5: 6.1+2.9. Kolmogorov-Smirnov test displayed normal distribution (p>0.05) for each group. Significant differences were detected between groups (ANOVA; p<0.05). RelyX Unicem and Panavia-F 2.0 revealed significantly less leakage compared to the other cements tested (t-test; p<0.05). **Conclusion:** Within the limits of this study, two adhesive cements revealed better results for cementation of quartz fiber posts showing less leakage in comparison to other cement systems tested.

Jung, SH, Min, KS, Chang, HS, Park, SD, Kwon, SN, Bae, JM. **Microleakage and fracture patterns of teeth restored with different posts under dynamic loading.** *J Prosthet Dent. 2007 Oct;98(4):270-6.*

Statement of problem: Many studies concerned with the microleakage of endodontically treated teeth restored with posts and cores and subjected to loading can be found in the literature. However, no studies have investigated microleakage under dynamic loading with simultaneous dye penetration, which is more relevant to clinical situations. **Purpose:** The purpose of this study was to compare microleakage and to classify fracture patterns of endodontically treated teeth restored with various post systems under dynamic loading. **Methods:** The crown portions of 40 human mandibular incisors were sectioned at the cementoenamel junction, and the teeth were endodontically treated. Teeth were divided into 4 groups (n=10): teeth restored with a cast post and core, prefabricated metal post (ParaPost), fiber-reinforced composite resin post (FRC Postec), and ceramic post (Cosmopost). After preparing the post space, each post was cemented with dual-polymerized resin cement (DuoLink). With the exception of the cast post-and-core group, the cores were formed directly using a light-polymerized composite resin (Light-Core). An intermittent load of 98 N at 1 Hz was applied for 50,000 cycles at an angle of 135 degrees to the long axis of the restored teeth, which were immersed in a 0.5% basic fuchsin solution. The ratio of the dyed surface area to the total area of the sectioned root surface was determined using an image analysis program. The data were analyzed by a 1-way ANOVA and Duncan's multiple range test (alpha =.05). The fracture patterns of the teeth were classified according to their fracture propagation lines. **Results:** The cast post group showed a significantly higher level of microleakage compared to the other groups (P=.001). Regarding the failure mode, the FRC Postec and Cosmopost groups showed fracture patterns that would favor retreatment. The number of cycles of repeated loading was not significantly different among the groups (P=.161). **Conclusions:** Both FRC Postec and Cosmopost groups showed less microleakage under dynamic loading and fracture patterns favoring a retreatment of fractured specimens.

Kazemi, R. B., Reid, L.C., Meiers, J. C**., A new test system for measuring concurrently fatigue and microleakage**, *J Dent Res. 81 (Spec. Iss. A) Abstract # 3130; 2002 (www.dentalresearch.org)*

Objectives: The purpose of this study was to develop and evaluate a non-destructive test system that could test concurrently fatigue and microleakage. **Methods:** A new multi-purpose computer-operated impact machine was designed and used in combination with a modified fluid filtration apparatus to evaluate concurrently both core integrity and post microleakage in the same sample. Crowns of single rooted teeth were removed and the roots were randomly assigned to five groups (n=10) and restored with the following post systems: one metallic group-Titanium ParaPost (TP) cemented with zinc phosphate, and four non-metallic groups- CosmoPost (CO), C-Post /Composipost (CP), Esthetic C-Post (EC), and FibreKor Posts (FK). All non-metallic posts were cemented with resin cement. Tetric Ceram was used for composite core for all groups. Samples were imbedded in an acrylic resin mold, connected to the filtration system and the baseline/control microleakage was measured. Samples were then placed in a positioning jig in the fatigue testing machine and subjected to 100,000 impacts at 45 degrees to the long axis of the root with a force of 55N at a frequency of 3HZ. After 60,000 impacts, the samples were subjected to 1,000 thermocycles (60KT) between 5^0C and 55^0C. Microleakage of the post systems was measured at 30K, 60K, 60KT and 100K cycles. **Results:** All samples showed no detectable displacement of any core. Mean +/-SD microleakage in microliters significantly increased in all groups as samples were subjected to increased impacts and thermocycling. The metallic group (TP) showed a statistically significant increase in microleakage ($p<0.05$) when compared to the non-metallic groups (CO, CP, EC and FK) at the conclusion of the study. **Conclusions:** The test design was successful in performing both fatigue loadings and microleakage measurements in the same sample using core integrity and prefabricated post microleakage as test parameters.

Reid, LC, Kazemi, RB, Meiers, JC. **Effect of fatigue testing on core integrity and post microleakage of teeth restored with different post systems.** *J Endod. 2003 Feb;29(2):125-31.*

The purpose of this study was to evaluate a new nondestructive test system, which could test concurrently fatigue and microleakage. Fifty, single-rooted teeth were restored with one of the following posts systems and a composite core: titanium ParaPost cemented with zinc phosphate cement; CosmoPost; C-Post; Esthetic C-Post; and FibreKor post, all cemented with resin cement. Samples were embedded and placed in a positioning jig. They were impacted at 45 degrees to the long axis of the tooth with a force of 55 N at a frequency of 3 Hz for a total of 100,000 impacts. After 60,000 impacts, samples were thermocycled. Core integrity and post microleakage were evaluated periodically throughout the 100,000 impacts. Samples showed no detectable displacement of any of the cores, but the metallic group showed a statistically significant increase in microleakage ($p < 0.05$) at the conclusion of the study compared with the nonmetallic groups. **PDF**

Usumez, A, Cobankara, FK, Ozturk, N, Eskitascioglu, G, Belli, S**. Microleakage of endodontically treated teeth with different dowel systems.** *J Prosthet Dent. 2004 Aug;92(2):163-9*

Statement of problem: Several new esthetic dowel systems are available for the restoration of endodontically treated teeth, but little is known about how effectively these dowels seal the restored teeth. **Purpose**: The purpose of this in vitro study was to compare microleakage of 3 esthetic, adhesively luted dowel systems with a conventional dowel system. **Methods:** The root canals of 41 human intact single-rooted extracted teeth were prepared using a step-back technique. The teeth were randomly divided into 4 experimental groups (n=10), and 1 tooth served as a positive control. The decoronated roots were obturated with gutta-percha using lateral condensation. Roots were restored with 1 of the following dowel systems according to the manufacturer's instructions: (1) stainless steel dowels (ParaPost), (2) glass fiber dowels (Snowpost), (3) resin-supported polyethylene fiber (Ribbond) dowels, or (4) zirconia dowels (Cosmopost). Using a fluid filtration method, coronal leakage of the specimens along the dowel space and root canal restorative material was measured. Fluid movement measurements were made at 2-minute intervals for 8 minutes to measure the presence of voids existing in the obturated canals, at 1 week, 3 months, and 6 months following dowel insertion. A repeated-measures analysis of variance (ANOVA) was used to analyze logarithmic transformations of data (time and dowel material) for significant differences. The Tukey HSD test and paired 2-tailed tests were used to perform multiple comparisons (alpha=.05). **Results**: The data indicated that the leakage values varied according to the dowel system used (P<.01). There was significant interaction between dowel systems and time of testing (P<.01). The sealing ability of zirconia dowels decreased over time (P<.01), but sealing abilities of stainless steel and resin-supported polyethylene fiber dowels remained constant (P>.05). The sealing ability of glass fiber dowels increased at 3 months (P=.032) and remained constant over the next 3 months (P=.758). Statistically, resin-supported polyethylene fiber and glass fiber dowels showed the lowest coronal leakage when compared with stainless steel and zirconia dowels at all time periods (P<.01). There were no significant differences between resin-supported polyethylene fiber and glass fiber dowels at any time period. The initial leakage measurement in zirconia dowel and stainless steel dowels were similar (P=.914), but became significantly different at 3 and 6 months (P<.01). **Conclusions:** Resin-supported polyethylene fiber dowels and glass fiber dowels tested exhibited less microleakage compared to zirconia dowel systems. The latter system should be further evaluated because of its unacceptable level of leakage

Viţalariu A, Comăneci R, Tatarciuc M .**Analysis on the stress induced by non metallic posts in dental and periodontal support by using the finite element method** *[Article in Romanian] Rev Med Chir Soc Med Nat Iasi. 2006 Jul-Sep;110(3):705-10*

Aim: The determination of the influence of non-metallic posts on the stress distribution to the supporting tissues. **Methods:** Two 3D models were created: one intact maxillary incisor and one reconstructed with post (ceramic, carbon fiber and glass fiber). The compressive load (30daN) was applied to an angle of 45 degrees on the palatal surface of the crown. The Algor software computed the stress for each model comparing the maximum registered intensity, localization and concentration into the dento-periodontal complex. **Results:** The fiber reinforced posts induced lower stress peak inside the root, the von Mises stress in the teeth reconstructed with carbon and glass fiber post being similar to that recorded in a tooth without post. The ceramic post produced the greatest stress concentration in the middle third of the root, this behavior supporting the potential risk of the vertical root fractures registered "in vivo". **Conclusions:** The fiber reinforced posts are more suitable for the clinical longevity of the tooth, representing the best choice to reconstruct an endodontically treated tooth.

E. Tipos de Falhas

Bae, J-M., Park, J-S, Kim, Y-J, et al **Effect of component and shape of posts on fracture aspects.** *J Dent Res. Vol 83 (Spec. Iss. A) Abstract #3135, 2004 (www.dentalresearch.org)*

Objectives: This study was to compare the fracture resistance and failure mode of natural teeth with endodontically treated teeth, with and without post systems that have different shapes and components. **Methods:** Total 45 human mandibular incisors were divided into 9 groups; natural teeth (A), root canal treated teeth without post (B), and teeth with their crowns removed and restored with seven kinds of post systems. Each post was cemented with dual-cured resin cement, Duo-Link (Bisco) and core build-up was done with light-cured composite, Light-Core (Bisco), except cast posts. Each specimen was embedded in acrylic resin with periodontal ligament simulation and shear load was applied using universal testing machine (Z020, Zwick) at a crosshead speed of 5 mm/min. After test, the fracture aspects were evaluated by naked eye and SEM. **Results:** The followings are the data of fracture resistance and they were analyzed by Kruskal-Wallis test and Duncan's multiple range test at P=0.01 (unit: N). Standard deviations are in parenthesis.

A	B	**Cast post**	**Parapost** (Whaledent)	**Parapost fiber white** (Whaledent)	**Filpost** (Filhol Dental)	**C-Post** (RTD/Bisco)	**FRC Postec** (Ivoclar)	**Cosmo post** (Ivoclar)
		46% Au alloy (parallel)	S-S (parallel)	Glass fiber (parallel)	Titanium (taper)	Carbon fiber (taper)	Glass fiber (taper)	Zirconia (taper)
974.0^{a} (80.0)	838.6^{b} (80.9)	642.4^{c} (102.3)	639.8^{c} (44.8)	542.4^{d} (40.0)	551.8^{d} (58.2)	556.4^{d} (31.3)	508.8^{d} (59.4)	501.6^{d} (39.8)

The highest fracture resistance was recorded for Cast post and Para post (P<0.01). In failure mode, C-Post and FRC Postec showed favorable aspects with few cracks around apical third. **Conclusions:** The carbon and glass fiber posts with tapered shape resulted in good failure mode, in spite of their lower strength than metal post, meaning the possibility of re-treatment.

Barjau-Escribano, A., Sancho-Bru, JL, Forner-Navarro, L et al, **Influence of prefabricated post material on restored teeth: Fracture resistance and stress distribution.** *Operative Dentistry, 2006 31-1, 47-54.*

Aims: This work studied how prefabricated intra-radicular post material affects the mechanical performance of restored teeth. The effect of using two different materials (glass fiber and stainless steel) with significantly different elastic moduli was studied. **Methods:** A combined theoretical and experimental method was used; first, an experimental fracture strength test was performed on 6 extracted human maxillary central incisors. The teeth were de-coronated, treated endodontically and restored-30 with glass fiber posts (Parapost Fiber White; Coltene/Whaledent, Cuyahoga Falls, OH, USA) and 30 with stainless steel posts (ParaPost; Coltene/Whaledent, Cuyahoga Falls, OH, USA). The data were recorded and the results compared using an ANOVA test. Then, the Finite Element technique was used to develop a model of the restored tooth. For both post systems, the model allowed for the study of the stress distribution patterns on the restored tooth under external loads. **Results:** For teeth restored with stainless steel posts, a significantly lower failure load was found, as compared with those teeth restored with glass fiber posts (520N versus 803N). The estimated distributions confirmed a worse mechanical performance on teeth restored using stainless steel posts, with a high stress concentration due to the significant difference between the elastic moduli of the steel and the surrounding materials (207GPa versus 18.6GPa). **Conclusion:** Within the limitations of this study, post systems where the elastic modulus of the post is similar to that of the dentin and core, have a better biomechanical performance. Moreover, the failure mode for these fiber post systems will allow for further repair.
PDF

Cormier, C., Burns, D., Moon, P., **In vitro comparison of the fracture resistance and failure mode of fiber, ceramic, and conventional post systems at various stages of restoration**. *J Prosthodont 2001; 10:26-36*

Purpose: This in vitro study evaluated 6 post systems over 4 simulated clinical stages of tooth restoration to (1) determine quantitatively the fracture resistance strength at each stage when a static loading force is applied to cause fracture (2) determine the failure mode for each post system at each simulated stage and (3) determne the feasibility of removing failed post systems. **Methods:** Ten post systems made with various materials and designs were tested at the following 4 stages of simulated clinical treatment: Stage 1: post only, loaded using a 3-point loading model to failure to determine transverse strengths and failure modes for each post system, Stage 2: Posts alone bonded into teeth, Stage 3: posts bonded into teeth with core build-up, Stage 4: post and core build-ups with full veneer restorations.For stages 2 through 4, the coronal portion of 60 mandibular premolars were amputated at the cemento-enamel junction (CEJ), the canals were treated enddodontically, and the specimens were mounted in acrylic blocks. A testing force was applied to the posts at 90 degrees to the long axis of the tooth, 4mm from the CEJ.The O'Brien test for constant variance was performed over the treatment groups. For non constant variance, the Welch analysis of variance was used to test for equalities of treatment means. The Tukey Kramer procedure determined which treatment procedures differed. **Results:** The failure thresholds for each post system were significantly different at each stage of testing, but the order of test results remained generally consistent from one stage to the next. ParaPosts (Coltene Whaledent) and and core build-up resulted in higher failyre thresholds through all 4 stages of testing. This post system also displayed a high number of nonfavorable tooth fractures. FibreKor Posts (Jeneric-Pentron) resulted in significantly lower failure threshold values, in stages 2 through 4. This post system displayed no tooth fractures in stages 2 and 3, and a similar number of nonfavorable tooth fractures in stage 4, when compared with the other systems. C-Post / Composipost (Bisco Dental / RTD, St Egreve, France) , Cosmopost (Ivoclar/Vivadent) and Aestheti-Post (Bisco Dental / RTD, St Egreve, France) grouped in descending order through stages 2 to 4.
These systems displayed intermediate fracture resistance strengths, as well as a moderate number of non-favorable tooth fractures. Cosmopost displayed a significant number of brittle post fractures with fragments left in the root canal at all stages. The fracture resitance of the cast metal posts varied from stage to stage. No teeth fractured at stage 2. At stage 3, 9 of 10 teeth fractured non-favorably , and all teeth fractured nonfavorably in stage 4. **Conclusions:** The fiber posts evaluated provided an advantage over a conventional post that showed a higher number of irretrievable posts and unrestorable root fractures. At the stage of final restoration insertion, there was no difference in force to failure for all but the FibreKor material, which continued to be weaker than all the other tested materials. The fiber posts were readily retrievable after failure, whereas the remaining post systems tested were non-retreivable. **PDF**

Fokkinga, W**.** A., Creugers, N. H., Kreulen, C. M. **In vitro failure mode of fiber-reinforced post-core systems: A systematic review**. *J Dent Res. Vol. 82 IADR Abstract #2563, 2003 (www.dentalresearch.org)*

Objectives: To compare in vitro failure modes of fiber reinforced post systems with prefab metal and cast post systems. **Methods:** The literature was searched using MEDLINE, with the year limits 1984-2002/6 for dental articles written in English, German or Dutch. Key words: (post or core or build-up or dowel) and (teeth or tooth) not (implant or orthodontic or periodontal or primary teeth). The following steps were conducted: 1) Inclusion of abstracts describing post-core techniques to reconstruct endodontically treated teeth and their mechanical characteristics (strength, fracture, failure, resistance, survival, retention, leakage, seal). Descriptive studies or reviews were excluded. 2) Inclusion if in vitro studies on fracture resistance of single rooted human teeth restored with prefab fiber posts and composite cores. 3) Failure mode categorization. Favorable failures were defined as repairable failures including adhesive failures, and fractures above bone simulation. Unfavorable were non-repairable, vertical root fractures. Steps 2) and 3) were conducted using the Aim, Materials and Methods and Results of the articles. All assessments were done by 2 operators. Consensus was reached in case of disagreement. Kappa's were used for observer agreement. Percentages of favorable failures of the post systems were compared using Wilcoxon Signed Rank Test. **Results:** MEDLINE identified 1237 articles. Results of each step: inclusion of 203 articles (Kappa=0.86) of which 21 dealt with fibers, 2) inclusion of 8 articles (Kappa=0.62) of which 6 dealt with failure mode of carbon fibers, 3) failure mode categorization per system (Kappa=0.99). Favorable failures occurred significantly more with the carbon fiber reinforced posts than with the prefab metal (n=11, p=0.05, z=1.96) and respectively, the cast post groups (n=8, p=0.02, z=2.39). **Conclusions:** These results suggest a more favorable failure mode of the Carbon fiber post systems compared with prefab metal and cast post systems. Comparative studies of the different post systems are scarce

Fuss, Z., Lustig, J., Katz, A., Tamse, A. **An evaluation of endodontically treated vertical root fractured teeth: impact of operative procedures**. *J Endod Vol. 27, No.1, 2001.*

Vertical root fractures of endodontically treated teeth are a frustrating complication that leads to extraction. The aim of the current survey was to evaluate the role of operative procedures in the etiology of this complication. A total of 154 endodontically treated vertical root fractured teeth were cleaned and washed after extraction and maintained in individual vials. Periapical radiographs before extraction, clinical findings and previous operative procedures were recorded. A post was observed in 95 teeth (61.7%), with 66 of these ending at the coronal third of the root. Most were screw posts of the

Dentatus type (n=64) and tapered cast post (n=14). A full crown was observed in 118 teeth, and 65 of these (55%) were extracted between 1-5 years after final restoration. In 24 crowned teeth extraction was conducted within 1 year after restoration and in 28 teeth after >5 years. It was concluded that post placement and root canal treatment are the major etiological factors for root fractures. Because signs and symptoms can appear years after the operative procedure in the root have been completed, coronal restorations would not interfere with the correct clinical diagnosis of vertical root fractures. Frequest recalls are recommendedto diagnose vertical root fractures early, especially in susceptible teeth, such as premolars and mesial roots of mandibular molars. **PDF**

Gu , XH, Huang, JP, Wang, XX. **An experimental study on fracture resistance of metal-ceramic crowned incisors with different post-core systems**. *Zhonghua Kou Qiang Yi Xue Za Zhi. 2007 Mar;42(3):169-72 [Article in Chinese]*

Objectives: To evaluate fracture resistance of metal-ceramic crown restored incisors with different post-and-core systems. **Methods:**: Selected 40 intact maxillary central incisors were endodontically treated and then randomly assigned to four groups of 10 teeth each. Teeth in Group A were prepared to root canal with 10 mm in length, 1.6 mm in diameter and restored with fiber-reinforced posts (Snowpost, Carbotech) and composite cores. Same final preparation but root canal with 1.5 mm in diameter was achieved for teeth in the other three groups. Teeth in Group B were restored with prefabricated titanium alloy posts (ParaPost, Coltene-Whaledent) and composite cores and teeth in Group C were restored with cast nickel-chromium post-cores. The posts were luted with a composite resin luting system, and metal-ceramic crowns were restored and cemented with the same luting system for all of the teeth in Group A, B and C. The other 10 teeth were restored with cast nickel-chromium post-cores and metal-ceramic crowns as a control, which were cemented with glass-ionomer cement. All restored teeth were thermocycled for 5000 cycles (5 degrees C/55 degrees C) as a fatigue test. The tooth was loaded in a universal testing machine at an angle of 135 degrees to the long-axis at the incisal edge with a crosshead speed of 1.5 mm/min until fracture. Fracture loads (N) and modes (repairable or catastrophic) were recorded. One-way ANOVA and SNK test were used to determine the significance of the failure loads between groups. Chi-square test was conducted for evaluation of the fracture mode. **Results:** The fracture loads from Group A, B, C and control group were (534.4 +/- 145.7) N, (499.8 +/- 168.9) N, (412.6 +/- 99.3) N, (337.4 +/- 121.2) N, respectively. A significant difference was existed among four groups ($P < 0.05$). The fracture loads of Group A and Group B were significantly higher than control group ($P < 0.05$). The repairable mode of fracture observed from Group A to control group was 80%, 40%, 20% and 30%, Group A had a significantly higher number of repairable fractures than those of the other groups ($P < 0.05$). **Conclusions:** Within the limitations of this study, fiber-reinforced post has an excellent fracture resistance, and can be recommended as an alternative to cast post-cores, especially for incisor esthetic restoration

King, PA, Setchell DJ. **An in vitro evaluation of a prototype CFRC prefabricated post developed for the restoration of pulpless teeth.** *J Oral Rehabil. 1990 Nov;17(6):599-609*

Carbon fibre reinforced carbon (CFRC) in the form of a prefabricated post has recently been developed and is theoretically acceptable for consideration in an endodontic post-retained crown system. This study compared four different types of postcore system cemented into 40 extracted anterior human teeth. The test groups consisted of CFRC posts cemented with a composite resin luting agent, and used with either a cast gold alloy core (Group B) or a composite resin core (Group C). Two existing post-core techniques were used as controls for comparison with the CFRC groups. One control was a prefabricated wrought precious alloy post having a cast gold alloy core, and cemented with zinc phosphate cement (Group A). The other was a prefabricated stainless steel post with a composite resin core, and cemented with a composite resin luting agent (Group D). All specimens were restored with a gold alloy crown and tested to failure with an obliquely applied compressive load at 130 degrees in an Instron using a cross-head speed of 5 cm min-1. The results showed that post-retained crowns using a prefabricated CFRC post exhibited properties comparable with, and in some cases better than, those of existing prefabricated posts. The mode of failure of specimens restored with a CFRC post was more favourable to the remaining tooth tissue than was that of specimens restored with a metallic post. **PDF**

Lang, H., Raab, W., **Interferometric assessment of teeth restored with different post systems.** *J Dent Res, Vol 84 (Spec. Iss. A) Abstract #0666, 2005 (www.dentalresearch.org)*

Objectives: This study evaluated the deformation of endodontically treated teeth with 3 different post systems at 4 simulated clinical stages. **Methods:** Extracted human anterior maxillary teeth (n=30) were used and randomly assigned to 3 groups (i.e. post systems): fiber-reinforced epoxy resin posts –Group 1 (ER DentinPost), zirconium oxide ceramic posts –Group 2 (ER CeraPost) and titanium posts –Group 3 (ER Titan post) (all from Komet, Brasseler GmbH, Lemgo, Germany). A series of endodontic treatments was applied and after each single procedure the teeth were loaded (3.75N) and the deformation was assessed using Speckle pattern interferometry. The following treatments were applied: a) no treatment (control), b) access preparation and initial root canal instrumentation (Kerr files ISO 40), c) post preparation (Size 110) and d) cementation of the posts (gr. 1+2: resin bonded / Gr. 3: zinc phosphate cement). **Results:** Access preparation (with root canal instrumentation) and post preparation significantly increased the deformation under loading ($p<0.05$ - one-way ANOVA and post-hoc Scheffé

test). All posts reduced the deformation of the teeth but the levels were significantly different: titanium posts - 0.38±0.02µm > zirconium oxide ceramic posts - 0.45±0.02µm > fiber-reinforced epoxy resin posts - 0.53±0.03µm ($p<0.05$). **Conclusion:** It can be concluded that a) the increase of stability corresponds to the mechanical properties of the post materials and that b) the fiber-reinforced epoxy resin posts can almost preserve the deformation pattern of teeth without a post. This might be favorable in view of studies showing a high incidence of unrestorable root fractures in case of post materials with mechanical properties significantly different from the properties of root dentine.

*Latta, ,M. A., Barkmeier,W. W. , Kimmes,,N. S. , O'Meara, J. D. **Failure resistance of post-core assemblies**. *J Dent Res 85, (Special Issue A) #0377, 2006 (www.dentalresearch.org)*

Resistance to lateral loading is critical for clinical success of the post/core assembly. **Objective:** The purpose of this in-vitro study was to evaluate the load resistance and failure mechanism of glass fiber and metal retained core build-ups. **Methods:** Following the removal of the clinical crown, gutta percha was used to restore canals prepared to size 40 in 60 extracted human anterior teeth. After storage in water for 1 week at 37^0C, post preparations were made to a depth of 9mm and parallel ParaPost, FibreKleer and FibreKor posts and tapered FibreKleer and D.T. Light-Post were cemented using Bond-1 adhesive and Lute-It cement. Using a gelatin capsule matrix a core was fabricated using Build-It resin. A flat area was prepared on the core at a 45º angle to the lingual/occlusal aspect of the post/core/tooth assembly. The specimens were stored in water for 24 hours at 37^0C, thermocycled and loaded to failure at a crosshead speed of 1mm/min in an Instron testing machine. **Results:** Mean load at failure (in Newtons) and failure pattern for each group are presented below

Post	Load (N)	Failure Mode
Parapost	563.5 ± 119.3	**7 root fracture**, 3 core failures
Parallel FibreKleer	376.9 ± 77.9[a]	10 core failures
Tapered FibreKleer	373.8 ± 45.2[a]	1 root fracture, 7 core failures, 2 post debonds,
Parallel FibreKor	368.0 ± 69.7[a]	9 core failures,1 post debond
Tapered D.T. Light	246.7 ± 81.4	10 core failures

ANOVA and post hoc LSD tests revealed significant differences in load failure ($p<0.05$). Groups with a similar letter are statistically similar ($p>0.05$). **Conclusion:** Metal posts generated the highest resistance to failure of the post/core assembly but also the highest root fracture.

*McLaren, J. Yaman, P., Dennison, JB,. Herrero, AA,.et al. **Effect of post length on fracture of endodontically treated teeth.** *J Dent Res. Vol 83 (Spec. Iss. A) Abstract #3097, 2004 (www.dentalresearch.org)*

Objectives: The objective of this study was to compare the fracture resistance and mode of failure of endodontically treated teeth restored with three different post systems at two lengths. **Methods**: Seventy human single-rooted premolars were endodontically treated and sectioned at the buccal CEJ. Teeth were randomly distributed into groups of ten and assigned to one of seven treatment groups. Three different pre-fabricated posts, Parapost XP, Light-Post and Snowlight, were cemented at either 5 or 10 mm into a post space and standardized composite cores fabricated. A composite core group with no post served as a control. Samples were stored for 24 hours in 100% humidity at 37°C and were subsequently loaded at 90° to the longitudinal axis until ultimate failure occurred. An initial failure load and mode of failure were also recorded and analyzed using two-way ANOVA. Results: The average initial failure loads at 10 mm in Newtons were: Parapost XP 170.05 ± 60.08; Light-Post 123.29 ± 46.64; Snowlight 70.43 ± 32.26. The average initial failure loads at 5 mm were: Parapost 111.08 ± 49.84; Light-Post 64.25 ± 33.83; Snowlight 62.85 ± 18.47. The control group value was 40.24 ± 9.52. Core debonding from the tooth interface was the mode of initial failure for all samples.. **Conclusions:** Parapost XP samples had significantly higher initial and ultimate failure loads than Light-Post or Snowlight samples at each of the two respective post lengths. Results indicate that stainless steel post provides better support for a core than glass or quartz fiber-reinforced post when a 90° load is applied. The glass and quartz fiber-reinforced post were not found to be significantly different for providing fracture resistance at 90° load angle. Root fractures upon ultimate failure occurred in 25% of the Parapost XP samples and no root fractures occurred in any other group.

Mannocci, F., Ferrari, M., and Watson, T. F. **Intermittent loading of teeth restored using quartz fiber, carbon-quartz fiber, and zirconium dioxide ceramic root canal posts**. *Journal of Adhesive Dentistry. 1: 153-158, 1999.*

Purpose: The purpose of the investigation was to compare the performances of teeth restored with quartz-fiber, carbon-quartz fiber, and zirconium-dioxide posts covered with all-ceramic crowns when subjected to a cyclic loading tests performed in a wet environment. **Methods:** Forty single-rooted human lower premolars having similar dimensions were endodontically

treated and mounted in acrylic resin blocks with a simulated periodontal ligament. The teeth were divided into three experimental groups and one control group. Post holes 8 mm long were prepared in the roots of the experimental groups in which quartz fiber (Aestheti-Plus, RTD, St Egreve, France), carbon-quartz fiber (Aestheti-Post; RTD, St Egreve, France), and zirconium dioxide (Cerapost) posts were cemented. In the control group, no posts were used. The crown buildup was made with composite resin. The teeth were covered with all-ceramic crowns and intermittently loaded an at angle of 45 degrees to the long axis of the tooth at a frequency of two loads per second. **Results:** Only one failure (root fracture + post fracture), was observed in each of the fiber post groups, while in the zirconium dioxide post group, six failures were observed (one crown fracture and 5 root fracture + post fractures). The Kaplan-Meier analysis of the three experimental groups showed that the survival rate of zirconium dioxide posts was significantly lower than that of both types of fiber post. All the experimental groups showed a survival rate higher than that of the control group. **Conclusions:** Fiber posts reduced to a minimum the risk of root fractures of teeth restored with composite cores and Empress crowns under the present experimental conditions (intermittent loading in a wet environment). **PDF**

*Ng, C., Dumbrigue, H., Al-Bayat, M., Griggs, J., Wakefield, C. **Influence of remaining coronal tooth structure location on the fracture resitance of restored endodontically treated anterior teeth.** *J Prosthet Dent 2006;95:290-6.*

Statement of problem: a restored endodontically treated tooth is less likely to fracture when there is axial tooth structure between the core base and preparation finish line. However an accurate prognosis requires knowing whether fracture resistance depends on a complete circumferential distribution of tooth structure or tooth structure in a specific location to the applied force. **Purpose:** This in vitro study investigated the fracture resistance of restored endodontically treated teeth when residual axial tooth structure was limited to one half of the circumference of the crown preparation. **Methods:** Fifty extracted maxillary anterior teeth were sectioned 18mm from ther apices, endodontically treated and divided into 5 groups of 10 teeth each. Four groups were prepared with full shoulder crown preparations having axial wall heights of 2mm around the preparation circumferences. In three of the groups with axial tooth structure, one half of the axial tooth structure was removed. Palatally, labially, or proximally and groups were identified according to the site of retained coronal tooth structure. For the fifth group, all axial tooth structure was removed to the level of the preparation shoulder. Thus, in one group the axial walls were circumferential, 360 degrees around the preparations (Complete group), in 3 groups the axial walls were continuous for 180 degrees (palatal, labial and proximal groups) and the last groups had no retained coronal tooth structure incisal to the finish line (Level Group). All 50 prepared teeth were then restored with quartz fiber posts (D.T. Light-Post; RTD, St Egreve, France/ Bisco Dental), composite cores (Bisco Dental) and metal crowns. A universal testing machine compressively loaded the tooth specimens at a crosshead speed of 0.5cm/minute at an angle of 135 desh line, the location degrees to the long axis of the teeth until failure occurred. A survival analysis was conducted using a log rank test followed by Holm-Sidak pairwise test (α=0.05) to detect significant differences in median failure load between groups. The mode of failure was determined by visual inspection of all specimens. **Results:** The median failure load (P<.001) was 607 N, 782N, 358N, 375N, and 172N for the Complete, Palatal, Labial, Proximal and Level groups, respectively. The predominant mode of failure was an oblique palatal to facial root fracture for the groups with remaining coronal tooth structure. In the Level group, post debonding was the predominant mode of failure. **Conclusion:** For restored endodontically treated teeth that do not have complete circumferential tooth structure between the core and preparation finish line, the location of the remaining coronal tooth structure may affect their fracture resistance. **PDF**

Pilo, R., Cardash, H., Levin, E., Assif, D. **Effect of core stiffness on the in vivo fracture of crowned, endodontically treated teeth**. *J Prosthet Dent 2002; 88:302-6.*

Statement of problem: Dentin and core materials that substitute for missing dentin are dissimilar materials. A core material with a lower elastic modulus may deform more under applied stress and therefore result in reduces stress concentration at the core/dentin junction. Purpose: This in vitro study examined the effect of core stiffness on the fracture resistance and failure characteristics of a crowned, endodontically treated tooth under simulated occlusal load. **Methods:** Forty extractyed human mandidular premolars were divided equally into four groups and prepared for posts and cast crowns as follows: group 1 = cast post and core, cast crown; group 2 = preformed metal post composite core and cast crown,; group 3 = preformed metal post, amalgam core and cast crown; group 4 (control) = preformed metal post, no core and cast crown. All prepared teeth had 2mm of sound dentin on which the cemented crown rested. A continuous load (kg) was applied to the buccal cusp as a 30-degree angle to the long axis of the tooth at a crosshead speed of 2mm/min. until failure. Collected data were subjected to 1-way analysis of variance with the Welch modification to compare groups (<.05). **Results:** Failure loads for the 4 test groups were as follows: Group 1 98.1 +/- 34.6, Group 2 94.4 +/- 41.8, group 3 105.5 +/- 18.6, group 4 (control) 101.1 +/- 55.3kg. No significant difference in failure load values was found among the 4 groups. The primary mode of failure (80%) in all groups was an oblique radicular fracture, either apical to the post or at the post level. Horizontal fracture of the root and post was found in groups 1, 2 and 3 (30%). Loosening of the crown, post and core was found only in group 2 (20%). **Conclusion:** Within the limits of this study, core stiffness did not effect the failure resistance of teeth restored with posts and cores and complete coverage cast metal posts. The dominant pattern of failure was unrepairable root fracture. Onlty the composite core exhibited repairable fractures. **PDF**

Raposo, L.H.A.. Silva, G.R., Santos-Filho, P.C.F., . Soares, P.V., Soares, C.J., **Effect of posts and materials on flared teeth's mechanical behavior** *J Dent Res. Vol 87 (Spec. Iss. A) Abstract #1862 (www.dentalresearch.org)*

Objectives: Assess the effect of different post systems and restorative techniques on stress-strain behavior and fracture resistance of flared roots. **Methods:** The coronary portion was removed from 105 bovine incisors, leaving a 15.0 mm root. After endodontic treatment samples were embedded in polystyrene resin and the periodontal ligament was simulated. The specimens were divided into 7 groups (n=15) and the roots of two reference groups were restored with cast post and core (CPC – G1) and fiber-glass post (FGP – G2). In the other groups, root canal were flared and restored with CPC (G3); FGP (G4); FGP and accessories FGP (G5); and FGP directly (G6) or indirectly (G7) rebased with accessories FGP and composite resin. All teeth were restored with all-metal crowns. Samples were submitted to mechanical fatigue ($3x10^5$ cycles of 50N). Strain-gauges were attached to the roots and strain values (μS) were obtained under a 100N load. Fracture resistance (N) was tested with a oblique load at a 0.5 mm/min cross-head speed. Data were analyzed with one-way ANOVA and Tukey HSD test ($p<0.05$). Failure mode was classified in accordance to the degree of dental structure destruction. Bi-dimensional finite element analysis was performed with representative models of each group, based on von Mises stress distribution criteria. **Results:** The results (N) were: G6- (867.9±198.1)a; G1- (859.9±199,2)a; G7- (847±112.2)a; G5- (842.7±174)a; G2- (627.1±119,8)b; G4- (625.3±164,3)b; G3- (620.2±164.2)b. There was no significant difference in the strains measured among groups, however, CPC increase catastrophic failures. Finite element analyses revealed higher stress concentration in CPC than in FGP, irrespective of restorative technique. **Conclusion:** Fiber-glass posts associated with composite resin or with accessory fiber-glass posts seem to be more indicated as **alternative to cast post** and core in flared roots, because of the lower risk of catastrophic failures and better stress distribution.

Salameh, Z, Ounsi, HF, Aboushelib, MN, Sadig, W, Ferrari, M. **Fracture resistance and failure patterns of endodontically treated mandibular molars with and without glass fiber post in combination with a zirconia-ceramic crown.** *J Dent. 2008 Jul;36(7):513-9. Epub 2008 May 13*

Objective: The aim of this study was to investigate the influence of a fiber post on the fracture mechanics of zirconia crowns inserted over endodontically treated teeth with different extent of coronal damage. **Methods:** Endodontically treated human molars with three types of coronal damage received fiber posts before cementation of zirconia-veneered crowns. Controls received composite resin cores without fiber posts. The specimens were loaded to failure and fractographically examined using a scanning electron microscope (SEM). **Results:** Statistical analysis revealed that specimens with fiber posts demonstrated significantly higher failure loads and favorable fracture pattern compared to the controls. At fractographic analysis, specimens with fiber posts demonstrated delamination of the veneer ceramic from intact zirconia under structure. Meanwhile, the specimens that were restored without a fiber post demonstrated micro-cracking of the composite core build-up resulting in loss of the support under the zirconia crowns which was responsible for the initiation of radial crack and catastrophic damage. **Conclusions:** Within the limitation of this study, the insertion of fiber post improved the support under zirconia crowns which resulted in higher fracture loads and favorable failure type compared to composite core build-up.
PDF

Salameh, Z, Sorrentin, R, Papacchin, F, Ounsi, HF, Tashkandi, E, Goracci, C, Ferrari, M. **Fracture resistance and failure patterns of endodontically treated mandibular molars restored using resin composite with or without translucent glass fiber posts**. *J Endod. 2006 Aug;32(8):752-5. Epub 2006 Jun 15*

The elastic modulus of the restorative material is important in restoring endodontically treated teeth. This study aimed to compare the fracture resistance and failure patterns of 90 mandibular molars restored using resin composites with or without fiber posts, with respect to the number of residual cavity walls. Five restoration types were performed corresponding to different wall defects (groups 1-5). Groups were divided in two subgroups corresponding to the use or absence of fiber posts. Teeth were loaded and resistance of specimens was measured as the axial compressive load to cause fracture and macroscopic fracture patterns were observed. One way ANOVA revealed a significant difference in fracture resistance ($p < 0.001$). Tukey post hoc test also revealed significant differences between groups as samples restored with fiber posts exhibited mostly restorable fractures. It was concluded that the resistance of endodontically treated mandibular molars restored with composite resins is mainly affected by the number of residual walls. Using fiber-reinforced posts optimized fracture patterns.

*Sorrentino, R., Monticelli, F., Goracci, C., Zarone, F., Tay, F., Garcia-Godoy, Ferrari, M. **Effect of post –retained composite restorations and amount of coronal residual structure on the fracture resistance of endodontically treated teeth.** *Am J Dent2007;20:269-274*

Purpose: To compare the fracture resistance and failure patterns of endodontically treated teethwith a progressively reduced number of residual walls , restored using resin composites, with or without translucent fiber posts. **Methods:** Ninety extracted

human single-rooted maxillary premolars were used. After endodontic treatment, the following groups were created: Group 1 (control group): endodontically treated single-rooted maxillary premolars with four residual walls, Group 2: three residual walls, Group 3: two residual walls, Group 4: one residual wall, Group 5: no residual wall. Groups 2-5 were each divided into two subgroups: subgroups "a" were restored with resin composites, while subgroups "b" were restored with translucent fiber posts (D.T. Light-Post; RTD St Egreve, France) AND resin composites. Static fracture tests and statistica analyses were performed. **Results:** The mean failure loads (N) were: Group 1=502.4 +/-152.5, Group 2a= 416.4 +/- 122.2, Group 2b= 423.0 +/- 103.3, Group3a= 422.1+/-138.9, Group 3b= 513.2+/-121.7, Group 4a=488.7+/-153.7, Group 4b= 573.4+/-169.2, Group 5a=856.7+/-112.2 and Group 5b= 649.5+/-163.5, respectively. The samples restored with the fiber posts exhibited predominately restorable fractures. The number of residual cavity walls influenced the mechanical resistance of endodontically treated teeth. **PDF**

Sorrentino, R, Salameh, Z, Zarone F, Tay, FR, Ferrari M. **Effect of post-retained composite restoration of MOD preparations on the fracture resistance of endodontically treated teeth**. *J Adhes Dent. 2007 Feb;9(1):49-56*

Purpose: The present study aimed to compare the fracture resistance and failure patterns of endodontically treated premolars with MOD preparations restored using different material combinations. The null hypothesis postulated that there was no association between the fracture resistance of endodontically treated premolars and the resin composite materials or the post-and-core system used to build up the restorations. **Methods:** Eighty single-rooted maxillary premolars were used. After endodontic treatment and preparation of MOD preparations, 8 groups of 10 samples each were created, using the following material combinations: group 1 (control), flowable and microhybrid resin composites; group 2, flowable A; group 3, flowable B; group 4, microhybrid resin A; group 5, microhybrid resin B; group 6, flowable B + microhybrid resin B; group 7, flowable A + microhybrid resin A + post A; group 8, flowable B + microhybrid resin B + post B. Mechanical static fracture tests were performed loading the specimens till fracture. **Results:** The mean failure loads (N) were 502 (control), 470 (group 7), 445 (group 8), 441 (group 6), 405 (group 5), 364 (group 4), 317 (group 2), and 302 (group 3). Statistically significant differences were found between groups 1 vs 2, 1 vs 3, and 3 vs 7 ($p < 0.05$). **Conclusions:** The fracture resistance of endodontically treated premolars with MOD preparations was enhanced by the use of the sandwich technique. The samples restored with posts predominantly showed restorable fractures, while teeth restored without posts mostly displayed unrestorable failures. **PDF**

Vitalariu AM, Comaneci R, Tatarciuc MS **Prevention of root fracture using posts reinforced with fiber glass..***Rev Med Chir Soc Med Nat Iasi. 2005 Apr-Jun;109(2):406-11*

The aim of this study was to evaluate the fracture strength and mode of failure of endodontically treated teeth reconstructed with glass fiber reinforced posts. Twenty maxillary central incisors, extracted for periodontal reasons, were divided in 2 groups: gr. 1 - glass fiber posts, and gr.2 - control (endodontically treated but without posts). All samples were embedded in resin bloks and mounted in stainless steel cylinders for the compressive test. The force was applied on oral surface of the crown, until the failure occurred. The compressive loads at failure were recorded and compared with the statistical method Student t. The mode of failure of the specimens were also evaluated. The statistical analysis of the force values showed no significant difference between the groups. In conclusion, because of their low Young's modulus, the non-metallic posts made of resin composite reinforced with glass fibers have a protective effect on the dental tissues, the recorded mode of failure being very similar with the control group.

McLaren, J.D., McLaren, C.I., Yaman, P., Bin-Shuwaish, M.S., Dennison, J.D., McDonald, N.J. **The effect of post type and length on the fracture resistance of endodontically treated teeth.** *J Prosthet Dent. 2009 Mar;101(3):174-82.*

Statement of problem: Few studies have been conducted to determine a correlation between the flexural modulus of metal and fiber-reinforced posts and the fracture resistance and failure mode of teeth restored with posts. Questions remain as to whether a longer post length or a post with a higher flexural modulus will significantly improve the fracture resistance of a tooth restored with a prefabricated post and core. **Purpose:** The purpose of this study was to compare the fracture resistance and mode of failure of endodontically treated teeth restored with 3 different post systems, including 2 fiber-reinforced posts (Light-Post and Snowlight) and a stainless steel post (ParaPost XP). **Methods:** Seventy single-rooted premolars were sectioned at the cemento-enamel junction and then endodontically treated. Teeth were distributed into 7 groups. Three different prefabricated posts were cemented into a post space either 5 or 10 mm in depth, and composite resin (ParaPost ParaCore automix) cores were fabricated. A composite resin core group without a post served as a negative control. Specimens were loaded at 90 degrees to the longitudinal axis until ultimate failure occurred. An initial failure load and mode of failure were also recorded. Statistical analysis was performed for initial and ultimate failure loads of groups by using 2-way ANOVA (P=.05). **Results:** The groups with ParaPost XP posts demonstrated significantly higher initial and ultimate mean failure loads when compared with the fiber-reinforced post groups. The highest mean (SD) initial failure load was with

the ParaPost XP group with a 10-mm post length (170.05 (60.08) N), and the lowest was with the Snowlight group with the 5-mm post length (62.85 (18.47) N). **Conclusions:** The stiffness and the load to initial fracture of the teeth restored with ParaPost XP posts were higher compared with the fiber-reinforced post groups. The stainless steel posts had an incidence of **25% root fractures,** while no root fractureas were observed with the fiber posts. Clinical Implications: The results of this study suggest that a stainless steel post may provide better support for a composite core than a fiber –reinforced post when a 90 degree load is applied. **PDF**

F . RESISTÊNCIA A FADIGA

*Baldissara, P., Zicari, F., Melilli, D., Monaco, C. **Effect of endodontic treatment on fatigue resistance of fiber post bonding**. *J Dent Res. Vol 82 (Special Issue A) Abstract # 2565, 2003 (www.dentalresearch.org)*

Objectives: The aim of this study is to evaluate the effect of the endodontic treatment on the fatigue resistance of endodontic post adhesive interfaces. **Methods:** FIFTY single-rooted human teeth have been severed at the CEJ and randomly assigned to 5 groups receiving different endodontic treatments as follows: 1) distilled water + gutta percha (control); 2) NaOCl 5% + gutta percha + Pulp Canal Sealer EWT (Kerr); 3) NaOCl 5% + gutta percha + TopSeal (Dentsply-Maillefer); 4) NaOCl 5% and EDTA 10% (alternatively) + gutta percha + Pulp Canal Sealer EWT; 5) NaOCl 5% and EDTA 10% (alternatively) + gutta percha + TopSeal. Subsequently, #2 DT Light-Post (RTD, St Egreve, France /Bisco) quartz fiber posts have been placed in the root canal using All-Bond 2 adhesive (Bisco) and Bis-Fil 2B composite (Bisco). Five specimens from each group have been subjected to 2,000,000 fatigue cycles ranging from 0 to 37.5N at 8Hz frequency and 37^{0}C water irrigation, whereas the remaining specimens were stored in distilled water at room temp. After the fatigue cycles, all of the specimens were severed obtaining 4 sections from each tooth, which were then evaluated with the push-out test at a constant speed of 1mm/min. Stereomicroscope and SEM observations were done to evaluate the interface failures. **Results:** no statistically significant differences were observed between the 5 groups in both fatigue stressed (p=0.298) and water stored specimens (p=0.093). Also, the microscope analysis of interface failures showed that the post-cement interface is weaker than the cement-dentin one. The difference was significant with P=0.001. **Conclusions:** the results suggest that the interface resistance is not influenced by the canal treatments adopted in this study. Probably the hard tissue removal necessary for post placement eliminated contaminated or altered dentin that may affect the bonding with the luting cement. High resistance of the cement-dentin interface strongly supports this last hypothesis.

*Baldissara, P, Pieri, F, Arcidiacono, A**, Fatigue resistance of fiber posts: a comparative study.** *J Dent Res.Vol. 80 (Special Issue A) Abstract #1434, 2001 (www.dentalresearch.org)*

Fiber posts are commonly used to restore endodontically treated teeth prepared for fixed partial dentures. Their mechanical properties and the use of adhesive cements seem to allow higher survival rates when compared to traditional cast or metal posts. The aim of this study was to compare the fatigue resistance of five different types of fiber posts. Fifty sound incisors, bicuspids and canines have been selected and endodontically treated. The crown was removed and they were randomly divided into five groups. Each group received 10 fiber posts inserted 9mm into the root. The posts were cemented using the dentin adhesive and the cement suggested by the manufacturer: 1) Carbon fiber (Composipost RTD; St Egreve , France / Bisco C-Post); All-Bond 2 / C&B Cement (Bisco), 2) Quartz fiber post Aestheti-Post (RTD; St Egreve , France / Bisco); All-Bond 2 / C&B Cement (Bisco), 3) Quartz fiber Light-Post (RTD, St Egreve , France / Bisco); One -Step (Bisco) and Duo-Link cement (Bisco), 4) Glass fiber FibreKor (Jeneric Pentron) Post; BOND-1 (Jeneric Pentron) and Cement-It! (Jeneric Pentron) , 5) Quartz fiber **D T Light-Post** (RTD / Bisco); One-Step (Bisco) and Duo-Link cement (Bisco). Post diameter was 1.4mm for groups 1 – 4 and 1.5mm for group 5. Each group was subdivided into a control group and an experimental one. Specimens from the experimental groups underwent 2 million 8Hz frequency load cycles in distilled water at 37^{0}C. During each cycle, the load ranged from 3 to 21 Newtons and was applied directly one the post in 45^0 direction. The controls were stored in water at 27^{0}C. After the tests, all the specimens were imbedded in epoxy resin and sectioned transversely, obtaining 1mm thick sections. The sections were observed under the stereomicroscope and the post/cement (PC) and (CD) cement/dentin interfaces were evaluated using an ordinal scale.. One post (Aestheti-Post) fractured after 1.5 million cycles. Light-Post and D. T. Light-Post gave the better results (P<0.009) at both interfaces. The PC interface appeared significantly stronger (P<0.05) than CD when tested with Kruskal-Wallis test. Significant differences (P<0.05) were found between controls and experimentals in groups 4 & 5. It was concluded that Quartz fiber posts are very resistant to fatigue stress and the adhesion at CD interface could be improved.

*Hayashi, M, et al. **Static and fatigue fracture resistannce of pulpless teeth restored with post-cores**, *Dent Mater (2008), doj:10.1016/jdental 2008.01.009*

Objectives: Superior restorative methods for effectively strengthening pulpless teeth need to be identified, since vertical root fractures of pulpless teeth are still a major problem in everyday clinical practice. The present study tested the null hypothesis thet there were no differences in static and fatigue fracture resistanceof pulpless teeth restored with different types of post-core systems. **Methods**: Extracted human premolars were restored with a combination of either a fiber post (D.T. Light-Post #3, RTD, St Egreve, France / Bisco USA) or metallic post and a composite resin core. Teeth with full crown preparations WITHOUT post-core restorations served as the control. A 90^0 vertical or 45^0 oblique static compressive load was applied to therestored teeth, and (static) fracture loads-and modes of fracture-were recorded. Fatigue fracture tests were conducted by applying sinusoidal cyclic loads to restored teeth from vertical or oblique directions. Fatigue limits for each restoration were calculated using the staircase approach. **Results:** In both static and fatigue fracture testing under vertical or oblique loadings, the fracture loads of the teeth restored with fiber posts were significantly greater thanthose of teeth restored with metallic posts. The fatigue limits of teeth restored with fiber and metallic posts were 112 kgf and 82kgf respectively under vertical loadings, and 26kgf and 20kgf under oblique loadings. **Significance:** the combination of a fiber post and a composite resin core showed superior fracture resistance against both static and fatigue loadings compared to restoration using a metal post and is therefore recommended in restoring pulpless teeth. **PDF**

Scotti, R, Valandro, LF, Galhano, GA, Baldissara, P, Bottino, MA. **Effect of post length on the fatigue resistance of bovine teeth restored with bonded fiber posts: a pilot study**. *Int J Prosthodont.. 2006 Sep-Oct;19(5):504-6*

This study evaluated the influence of the cementation length of glass fiber-reinforced composite (FRC) on the fatigue resistance of bovine teeth restored with an adhesively cemented FRC. Thirty roots of single-rooted bovine teeth were allocated to 3 groups (n = 10), according to the ratio of crown length/root length (post cementation length): group 1 = 2/3, group 2 = 1/2, and group 3 = 1/1. The roots were prepared, the fiber posts (FRC Postec Plus) were cemented, and the specimens were submitted to 2 million mechanical cycles. After fatigue testing, a score was given based on the number of fatigue cycles until fracture, and data were submitted to statistical analysis. All specimens were resistant to fatigue. Taking into account the methodology and results of this study, the evaluated fiber posts can be cemented based on the ratio of crown/root at 1/1. Further clinical studies must be conducted to verify this ratio. **PDF**

*Wiskott, HWA, et al**. Rotational fatigue-resistance of seven post types anchored on natural teeth. :** *Dent Mater. 2007 Nov;23(11):1412-9. Epub 2007 Jan 30.*

Purpose: To develop a laboratory model aimed at duplicating the failure process of post and core restorations. The load pattern applied was to be repetitive (fatigue) and multivectorial. To determine and compare the resistance under fatigue loading of seven endodontic post/natural root combinations: stainless steel-, titanium-, ceramic-, composite-fiber/epoxy-, two glass-fiber/epoxy- and glass-fiber/acrylic posts. **Methods:** The repetitive, alternating and multivectorial intraoral force pattern was reproduced by subjecting the specimens to the rotating cantilever beam test. To this end, the samples were designed as rotation-symmetric structures comprising a root, a post, periodontal ligament- and bone analogs and a restoration analog. The following posts were tested: Unimetric-Ti, Unimetric-SS, Biopost, Composipost, Easypost, DT Light-Post, Everstick post. The samples were spun around their long axes while being clamped into a revolving collet on one end and loaded normal to their long axis on the other end. The aim was to determine the load level at which 50% of the specimens survived- and 50% fractured before 10E6 cycles. The 50% means were determined using the staircase procedure. **Results:** In increasing order of magnitude, the resistances to fatigue loading were as follows: Biopost, Unimetric-Ti, Unimetric-SS, Composipost, Easypost, Everstickpost, D.T. Light-Post. **Significance:** The fatigue resistance of the two fibrous posts with the highest fatigue resistance (Everstickpost, D. T. Light-Post) was twice that of any of the ceramic or metal posts. **PDF**

*Zamboni, SC, Baldissara, P, Pelogia, F, Bottino, MA, Scotti, R, Valandro, LF**. Fatigue resistance of bovine teeth restored with resin-bonded fiber posts: effect of post surface conditioning.** *Gen Dent. 2008 Jan-Feb;56(1):56-9*

This study evaluated the effect of post surface conditioning on the fatigue resistance of bovine teeth restored with resin-bonded fiber-reinforced composite (FRC). Root canals of 20 single-rooted bovine teeth (16 mm long) were prepared to 12 mm using a preparation drill of a double-tapered fiber post system (D.T. Light-Post; RTD, St Egreve France). Using acrylic resin, each specimen was embedded (up to 3.0 mm from the cervical part of the specimen) in a PVC cylinder and allocated into one of two groups (n = 10) based on the post surface conditioning method: acid etching plus silanization or tribochemical silica coating (30 pm SiO(x) + silanization). The root canal dentin was etched (H2PO3 for 30 seconds), rinsed, and dried. A multi-step adhesive system was applied to the root dentin and the fiber posts were cemented with resin cement. The specimens were submitted to one million fatigue cycles. After fatigue testing, a score was given based on the number of fatigue cycles until fracture. All of the specimens were resistant to fatigue. No fracture of the root or the post and no loss of

retention of the post were observed. The methodology and the results of this study indicate that tribochemical silica coating and acid etching performed equally well when dynamic mechanical loading was used.

IV. Adesão / Testes de Retenção

A. PINO A RAÍZ

Akgungor G, Akkayan B. **Influence of dentin bonding agents and polymerization modes on the bond strength between translucent fiber posts and three dentin regions within a post space.** *J Prosthet Dent. 2006 May;95(5):368-78*

Statement of problem: Debonding is the most frequent failure encountered with translucent fiber posts and usually occurs along the post space dentin-adhesive interface. **Purpose:** The purpose of this study was to evaluate the effect of different dentin bonding agents and polymerization modes on the bond strength between translucent fiber posts and root dentin in different regions of the post space. **Methods:** Forty maxillary canines with similar root lengths were selected, sectioned at the cemento-enamel junction, and the roots were endodontically treated. Following post space preparation, the roots were divided into 4 groups of 10 specimens each, and the post spaces were treated with 1 of 4 different dentin bonding agents: light-polymerized, single-bottle bonding agent Excite (Group EX); dual-polymerized, single-bottle bonding agent Excite DSC (Group EX-DSC); self-etching primer Clearfil Liner Bond 2V with a light-polymerized bonding agent, Bond A (Group CL-LC); or self-etching primer Clearfil Liner Bond 2V with a dual-polymerized bonding agent, Bond A+B (Group CL-DC). Translucent fiber posts (D.T. Light-Post, RTD, St Egreve, France), 2.2 mm in diameter, were luted (Panavia F) in each specimen after respective dentin bonding procedures. The roots were cut into 3-mm-thick sections, perpendicular to the long-axis in cervical, middle, and apical post space dentin. Push-out tests were performed with a universal testing machine at a crosshead speed of 0.5 mm/min, and bond strength values (MPa) were calculated by dividing the force at which bond failure occurred by the bonded area of the post. The data were analyzed with 1- and 2-way analysis of variance and Tukey multiple comparison tests (alpha=.05). Dentin adhesive bonding mechanisms in different regions of the post spaces were evaluated with a scanning electron microscope. **Results:** The highest mean bond strength values were obtained for Group CL-LC (18.3 +/- 4.1 MPa). The dual-polymerized bonding agent resulted in significantly lower bond strength (P<.001) in combination with self-etching primer (Group CL-DC) (13.2 +/- 2.5 MPa). The light-polymerized and dual-polymerized single-bottle bonding agents provided similar bond strengths (12.7 +/- 5.0 for EX; 13.5 +/- 5.3 for EX-DSC). The regional bond strength values of single-bottle bonding agents were reduced significantly in apical post space dentin (P<.001). Self-etching primers did not demonstrate regional differences in post space dentin bonding and dense resin tags were apparent. **Conclusions:** Data suggests that the self-etching primer system used in this study was unaffected by the morphological variations in the post space dentin compared to the single-bottle bonding agents. Dual polymerization did not improve the bond strength values of the bonding agents tested. **PDF**

* Aksornmuang, J, Nakajima, M, Foxton, RM, Panyayong, W, Tagami, J. **Regional bond strengths and failure analysis of fiber posts bonded to root canal dentin.** *Oper Dent. 2008 Nov-Dec;33(6):636-43.*

This study evaluated the regional bond strengths of fiber posts to root canal dentin luted with dual-cure resin composite. Twelve extracted human premolars were decoronated and post spaces prepared to a depth of 8 mm. The root canal dentin was treated with Clearfil SE Bond and light-cured for 20 seconds. Three posts from each of the following four types of fiber posts-Snowlight, FibreKor, DT Light-Post and GC Fiber Post-were surface-treated with a mixture of Porcelain Bond Activator and Photobond, then luted into the post spaces with Clearfil DC Core Automix and light-cured for 60 seconds. After 24-hour water storage, each specimen was serially sliced into eight 0.6 x 0.6 mm-thick beams for the microtensile bond strength (microTBS) test. Failure modes were observed using SEM. The microTBS data were divided into coronal and apical regions and statistically analyzed. The highest bond strengths were obtained from FibreKor posts. Regional factors had no effect on bond strength. FibreKor and DT Light-Post specimens primarily failed at the post-resin composite interface, whereas Snowlight and GC Post cohesively failed within the post.

Ariki, E.K, , Gonçalves, M, Souza, ROA, Z , S.C.,Gia˙ PEL, Takahashi, F.E., Bottino, M.A, **Resin bond to root dentin: Accessory posts and dentin hybridization effect**. *J Dent Res. Vol 87 (Spec. Iss. A) Abstract 1748 (www.dentalresearch.org)*

Objective: To evaluate the influence of accessory fiber posts (AFP) and intraradicular dentin hybridization (IDH) on the push-out bond strength of fiber post luted with resin cement to bovine root dentin. The null hypotheses were that the AFP using and IDH do not affect the push-out bond strength. **Methods:** The canals of forty single-root bovine roots (16mm in length) were prepared at 12mm using the preparation drill (N0 3, RTD, France). With an assistance of a modifier parallelometer, each root had your apical region (4 mm length) embedded in acrylic resin and the roots were randomically divided into four groups, according the luting procedures (N=10): Gr1- IDH + fiber post n0 3; Gr2- IDH + fiber post n0 1; Gr3- IDH + fiber post n0 1 + AFP; Gr4- Fiber post n0 3 without IDH. Except for the group Gr4, the specimens (sps) were treated with the adhesive system (All Bond 2) and the fiber posts (Macro- Lock Illusion) were luted (Duolink) and after stored in distilled water prior the mechanical test (24 h, 37°C). Each specimen was cut in 4 disc samples (1.8 mm in thickness), which were submitted to the push-out test on a universal test machine (EMIC, model DL-1000) at a speed of 1mm/min. The data (MPa) were analyzed statistically by one-way analysis of variance (ANOVA). **Results:** The means (± standard deviation) values obtained after push out test were: Gr1- 5.4±1.3 MPa; Gr2- 4.2±2.4 MPa; Gr3- 4.6±1.5 MPa; Gr4- 3.3±1.7 MPa. The statistical analysis didn't observe influence among the groups (p=0.0966> 0.05). The null hypotheses were accepted. **Conclusion:** The AFP and the IDH do not improve nor diminish the bond strength of fiber post luted to bovine root dentin.

Baldissara, P. Monaco , C., Valandro, L.F., . Scotti, R. Retention of quartz fiber posts using different luting cements ***.J Dent Res. Vol 88 (Spec. Iss. A) Abstract # 976, 2009. (www.dentalresearch.org)***

Objectives: To determine the effect on the pull-out strength of threads cut into the surface of quartz fiber post cemented with three luting materials. Methods: 42 human single-rooted, crownless teeth were treated endodontically and randomly assigned to six fiber posts groups: 1) to 3) were restored with Macro-Lock #3 posts (RTD); 4) to 6) with control posts made of the same material but lacking threads (RTD). The posts were cemented 12mm deep using Panavia(Kuraray), RelyX Unicem (3M ESPE), and Fuji Plus (GC) following the manufacturer instructions. The specimens were subjected to 5000 thermal cycles at 5 and 55°C and wet stored. Retentions were made on the emerging portion of the controls using a diamod bur, then a composite core was made using a mold. A pull-out stress was applied by clamping the core with an Instron machine (2mm/min speed). The pull-out strength was recorded for each group and compared (alpha=0.05). After the test, the specimens were observed under the stereomicroscope to determine failure patterns. Results: The Macro-Lock demonstrated higher retention with all the luting materials employed, statistically significant when RelyX and Fuji were used (P<.05), suggesting that the threads on their surface are effective to improve the pull-out strength. The highest retention of Macro-Locks was obtained using the Fuji GIC and the self-adherent cement (RelyX). The resin cement coupled with an adhesive system (Panavia) showed lower retention forces, probably caused by the "C" factor dynamics. Conclusion: The grooves on Macro-Lock surface are effective to improve the retention; these posts could be used safely with low cost, easy to use materials such as resin modified GIC. Control posts were less retentive, particularly when RelyX Unicem was used. This could be explained by the smooth surface and lack of any thread.

*Baldissara, P., Zicari, F., Melilli, D., Monaco, C. **Effect of endodontic treatment on fatigue resistance of fiber post bonding**. *J Dent Res. Vol 82 (Special Issue A) Abstract # 2565, 2003 (www.dentalresearch.org)*

Objectives: The aim of this study is to evaluate the effect of the endodontic treatment on the fatigue resistance of endodontic post adhesive interfaces. **Methods:** FIFTY single-rooted human teeth have been severed at the CEJ and randomly assigned to 5 groups receiving different endodontic treatments as follows: 1) distilled water + gutta percha (control); 2) NaOCl 5% + gutta percha + Pulp Canal Sealer EWT (Kerr); 3) NaOCl 5% + gutta percha + TopSeal (Dentsply-Maillefer); 4) NaOCl 5% and EDTA 10% (alternatively) + gutta percha + Pulp Canal Sealer EWT; 5) NaOCl 5% and EDTA 10% (alternatively) + gutta percha + TopSeal. Subsequently, #2 D.T. Light-Post (RTD; St Egreve , France /Bisco) quartz fiber posts have been placed in the root canal using All-Bond 2 adhesive (Bisco) and Bis-Fil 2B composite (Bisco). Five specimens from each group have been subjected to 2,000,000 fatigue cycles ranging from 0 to 37.5N at 8Hz frequency and 37^0C water irrigation, whereas the remaining specimens were stored in distilled water at room temp. After the fatigue cycles, all of the specimens were severed obtaining 4 sections from each tooth, which were then evaluated with the push-out test at a constant speed of 1mm/min. Stereomicroscope and SEM observations were done to evaluate the interface failures. **Results:** no statistically significant differences were observed between the 5 groups in both fatigue stressed (p=0.298) and water stored specimens (p=0.093). Also, the microscope analysis of interface failures showed that the post-cement interface is weaker than the cement-dentin one. The difference was significant with P=0.001. **Conclusions:** the results suggest that the interface resistance is not influenced by the canal treatments adopted in this study. Probably the hard tissue removal necessary for post placement eliminated contaminated or altered dentin that may affect the bonding with the luting cement. High resistance of the cement-dentin interface strongly supports this last hypothesis.

Barros, B.A.C., Vieira, L.L.C., Baratieri, L.N. **Push-out bond strength of fiber posts cemented with different cements.** *J Dent Res. Vol 88 (Spec. Iss. A) Abstract # 962, 2009. (www.dentalresearch.org)*

Objectives: The aim of this in vitro study was to evaluate the shear bond strength (push-out) when luting fiber posts (FRC Postec Plus) to intraradicular dentin using three different types of cement. **Methods:** Thirty four maxillary anterior teeth were selected. After removing the coronal portion, all teeth were endodontically treated and dowel spaces were prepared using post drills provided by the manufacturer. The specimens were randomly divided into five groups, according to the cement: Group 1, Variolink II +Excite DSC; Group 2, Relyx ARC + Scotchbond Multi-Purpose Plus; Group 3, Relyx Unicem; Group 4, Multilink; and Group 5, Zinc phosphate cement (SSWhite). After storage for one week, the teeth were serially-sectioned in 6 slices (1mm thick), two from each third (cervical, middle, and apical). Push-out shear testing was performed in a Universal Testing Machine (Instron 4444, cross-head speed of 0.5mm/min). The data were submitted to Kruskal Wallis test. **Results:** The results revealed that there was no difference between Groups for cervical and middle thirds, regardless of the cement. In the apical third groups 2 and 4 exhibited statistically significantly lower mean bond strengths. **Conclusion:** It is concluded that resin cements can not increase the bond strength of fiber posts, when compared to zinc phosphate cement.

*Beriat, N.C., Gülay, G., Yilmaz ,Z., Ertan, A.A. **Bond Strength of fiber posts luted with self etch adhesive.** *J Dent Res. Vol 88 (Spec. Iss. A) Abstract # 970, 2009. (www.dentalresearch.org)*

Objectives: To evaluate the push-out bond strengths of fiber posts luted with self etch self adhesive luting agent. **Methods:** Twenty six extracted single-rooted teeth were randomly divided in two groups and restored using D.T. Light Post and the following luting agents: Variolink II/ExciteDSC/37% phosphoric acid (Ivoclar-Vivadent) and Maxcem (Kerr). For push-out bond strength measurements, thirteen roots per group were tested. Each posted root was cut horizontally into 1mm-thick slices at coronal and apical portions. On every slice the post was loaded by means of an adequately sized punch that pushed the post segment in an apical-coronal direction until the post-root bond failed. This was manifested by the extrusion of the post segment from the root slice, and the load recorded at this time was divided by the area of the post-root interface, in order to express the bond strength in MPa. **Results:** The mean bond strength achieved by Variolink at apical portion (14.77 ± 4.31 MPa), Variolink coronal portion (14.60 ± 4.09 MPa) and Maxcem apical (13.98 ± 4.58 MPa), Maxcem coronal (13.58 ± 4.93 MPa). **Conclusion:** The push-out bond strength was not statistically significantly different between the coronal and apical sections for each luting agent (p>0,005). The highest push-out bond strength was measured for Variolink however it was not statistically significant from Maxcem (p<0,005).

Boff , LL, Grossi, ML, Prates, LH, Burnett ,LH, Shinkai ,RS. **Effect of the activation mode of post adhesive cementation on push-out bond strength to root canal dentin**. *Quintessence Int. 2007 May;38(5):387-94*

Objective: To evaluate the effect of the activation mode of adhesive cementation on push-out bond strength of fiber-reinforced resin posts to root canal dentin. **Methods:** Forty mandibular premolars were endodontically treated and randomly divided into 4 equal groups. In groups G-1, G-2, and G-3, Single Bond (3M Espe) was applied and light polymerized for 20 seconds; in group G-4, Scotchbond Multi-Purpose Plus (3M Espe) was used as an autopolymerized adhesive. The dual-cure resin cement Rely X ARC (3M Espe) was light polymerized in G-2 and G-3 but not in G-1 and G-4. The translucent post Light-Post (RTD, St Egreve, France /Bisco) was used in G-3 and the opaque post Aestheti-Plus (RTD, St Egreve, France /Bisco) in the other groups. The roots were sectioned in 3 parts (cervical, middle, apical); each slice was submitted to the push-out test at a crosshead speed of 0.5 mm/min. Data were analyzed by analysis of variance and Tukey test (a = .05). **Results:** Light polymerization of both the adhesive and resin cement in G-2 led to significantly higher bond strength than in G-1, where only the adhesive was light polymerized. No difference was found between G-2 (opaque post) and G-3 (translucent post). The autopolymerized adhesive showed the highest bond strength in all root regions. The middle and apical post/root regions had similar bond strength, but it was significantly lower than that in the cervical region (P <.001). **Conclusion:** Bond strength to root dentin varied as a function of the activation mode of post adhesive cementation and post/root regions

Bolhuis P, de Gee A, Feilzer A**. Influence of fatigue loading on four post-and-core systems in maxillary premolars.** Q*uintessence Int. 2004 Sep;35(8):657-67.*

Objective: Clinical studies show a high failure incidence after years of service of endodontically treated premolars, when restored with post-core crowns, especially those with short posts or deficient ferrules. The reason for this can be a deterioration of the luting cement around the post by fatigue from functional loading. In particular, the anatomy of premolars may frequently be incompatible with the application of long endodontic posts. The aim of this study was to evaluate the influence of fatigue loading on the quality of the cement layer between posts with restricted lengths and the root canal wall in premolars. As the stiffness of posts may affect the outcome, post-and-core systems with varying post stiffness were selected. **Methods:** Four types of post-and-core systems were selected for this study: three prefabricated post systems combined with a resin composite core material and one cast post and core. The three prefabricated posts were titanium posts (Tenax), quartz-fiber posts (Aestheti-Post, RTD, St Egreve, France), and quartz-coated-carbon-fiber posts (Aestheti-Plus, RTD, St Egreve, France). The post-and-core restorations were made on single-rooted, human, maxillary premolars from which the coronal sections were removed at the level of the proximal cementoenamel junction. Following endodontic treatment, a cast

post and core (post length 6 mm) was prepared for each tooth individually (direct method) and cemented into the root canal with chemical cure Panavia 21 TC. The prefabricated posts were directly cemented in the root canal and then, after applying a dual-cure adhesive (Clearfil Photobond), built up with a core build-up composite (Clearfil Photocore). For each group (n = 8), half of the specimens were exposed to fatigue loading (10(6) load cycles) almost perpendicular to the axial axis (85 degrees), while the other half was used as the control. Three parallel, transverse root sections of 1.5-mm thickness, were cut from each specimen. These sections were examined by scanning electron microscopy (SEM) to evaluate the cement integrity, while the retention strength of the cemented post sections was determined with a push-out test. **Results:** Fatigue loading did not cause separation of the buildups from the roots or affect the push-out strength. On a univariate level, only SEM evaluation showed significant differences between the types of post, fatigue loading, and between the levels of root sections. The cement integrity with the titanium post was significantly less than with the other three systems, which did not differ among themselves. **Conclusions:** A composite core build-up material bonded to the dentin and supported by quartz-fiber posts or quartz-coated-carbon-fiber posts, cemented with adhesive cement may be a viable alternative for the conventional cast core.

*Borer, R., Leandro, R and Haddix, J. **Effect of dowel length on the retention of two different prefabricated posts.** *Quintessence Int. 2007;38:173.e164-168*

Objectives: to compare the in vitro retentive values of stainless steel, parallel sided posts to quartz fiber tapered posts for two different dowel lengths (5mm and 10mm). **Methods:** Both post systems were cemented with a dual-cure adhesive resin cement. Single rooted extracted human teeth (n-40) were de-coronated and randomly divided into 4 groups of 10 samples each. Posts of 5 and 10mm in length were luted with the resin cement. Each sample was placed on a universal testing machine, and using a push-out method, a vertical load was applied at a crosshead speed of 2mm/min. The amount of force required to dislodge the post was recorded. The effect of post type and length was evaluated using a 2-way analysis of variance. **Results:** A statistically significant main effect was found for post length (P<.001) with the 10mm posts of both post systems requiring greater force to dislodge than the 5mm posts. There was no interaction between post length and post type (P>.05). **Conclusions**: It is concluded from this study that there is no statistical difference in retention between quartz fiber tapered posts (D. T. Light-Post; RTD, St Egreve, France) and stainless steel parallel-sided posts (ParaPost, Coltene Whaledent, Cuyahoga Falls, OH USA) when they are cemented with the same resin cement (P> .05). The study also concludes that adequate retentive values are achieved with both systems at the shorter, 5mm post length. **PDF**

*Bottino, MA, Baldissara, P, Valandro, LF, Galhano, GA, Scotti, R. **Effects of mechanical cycling on the bonding of zirconia and fiber posts to human root dentin.** *J Adhes Dent. 2007 Jun;9(3):327-31.*

Purpose: To evaluate the effect of cyclical mechanical loading on the bond strength of a fiber and a zirconia post bonded to root dentin. **Methods:** Forty single-rooted human teeth (maxillary incisors and canines) were sectioned, and the root canals were prepared at 12 mm. Twenty randomly selected specimens received a quartz fiber post (FRC) (D.T. Light-Post; RTD, St Egreve, France) and 20 others received a zirconia post (ZR) (Cosmopost). The posts were resin luted (All Bond 2 + resin cement Duo-link) and each specimen was embedded in epoxy resin inside a PVC cylinder. Ten specimens with FRC post and 10 specimens with ZR post were submitted to fatigue testing (2,000,000 cycles; load: 50 N; angle of 45 degrees; frequency: 8 Hz), while the other 20 specimens were not fatigued. Thus, 4 groups were formed: G1: FRC+O cycles; G2: FRC+2,000,000 cycles; G3: ZR+O cycles; G4: ZR+2,000,000 cycles. Later, the specimens were cut perpendicular to their long axis to form 2-mm-thick disk-shaped samples (4 sections/specimen), which were submitted to the push-out test (1 mm/min). The mean bond strength values (MPa) were calculated for each tooth (n = 10) and data were submitted to statistical analysis (alpha = 0.05). **Results:** Two-way ANOVA revealed that the bond strength was significantly affected by mechanical cycling (p = 0.0014) and root post (p = 0.0325). The interaction was also statistically significant (p = 0.0010). Tukey's test showed that the mechanical cycling did not affect the bonding of FRC to root dentin, while fatigue impaired the bonding of zirconium to root dentin. **Conclusion:** (1) The bond strength of the FRC post to root dentin was not reduced after fatigue testing, whereas the bonding of the zirconia post was significantly affected by the fatigue. (2) Cyclical mechanical loading appears to damage the bond strength of the rigid post only.

Cury, AH, Pegoraro, TA,. Pereira, JC, Suh, BI, Carvalho, RM. **Effects of polymerization-mode on the push-out retention of self-adhesive resin-cements** *J Dent Res. Vol 87 (Special Issue A) Abstract # 0379, 2008 (www.dentalresearch.org)*

Objectives: To evaluate push-out retention strength of fiber posts cemented with two self-adhesive resin cements (RelyX Unicem, 3M ESPE and Biscem, BISCO Inc.) under different curing modes (dual-cured or self-cured), on each regional root-third. **Methods**: Twenty extracted human teeth were endodontically treated. Post space was prepared and cleaned (5% sodium hypochlorite), and roots were assigned to four groups (N=05): *Group 1*: Unicem light-cured; *Group 2*: Unicem self-cured; *Group 3*: Biscem light-cured; *Group 4*: Biscem self-cured. A Light-cure unit (VIP, BISCO, Inc.) was employed to irradiate the coronal aspect of each tooth for 20 sec@600mW/cm^2. For the self-cured mode, teeth were allowed to dark cure

at 37 °C for 6 minutes. Each root was cut horizontally into 1mm-thick slices. A universal testing machine Vitrodyne V-1000 (Chatillon Force Measurement Systems) was utilized with a custom-made cylindrical plunger (0.79 mm diameter), which was positioned on the apical face of the root slice. The loading was applied (0.5mm/min) until complete post displace and extrusion from root slice. The results were calculated and expressed as the bond strength in MPa.

Results: MPa±SD (N). Data were analyzed by ANOVA and Tukey Test ($p<0.05$). Capital letters/Columns; Lowercase/rows.

Material	Polymerization Mode	Thirds†			Total†
		Apical	Middle	Coronal	
Biscem	Light-cured	10,9±3,6(15)[a]	8,9±2,8(15)[a]	10,8±2,6(13)[a]	10,1±3,1(43)[B]
	Self-cured	7,9±3,4(19)[a]	5,7±2,7(16)[ab]	4,4±3,7(14)[b]	6,3±3,6(49)[A]
RelyX Unicem	Light-cured	6,4±2,3(13)[a]	7,0±2,4 (12) [a]	9,1±4,9(12)[a]	7,5±3,5(37)[A]
	Self-cured	10,7±3,4(18)[a]	7,0±1,8(16)[b]	6,7±3,0(15)[b]	8,3±3,4(49)[A]

Results: ANOVA revealed that "polymerization mode" and interaction of "cement" and "polymerization mode" had significant influences on the push-out strength ($p<0.05$). **Conclusion**: For some dual-cured resin-cements light-activation is further important to achieve optimal properties. When the self-cure mode was used highest values were recorded on the apical third.

Dallari, A, Rovatti, L, Dallari, B, Mason, PN, Suh, BI. **Translucent quartz-fiber post luted in vivo with self-curing composite cement: case report and microscopic examination at a two-year clinical follow-up.** *J Adhes Dent. 2006 Jun;8(3):189-95*

A maxillary central incisor with mild periodontitis and extensive loss of coronal tooth structure was endodontically treated and restored with a translucent quartz-fiber post and a composite core. Treatment was completed with the cementation of full-ceramic crowns on teeth 11 and 21. Informed consent was obtained from the patient. Due to the extent of the periodontal disease, tooth 11 was extracted two years later. With the patient's consent, the tooth was used for research. The tooth was sectioned at 11 levels perpendicularly to the long axis and investigated by means of optical microscopy and scanning electron microscope (SEM). The visual examination showed perfect adhesion between the various interfaces (restoration-dentin-post) at both the coronal and root levels. The adhesion between the post and dentin appeared to be free of gaps, and even where the composite cement showed a nonhomogeneous thickness, voids were not apparent. The tooth under examination allowed the authors to check the effectiveness of the adhesion and the integrity of the hybrid layer after exposure to the oral cavity for two years. The results of this investigation show that there were no gaps between the adhesive resin and dentin and no hydrolysis of the adhesive bond. This case suggests that it is possible to obtain good results in the short term from the cementation of quartz-fiber posts with composite resin cements. **PDF**

Dallari, A., Mason, P., Rovatti, L., Dallari, B. Effect of surface treatments on retention of quartz- fiber posts.** ***J Dent Res. Vol 87 (Spec. Iss. C) Abstract #0383, PEF Division 2008 (www.dentalresearch.org)

The use of quartz fiber-reinforced posts, adhesively luted into root canal, has increased in popularity for the post-endodontic restorations. Objectives: The aim of this in vitro study is to verify the influence of different surface pre-treatments on micro-tensile bond strength between quartz posts and composite luting cement. Methods: 50 quartz fibers posts (40 DT Light-Post, RTD, France + 10 Macro-Lock Post, RTD, France) have been subdivided into 5 groups: 1) 10 DT Light-Post with no surface treatment (as control). 2) 10 DT Light-Post pre-treated with hydrofluoric acid 9.6 % for 15 sec. 3) 10 DT Light-Post coated with industrial procedure by the factory. 4) 10 DT Light-Post pre-treated with methyl-methacrylate for 1 minute. 5) 10 Macro-Lock Post, with carved surface and not subjected to chemical pre-treatments. Posts have been luted using the same composite cement (BisCem, Bisco, USA) in plastic cylinders (Endo Trainers, Frasaco, USA), and slices 2.0 mm thick have been obtained with a diamond wheel (Leitz 1600). Slices have been subjected to pull-out test with Instron Machine. Results: Group 1: 13.28 MPa; Group 2: 24.60 MPa; Group 3: 26.90 MPa; Group 4: 34.20 MPa; Group 5: 32.05 MPa. Conclusions: All the post-surface pre-treatments lead to a real (double or more) improvement of tensile bond strength values. Macro-retention provided by carving of the surface (Macro-Lock Post) and micro-retention obtained with methyl-methacrylate pre-treatment reached the highest results.

*Gernhardt, CR, K. Bekes, K., Schaller, HG . **Effect of Different Fibre Post Diameters on Retentive Strength**. *J Dent Res (Special Issue A) #1586, 2006 (www.dentalresearch.org)*

Objectives: The retention of endodontic posts is believed to be a major factor in restoration survival. The purpose of this study was to evaluate the effect of post diameter on the bond strength of the fiber post D.T. Light Post using two different cements. **Methods**: Sixty caries free human incisors were selected for standardized size and quality, endodontically treated and coronally reduced to the cemento-enamel junction. The specimens were randomly assigned to three experimental groups: (I): canal preparation with DT drill #1, insertion of DT Light Post #1, (II): canal preparation with DT drill #2, insertion of DT Light Post #2; (III) canal DT drill #3, insertion of DT Light Post #3. The fibre posts were cemented using either Calibra (subgroup C) or Panavia F (subgroup P). Retentive strength was measured 24 hours after cementation using a universal testing machine. Data were analyzed with SPSS 10.0. **Results:**

The following mean retentive strengths were evaluated:

		IC	**IIC**	**IIIC**	**IP**	**IIP**	**IIIP**
Mean value and standard deviation	in N	111.39 (+/- 26.63)	127.63 (+/- 29.67)	138.82 (+/-36.55)	127.58 (+/- 28.56)	163.37 (+/- 35.85)	200.98 (+/- 28.66)
	in MPa (N/mm²)	10.91 (+/- 2.61)	11.16 (+/- 2.59)	10.14 (+/- 2.67)	12.51 (+/- 2.80)	14.26 (+/- 3.13)	14.68 (+/- 2.09)

Statistic analysis showed that the post diameter did not affect the bond strengths the fibre posts of the D.T. Light Post system ($p < 0.05$, Tukey test). Posts cemented with Panavia showed higher bond strengths. In the case of size 3 posts this difference was significant ($p < 0.05$, Tukeyxs test). **Conclusions:** The reconstruction of endodontically treated single rooted teeth with fibre posts showed acceptable retentive values for both cements used in this in vitro study. The post diameter did not affect the bond strengths of the D.T. Light Post system (RTD, St Egreve, France).

Galhano, G., Melo, R. M., Valandro, L. F., Bottino, M. A., Baldissara, P., Scotti, ' R, **Mechanical cycling of ceramic and FRC posts bonded to root-dentin.** *J Dent Res. Vol 85 (Spec. Iss. B) Abstract #0660, 2006 (www.dentalresearch.org).*

Objectives: This study aimed to evaluate the effect of mechanical cycling on the adhesive bond strengths at the root dentin/resin cement and resin cement/ceramic post interfaces. **Methods:** Forty single rooted human teeth were transversally sectioned, with 16mm left for specimens. The canal preparation of 20 teeth was performed to receive a 12mm high ceramic post (Cosmo Post, Ivoclar) and another 20 teeth were prepared to receive a fiber reinforced post (FRC Postec, Ivoclar). The canals were treated with All-Bond 2 (Bisco) chemical polymerizable adhesive system and Duo-Link dual resin cement (Bisco). After that, ten specimens of each post were subjected to 2,000,000 mechanical cycles. A 1,6 mm thick punch induced loads of 37,5Kg, at 45° angulation to the long axis of specimens and frequency of 8Hz, on the posts. To evaluate the bond strengths, the specimens were sectioned perpendicular to the long axis of teeth, generating slices of about 2mm (5 sections per teeth), which were subjected to the push-out test in a universal testing machine, EMIC, at 1mm/min crosshead speed. The mean bond strength was taken to each tooth and ten values per group (n=10) were subjected to statistical analysis. **Results:** The Tukey test (5%) showed that the mean of the ceramic group subjected to the mechanical cycling (3,2577 ± 2,3345) was different to both ceramic control group (7,6819 ± 1,2628), Fiber reinforced group subjected to the mechanical cycling (6.901±1.930) and Fiber reinforced control group (6.823±2.214) . These three last groups did not differ statistically. **Conclusion:** It was possible to conclude that the mechanical cycling of ceramic posts reduced the bond strengths at the root dentin/resin cement and resin cement/ceramic post interfaces.

Gernhardt, C., Fiedler, T, Widera, M., Schaller, H-G. **Influence of different cementation modalities on retention of fibre posts.** *J Dent Res. Vol 81 (Spec. Iss. A) Abstract #0421, 2002 (www.dentalresearch.org).*

Objectives: The retention of endodontic posts is believed to be a major factor in restoration survival. The aim of this study was to compare the retentive strength of fibre posts cemented with two different cements in combination with different pre-treatments. **Methods:** Forty caries free human maxillary incisors were selected for standardized size and quality, endodontically treated and coronally reduced to the cemento-enamel junction. During the experimental period the teeth were stored in saline. All specimens were randomly assigned to four experimental groups of ten samples each. In group A the fibre posts were sand-blasted and cemented with Panavia F. In group B the posts were cemented without sand-blasting. Group C received sand-blasted fibre-posts cemented with Ketac-Cem. In group D the posts were cemented without sand-blasting. Post holes were prepared according to manufacturers' instructions. The fibre posts (Mirafit Carbon) were then cemented with one of the two cements as recommended. Retentive strength was measured 24 hours after cementation using a universal testing machine. **Results:** The following mean retentive strengths in Newtons for the different groups were: group A: 448.4 N (+/- 105.9 N); group B: 395.7 N (+/- 99.9 N); group C: 210.9 N (+/- 66.5 N); group D: 176.8 N (+/- 67.2 N). Retentive strength in group A and B (Panavia F) was significantly increased compared to group C and D (Ketac-Cem) ($p < 0.05$, Tukey xs test). The influence of sandblasting was for both cements not significant. **Conclusions:** The reconstruction of endodontically treated

single rooted teeth with fibre posts showed acceptable retentive values for all cementation modalities used in this study. The values observed for the composite cement Panavia F were significantly higher compared to the conventional cement Ketac-Cem.

Goracci C, Grandini S, Bossù M, Bertelli E, Ferrari M. **Laboratory assessment of the retentive potential of adhesive posts: a review.** *J Dent. 2007 Nov;35(11):827-35*

Objectives: This review aimed at summarizing the laboratory evidence collected on the retentive ability of adhesive posts since their introduction in dentistry. **Data:** Data were searched in articles published or in press in peer-review journals listed in MEDLINE. **Sources:** Papers were retrieved through PubMed. **Study selection:** To collect the evidence of interest, the following search terms were used: bond* AND fiber post AND in vitro; lut* AND fiber post AND in vitro; push-out AND fiber post; pull-out AND fiber post; microtensile AND fiber post. "Related Links" were also considered and articles cited in the initially retrieved papers were included if relevant. No time limit was given to the query. **Conclusions:** Seventy relevant papers were reviewed. The retentive ability of adhesive posts has been tested with the microtensile technique, post-pull-out and push-out tests. If small-sized specimens are obtained, such as in microtensile and thin-slice push-out, stress uniformity is favoured, local differences in bonding conditions can be discerned, and the number of teeth needed for the test can be reduced. Although adhesion to intraradicular dentin is more challenging to achieve than bonding to crown tissues, the post-retention achieved with current luting systems and techniques is adequate to ensure the clinical success of adhesive post-retained restorations. To enhance the bond at the post-core and post-cement interfaces, several chemical pre-treatments of the post-surface have been tested with positive results. Self-adhesive resin cements, recently proposed to simplify the post-luting procedure, should be investigated further with regard to durability.

Goto, Y., Nicholls, J. I., Phillips, K., Junge, T., **Fatigue resistance of endodontically treated teeth restored with three dowel-and-core systems.** *J Prosthet Dent 2005;93:45-50*

Purpose: The purpose of this study was to compare the load fatigue of 3 dowel and core systems. **Methods:** Fifteen endodontically treated maxillary central incisors were sectioned perpendicular to the long axis at a point 1.5mm incisal to the CEJ. At the level of the CEJ, specimens were then prepared for crowns with 1mm complete shoulder finish lines and 1.5mm of axial wall height. The prepared teeth were divided into three groups (n=5) and restored with one of of the following dowel and core combinations: Group CG, cast gold dowels and cores, Group TA, Titanium Alloy dowels (ParaPost XH) with composite cores, or Group FR, fiber-reinforced resin dowels (ParaPost FiberWhite) with composite cores. A dentin bonding agent (Optibond Solo) was placed prior to the composite cores. Dowel and core castings and Titanium alloy dowels were cemented with zinc phosphate cement. The fiber-reinforced dowels were cemented with a resin cement (ParaPost Cement). The crowns for all specimens were cast with an incisal notch for applying the fatigue load. The independent variable was the number of load fatigue cycles required to cause luting cement failure. The data were subjected to 1-way analysis of variance and the Student-Newman-Keuls test for 3 subsets (a=.05). **Results:** The mean value +/- standard deviation for the cycles to failure for each group was Group CG: 11,897 +/- 4080 load cycles, Group TA: 24,384 +/- 8231 load cycles, and Group FR: 50,696 +/- 7063 load cycles. Significant differences were found between all groups ($P<.05$). **Conclusions:** Fiber-reinforced dowels and bonded composite cores under fatigue loading provided significantly stronger crown retention than cast gold dowels and Titanium Alloy dowels with composite cores. **PDF**

Hader, S., Wiedig, C.A., Lachermeier, B., Peez, R. **Adhesion of various adhesive resin cements to fiber post.** *J Dent Res. Vol 88 (Spec. Iss. A) Abstract # 1856, 2009. (www.dentalresearch.org)*

Objectives: The purpose of this in vitro investigation was to evaluate the bond strength of self adhesive and adhesive resin cements to RelyX™ Fiber Post, a new glass fiber reinforced composite post (RLXFP, 3M ESPE). **Methods:** RelyX™ Unicem Aplicap™ self adhesive universal resin cement, (RXU, 3M ESPE), BisCem® (BIS, Bisco), G-CEM Capsule (GCM, GC), Maxcem™ (MC, Kerr) as well as Variolink® II (VAR) and Multilink® Automix (MUL, both from ivoclar vivadent) were used in combination with RLXFP (size 3). Except for MUL and VAR the fiberpost was not pre-treated. In case of MUL and VAR Monobond-S (MON, ivoclar vivadent) was used to silanize the post surface. Cements were light-cured (LC) or dark-cured (DC). Adhesion was tested on the conical part of the fiberposts and measured in a pull-off setup using an universal testing machine (Zwick Z010, crosshead speed 1mm/min). Data obtained from the different groups were analyzed using ANOVA. **Results:** The following table summarizes the mean adhesion values.

Cement	RXU	BIS	GCM	MC	MON & MUL	MON & VAR
Adhesion [MPa] LC	23,3±0,9	20,9±1,0	20,7±1,0	14,7±2,2	21,3±1,9	22,3±0,7
Adhesion [MPa] DC	23,1±1,9	21,1±3,3	20,4±1,6	13,0±1,5	16,6±1,3	not tested

Conclusions: RXU self adhesive universal resin cement showed best performance in both curing modes without any surface pre-treatment, whereas MON&MUL showed significantly lower bond strength when the dark cure mode was used. MC was found to have significantly lower bond strength in both curing modes.

Hayashi, M, Okamura, K, Wu H, Takahashi, Y, Koytchev, EV, Imazato, S, Ebisu, S. **The root canal bonding of chemical-cured total-etch resin cements.** *J Endod. 2008 May;34(5):583-6. Epub 2008 Mar 24.*

Discovering a durable restorative method to reconstruct and reinforce pulpless teeth is a vital key to help prevent root fractures. Complete and firm adhesion of resin cement in root canal dentin using a post is critical to achieve it. The null hypothesis in the present study was that the bond strength of dual-cured and chemical-cured adhesive resin cements to root canal dentin is not affected by their vertical locations in the root canal. In the experiments, extracted human incisors restored with fiber-reinforced posts and adhesive resin cements were subjected to microtensile bond strength testing. Then, the failure modes and the dentin-bonding interfaces were observed. Self-etch and self-adhesive dual-cured resin cements showed frequent pretesting failure despite using a silane coupling agent. Chemical-cured total-etch adhesive material showed stable bonding performances throughout the entire post space and thus has an advantage in post-core restorations.

*Hedlund, S-O, Johanson, N. G., Sjogren, G. **Retention of prefabricated and individually cast posts in vitro**. *British Dental Journal Vol 195, No. 3. Aug 9, 2003 155-158.*

Objectives: The aim of the study was to evaluate the retention of prefabricated root canal posts made of a variety of materials that have recently been introduced to dentistry. **Methods**: The posts studied were Cosmopost (ceramic), Composipost / C-Post (Carbon fibres), Aestheti-Plus post (Quartz Fibres), Light-Post (Quartz fibres) and ParaPost White (glass fibres). The posts were luted in extracted human pre-molars and the cores were built up with the resin composites recommended by the (post) manufacturers. The retention of individually cast gold alloy posts luted with zinc phosphate cement were used as reference. A universal testing machine was used to determine the retention of each cemented post. Data were compared using ANOVA supplemented with Fisher's PLSD at a significance level of $p<0.05$. **Results:** Only the Cosmopost system exhibited retention values that were significantly lower than for the conventional cast gold alloy posts luted with zinc phosphate cement. The force necessary to loosen the Cosmopost specimens was significantly less than that needed to loosen the Aestheti-Plus post ($p<0.05$) and the Light-Post systems ($p<0.01$). The force necessary to loosen the ParaPost White specimens was significantly less than for the Light-Post system ($p<0.01$). Other combinations did not differ significantly ($p<0.05$). **PDF**

Huber, L, Cattani-Lorente, M, Shaw, L, Krejci, I, Bouillaguet, S. **Push-out bond strengths of endodontic posts bonded with different resin-based luting cements.** *Am J Dent. 2007 Jun;20(3):167-72.*

Purpose: To compare the push-out bond strengths of endodontic posts bonded with different resin-based luting cements and to verify that bond strengths did not vary with cement thickness. **Methods:** 48 root canals were shaped using 6% NiTi rotary files, obturated with gutta-percha and AH Plus sealer and prepared for post cementation using Panavia F, Parapost cement, SuperBond and Unicem Rely X. All roots were sectioned into 0.7 mm thick slices and digital photographs of each slice were analyzed using Scion Image to measure the surface area of the luting cement. The root slices were stressed to failure at 1 mm/minute using a push-out test. Push-out strength was calculated as the force at failure divided by the bonded surface area. Least squares linear regression analysis was used to assess the effect of cement thickness on bond strength. Fractured specimens were further observed under the SEM. **Results:** Mean push-out bond strengths were: Panavia F (8.8 +/- 3.6 MPa), Parapost cement (9.1 +/- 4.4 MPa) SuperBond (14.6 +/- 2.9 MPa) and Rely X Unicem (12.4 +/- 3.3 MPa). The Panavia F and the Parapost cement were not significantly different from each other, but both were significantly lower ($P < or = 0.05$) than SuperBond and Rely X Unicem. **Conclusions:** Although there were large variations in cement thickness, the cementation of fiber posts with thicker cement layers did not affect the performance of the adhesive luting cements applied to root canal dentin.

Kececi , AD, Ureyen Kaya, B, Adanir N. **Micro push-out bond strengths of four fiber-reinforced composite post system and 2 luting materials.** *Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2008 Jan;105(1):121-8*

Objectives: The aim of this study was to compare the bond strengths of 2 types of dual-cured luting agents used for cementation of 4 different fiber-reinforced composite (FRC) posts by using a push-out test and to evaluate the failure modes of these systems. **Study Design:** Eighty human maxillary central incisors were divided into 8 groups (n = 10), decoronated,

and roots filled and restored with one of the following post systems: groups 1 to 4: translucent quartz FRC posts; groups 5 and 6: opaque glass FRC post; and groups 7 and 8: individually formed electrical glass fiber post. Cementation was performed with 2 types of dual-polymerizing resin luting agents: Variolink II (groups 1, 3, 5, and 7) and a new self-adhesive resin cement, RelyX Unicem (groups 2, 4, 6, and 8). Slices with a thickness of 1.00 +/- 0.05 mm were prepared from the coronal third of each root by using a low-speed saw. Push-out tests were performed at a crosshead speed of 1 mm/min by using a universal testing machine, and the data was statistically analyzed (analysis of variance [ANOVA] and Duncan tests; $P < .05$). Fracture modes were evaluated at original magnification x40. **Results:** Micro push-out bond strengths were significantly affected by the type of luting agent and the type of post ($P < .05$, 2-way ANOVA). A significant difference was found among the groups (1-way ANOVA, $P < .05$). Fiber-reinforced composite posts luted with Variolink II showed higher bond strengths, and the groups ordered as 5, 1, 3, 7, 6, 2, 4, and 8, with the values (MPa, mean +/- SD): 13.80 +/- 5.00, 13.77 +/- 3.78, 12.20 +/- 4.79, 9.39 +/- 2.48, 9.21 +/- 7.76, 7.25 +/- 1.56, 3.89 +/- 4.41, and 3.77 +/- 1.20, respectively. Adhesive failures between dentin and cement were observed more than cohesive failures in cement or post. **Conclusions:** Push-out bond strengths can be affected by luting agent and post type. Variolink II and fiber post combinations resulted in high bond strength values.**PDF**

Krause, F., Bahr, P., Jepsen, S., Braun, A. **Bonding of glass-fiber posts to root canal dentin in vitro**. *J Dent Res. Vol 88 (Spec. Iss. A) Abstract # 3194, 2009. (www.dentalresearch.org)*

Objectives: The aim of this study was to determine bonding properties of different cements and dentin adhesive systems for glass-fiber posts. **Methods:** 45 freshly extracted human teeth were endodontically treated. Glass-fiber posts were cemented using three different methods: dual-cured composite (Multilink™) with conditioning of dentin (I), composite-reinforced glass ionomer cement (Meron™) without conditioning of dentin (II) and dual-cured composite (Rebilda™) with conditioning of dentin (III). After thermocycling, the end of the post was exposed by cutting the root 5 mm to the end at the level gutta-percha/ glass-fiber post. For REM analysis, impressions of the exposed root surfaces were taken and replicas were produced. Teeth were cleared using nitric acid (5%), alcohol (80%, 90%, 100%) and methyl-salicylate. Subsequently, an ink penetration procedure was performed to assess leakage between the glass-fiber post and root dentine by measuring the depth of dye penetration. **Results:** In goup II, a statistically significant deeper dye penetration (median: 1.02 [mm], min: 0, max: 1.02) could be observed compared to group III (median: 0.36 [mm], min: 0, max: 1.52) ($p<0.05$) with no difference between group I (median: 0.57 [mm], min: 0, max: 2.66) and III ($p>0.05$). Regarding apical leakage after REM analysis, no differences between the groups became evident ($p>0.05$). **Conclusion:** In endodontically treated teeth, glass-fiber posts should be inserted preferably with a dual-cure composite after conditioning the root dentin. In this study, the evaluated dual-cure composites in combination with the respective dentin adhesive system were not different with respect to apical leakage.

*Kremeier, K, Fasen, L, Klaiber, B, Hofmann, N. **Influence of endodontic post type (glass fiber, quartz fiber or gold) and luting material on push-out bond strength to dentin in vitro.** *Dent Mater. 2008 May;24(5):660-6. Epub 2007 Aug 23.*

Objectives: To determine the influence of post type and luting material on bond strength to dentin. **Methods:** The root canals of extracted human upper central incisors were instrumented and post space was prepared using the respective drills for each post system. Glass fiber posts (Luscent Anchor, Dentatus [LA]) were luted using three dual-curing adhesive systems (Excite DSC/Variolink II, Vivadent [VL2]; EnaBond/EnaCem, Micerium [ENA]; Prime & Bond NT/Calibra, DentSply DeTrey [CAL]). A different brand of glass fiber post (EasyPost, DentSply Maillefer [EP]) and quartz fiber post (DT Light Post, VDW/ RTD, St Egreve, France [DT]) were luted using CAL. Gold posts (Perma-dor, VDW) were luted either adhesively following tribo-chemical silicate coating (Rocatec, ESPE-Sil, 3M ESPE; CAL) or conventionally using glass ionomer cement (Ketac Cem, 3M ESPE). Three slices of 2mm height were cut perpendicular to the post from each restored root. Bond strength was determined by pushing out the post using a universal testing machine (/1449, Zwick)**. Results:** For all experimental groups combined, bond strength increased from the coronal to the apical section (Friedman test: $P<0.001$). Significant differences were observed among the fiber posts (DT/CAL>LA/CAL; Mann-Whitney U-test with Bonferroni-Holm adjustment: $P<0.05$; EP/CAL ranging in between) but not among luting materials (LA/VL2, LA/ENA, LA/CAL: n.s.). The gold posts were equivalent to DT/CAL with both luting procedures. **Significance:** Selection of post type may be more important for bond strength than luting material. Bond strength of fiber posts was equivalent but not superior to adhesively or conventionally luted gold posts. **PDF**

Lombardo, G., Souza, R., Michida, S., deMelo, R., Bottino, M A. Valandro, L. **Resin bonding to root canal dentin: Effect of the application of an experimental hydrophobic coating anter an all-in-one adhesive.** *Journal of Contemporary Dental Practice Vol. 9, No. 4, May 1 , 2008.*

Aim: Based on the hypothesis the application of a low-viscosity hydrophobic resin coating improves the bond of all-in-one adhesive, the purpose of the study was to evaluate the bond strength of four adhesive systems to bovine root dentin using the push-out test method. **Methods:** The root canals of 32 bovine roots (16 mm) were prepared to a length of 12 mm using a FRC Postec Plus preparation drill. The specimens were allocated into four groups according to the adhesive system used: (Group 1) All-in-one Xeno III; (Group 2) All-in-one Xeno III+ScotchBond Multi-Purpose Plus Adhesive; (Group 3) Simplified Etch & Rinse One Step Plus; and (Group 4) Multi-Bottle Etch & Rinse All-Bond 2. A fiber-reinforced composite retention post was reproduced using an additional silicon impression and fabricated with DuoLink resin cement. The root specimens were treated with the selected adhesive systems, and the resin posts were luted in the canals with DuoLink resin cement. Each root specimen was cross sectioned into four samples (+/-1.8 mm in thickness), and the post sections were pushed-out to determine the bond strength to dentin. **Results:** Group 2 (2.9+/-1.2) was statistically higher than Group 1 (1.1+/-0.5) and Group 3 (1.1+/-0.5). Groups 1 and 3 showed no statistically significant difference while Group 4 (2.0+/-0.7) presented similar values ($p>0.05$) to Groups 1, 2, and 3 [(one-way analysis of variance (ANOVA)] and Tukey test, $a=0.05$). **Conclusion:** The hypothesis was accepted since the application of the additional layer of a low-viscosity bonding resin improved the bond of the all-in-one adhesive. Further studies must be conducted to evaluate the long-term bond. **PDF**

*Mallmann ,A, Jacques, LB, Valandro, LF, Mathias, P, Muench, A. **Microtensile bond strength of light- and self-cured adhesive systems to intraradicular dentin using a translucent fiber post.** *Oper Dent. 2005 Jul-Aug;30(4):500-6*

This study evaluated the bond strength of a light- and self-cured adhesive system to different intraradicular dentin areas (cervical, middle and apical thirds). Twenty single-rooted teeth were instrumented and their roots were prepared to receive a #2 translucent fiber post (Light Post). The root canals were irrigated with 0.5% sodium hypochlorite for one minute, rinsed with water and dried using paper tips. The teeth were divided into two groups (n=10): Single Bond [SB] (light-cured) and Scotchbond Multi-Purpose Plus [SBMP] (self-cured). To avoid polymerization of the materials through the root lateral walls, the teeth were placed in a silicone mold and the adhesives applied with a thin microbrush according to manufacturer's instructions. The resin cement, Rely X ARC, was inserted into the root canals using Lentulo burs. The post was then placed and the light-curing procedure was carried out for 40 seconds (+/-500 mW/cm2). The roots were kept in a 100% relative moisture environment for 24 hours and stored in distilled water for an additional 24 hours. Each root was perpendicularly sectioned into 1-mm thick sections, resulting in approximately four slices per region. Dumbbell-shaped slices were obtained by trimming the proximal surfaces of each slice using a diamond bur until it touched the post. The bonded area was calculated, slices were attached to a special device and submitted to microtensile testing at 1 mm/minute crosshead speed. Data were analyzed using ANOVA and Tukey's test. The mean bond strength values (MPa) were: SBMP: cervical=10.8a, middle=7.9b%, apical=7.1bc; SB: cervical=8.1b, middle=6.0c, apical=6.9b. Significant differences were found between adhesive systems only for the cervical third. The cervical region showed higher mean bond strength values than the middle and apical regions ($p<0.0001$). **PDF**

*Mallmann, A, Jacques, LB, Valandro, LF, Muench, A**. Microtensile bond strength of photoactivated and autopolymerized adhesive systems to root dentin using translucent and opaque fiber-reinforced composite posts**. *J Prosthet Dent. 2007 Mar;97(3):165-72*

Statement of Problem: The use of fiber-reinforced composite resin posts in endodontically treated teeth has increased. However, selecting an adhesive system that provides reliable and long-lasting bonding to root canal dentin remains difficult. **Purpose:** This study evaluated the microtensile bond strength of 2 adhesive systems to root dentin and 2 different fiber-reinforced composite resin posts. **Methods:** Forty single-rooted teeth were instrumented, and root canals were prepared for translucent (Light Post [LP]) or opaque (Aestheti Post [AP]) quartz fiber-reinforced composite resin posts. Two adhesive systems were used: Scotchbond Multi-Purpose Plus (SBMP) (autopolymerized) as a control group, and Single Bond (SB) (photoactivated). Teeth were assigned to 4 groups (n=10): SBMP+LP, SBMP+AP, SB+LP, SB+AP. After post cementation, roots were perpendicularly sectioned into 1-mm-thick slices, which were trimmed to obtain dumbbell-shaped specimens. The specimens were divided into 3 regions: cervical (C), middle (M), and apical (A). To determine the bond strength, the bonding area of each specimen was calculated, and specimens were attached to a device to test microtensile strength at a crosshead speed of 1 mm/min. Data were analyzed using 3-way analysis of variance and the Tukey test (alpha=.05). Fractured specimens were examined under a x 25 stereomicroscope to determine the mode of fracture. **Results:** There were significant differences only among root dentin regions ($P<.001$). The cervical third (9.16 +/- 1.18 MPa) presented higher mean bond strength values, especially for SBMP. Middle and apical regions demonstrated lower values (7.08 +/- 0.92 and 7.31 +/- 0.60 MPa, respectively). Adhesive and post main factors did not demonstrate significance. Also, no interaction was significant. No cohesive fractures within resin cement, fiber-reinforced composite resin post, or root dentin were identified. **Conclusions:** Both adhesive systems tested demonstrated reliable bonding when used with translucent and opaque fiber-reinforced composite posts. **PDF**

Michida, SMA, Souza, ROA, Passos, SP, Mesquita, AMM. Pereira, PC, Valandro, LF, Takahashi, FE, Bottino MA. **Influence of cement insertion technique on fiber post bond strength**, *J Dent Res.Vol 87 (Spec Iss A) Abstract #1745, 2008 (www.dentalresearch.org)*

Objective: this study evaluated the influence of different methods of resin cement insertion on the bond strength between bovine root dentine and fiber posts (null hypothesis: the insertion methods do not influence the bond strength). **Methods:** forty bovine roots (16mm) (single-root) were prepared to 12 mm with custom drill of the fiber post system (FRC Postec Plus). The roots were embedded in chemically cured acrylic resin using a surveyor. The specimens were divided into 4 groups, according to the methods of resin cement insertion: G1- Lentulo drill, G2- Centrix syringe, G3- Explorer #5, G4- with the aid of the post. The root canals were rinsed with 20 mL of distilled water, and dried with paper points. The root dentine was etched with H2PO3 37%/15s + washing/drying and the adhesive system All-Bond 2 was applied, and right away the cylinder quartz fiber posts (Aestheti-Plus) were cemented (RelyX). The samples were kept in distilled water 37^0 C for 24 h, then, each specimen was cut into 4 slices of ±1.8 mm of thickness, and the samples were submitted to push-out test (Emic DL-1000) (1mm/min). **Results:** ANOVA (a=0.05) showed that the bond strength (MPa) was not affected by resin cement insertion methods (P>0.05). G1 (4.21±1.27a), G2 (3.17±1.79a), G3 (4.46±0.95a), G4 (3.12±1.28a), (null hypothesis was accepted). **Conclusion:** the resin bond strength between the bovine root dentin and the fiber posts are not influenced by the resin cement insertion methods.

Mazzitelli, C, Ferrari, M, Toledano, M, Osorio, E, Monticelli, F, Osorio, R. **Surface roughness analysis of fiber post conditioning processes.** *J Dent Res. 2008 Feb;87(2):186-90.*

The chemo-mechanical surface treatment of fiber posts increases their bonding properties. The combined use of atomic force and confocal microscopy allows for the assessment and quantification of the changes on surface roughness that justify this behavior. Quartz fiber posts were conditioned with different chemicals, as well as by sandblasting, and by an industrial silicate/silane coating. We analyzed post surfaces by atomic force microscopy, recording average roughness (R(a)) measurements of fibers and resin matrix. A confocal image profiler allowed for the quantitative assessment of the average superficial roughness (R(a)). Hydrofluoric acid, potassium permanganate, sodium ethoxide, and sandblasting increased post surface roughness. Modifications of the epoxy resin matrix occurred after the surface pre-treatments. Hydrofluoric acid affected the superficial texture of quartz fibers. Surface-conditioning procedures that selectively react with the epoxy-resin matrix of the fiber post enhance roughness and improve the surface area available for adhesion by creating micro-retentive spaces without affecting the post's inner structure.

*Monticelli, F, Osorio, R, Tay, FR, Sadek, FT, Ferrari, M, Toledano M. **Resistance to thermo-mechanical stress of different coupling agents used as intermediate layer in resin-fiber post bonds.** *Am J Dent. 2007 Dec;20(6):416-20.*

Purpose: To evaluate the microtensile bond strength (MTBS) of different coupling agents used in fiber post-composite bonds to withstand different in vitro challenging procedures. **Methods:** 63 fiber posts (D.T. Light-Post: RTD, St Egreve, France) etched with 10% hydrogen peroxide were divided into three groups according to the silane/adhesive system applied: (1) Porcelain Bond Activator (PBA) + Clearfil SE Bond; (2) PBA + Clearfil Tri S Bond; (3) Monobond-S. A composite build-up (Clearfil AP-X) was performed around the post producing cylindrical specimens that were divided into three subgroups according to the different aging protocol: (1) 24-hour storage at room temperature; (2) Thermocycling (5000 cycles, 5 degrees/55 degrees C dwell time: 30 seconds); (3) Cyclic loading (45 degrees angle, 20,000 cycles, load 5-50 N at 3.0 Hz). Samples were then cut obtaining sticks that were loaded in tension until failure. Bond strength values were statistically analyzed with two-way ANOVA and Tukey test (alpha = 0.05). Failure mode was recorded and the morphologic aspect of post/core interface after aging was evaluated under SEM. **Results:** Both post superficial treatment, thermocycling and cyclic loading influenced bond strength. After 24 hours, samples treated with silane/adhesive couplings attained higher MTBS than those bonded with conventional silane. No significant differences in the microtensile bond strength at the post/core interface were recorded between the different silane/adhesive couplings. After challenging, no differences were found between the tested groups.

Naumann, M, Sterzenbach, G, Rosentritt, M, Beuer, F, Frankenberger, R. **Is adhesive cementation of endodontic posts necessary?** *J Endod. 2008 Aug;34(8):1006-10.*

Recently, the appropriate, durable bond of adhesive systems and composite resin cements to retain endodontic posts was challenged. The question arises whether it would be possible to place glass fiber posts in a less technique sensitive conventional non-adhesive approach. The influence of nonadhesive, self-adhesive, and etch-and-rinse systems on load

capability of postendodontic restorations was studied. Human maxillary central incisors were divided into 4 groups (n = 10). Teeth were endodontically treated and restored by using glass fiber posts luted with different cements/composite resin combinations: (1) RelyX Unicem (3M ESPE, Seefeld, Germany)/Clearfil Core (Kuraray Europe, Duesseldorf, Germany), (2) RelyX Unicem/LuxaCore, (3) zinc phosphate cement/Clearfil, and (4) LuxaCore (DMG, Hamburg, Germany)/Clearfil. A 2 mm-ferrule preparation was performed. All specimens received adhesively luted all-ceramic crowns and were exposed to thermal cycling and mechanical loading before subsequent static loading. Significant differences between the experimental groups regarding load capability and fracture patterns were observed. The conventional non-adhesive post cementation is less reliable to withstand simulated functional forces compared to adhesive approaches. **PDF**

*Perdigão J, Gomes G, Augusto V. **The effect of dowel space on the bond strengths of fiber posts**. *J Prosthodont. 2007 May-Jun;16(3):154-64*

Purpose: The purpose of this study was to evaluate the effect of the degree of mismatch between post space and post diameters on the bond strength of a fiber-reinforced resin post. **Methods:** Thirty-two extracted human maxillary central incisors and canines were endodontically treated and assigned to four groups: Group 1--Canal prepared with a D.T. Light - Post #1 drill (control); Group 2--Canal prepared with a D.T. Light -Post #2 drill; Group 3--Canal prepared with a D.T. Light-Post #3 drill; Group 4--Canal prepared with a Gates Glidden #6 drill. A D.T. Light -Post size 1 was then luted into the canal using One-Step Adhesive and Post Cement Hi-X. A push-out test was performed on three sections of each root to measure push-out bond strengths. Data were analyzed with ANOVA and Bonferroni's test at $p < 0.05$. Two extra teeth for each group were restored in the same fashion and processed for SEM observation. **Results:** (in MPa): Group 1: 15.7 +/- 6.9; Group 2: 14.7 +/- 6.5; Group 3: 14.0 +/- 5.0; Group 4: 14.0 +/- 5.1. The variable "post space" resulted in no statistically significant difference in mean bond strengths ($p > 0.05$). For the variable "root region," the coronal third (17.5 +/- 6.0) resulted in statistically greater mean bond strengths than the apical third (12.3 +/- 6.0) at $p < 0.008$. The middle third (14.0 +/- 5.3) resulted in no statistically significant different mean bond strengths from the coronal third at $p > 0.119$ and from the apical third at $p > 0.999$. Under the SEM, some areas of the canal system still displayed residual gutta-percha, which resulted in debonding of the interface between the resin cement and dentin. Areas with incomplete dentin hybridization were observed in localized areas of all groups. **Conclusions:** The diameter of the post space did not affect the push-out bond strengths. Bonding at the coronal level of the root canal is more reliable than bonding at the apical level. The presence of residual gutta-percha and the deficient dentin hybridization may result in deficient seal of the resin-dentin interface. **PDF**

Perez, BE, Barbosa, SH, Melo, RM, Zamboni, SC, Ozcan, M, Valandro, LF, Bottino, MA. **Does the thickness of the resin cement affect the bond strength of a fiber post to the root dentin?** *Int J Prosthodont. 2006 Nov-Dec;19(6):606-9*

This study aimed to evaluate the influence of cement thickness on the bond strength of a fiber-reinforced composite (FRC) post system (Light-Post, RTD, St Egreve, France) to the root dentin. Eighteen single-rooted human teeth were decoronated (length: 16 mm), the canals were prepared, and the specimens were randomly allocated to 2 groups (n = 9): group 1 (low cement thickness), in which size 3 FRC posts were cemented using adhesive plus resin cement; and group 2 (high cement thickness), in which size 1 FRC posts were cemented as in group 1. Specimens were sectioned, producing 5 samples (thickness: 1.5 mm). For cement thickness evaluation, photographs of the samples were taken using an optical microscope, and the images were analyzed. Each sample was tested in push-out, and data were statistically analyzed. Bond strengths of groups 1 and 2 did not show significant differences (P = .558), but the cement thicknesses for these groups were significantly different (P < .0001). The increase in cement thickness did not significantly affect the bond strength ($r2 = 0.1389$, P= .936). Increased cement thickness surrounding the FRC post did not impair the bond strength. **PDF**

Pest, L. B., Cavalli, G., Bertani, P., Gagliani, M. **Adhesive post-endodontic restorations with fiber posts: push-out tests and SEM observations**. *Dental Materials 18 (2002) 596-602*

Objectives: Nowadays, the restoration of endodontically treated teeth is based on the use of materials with a modulus of elasticity similar to that of dentin (18.6 GPa). Fiber posts, resin cements and some composite resins all have this characteristic. This study evaluated the bond strength between luting materials, root dentin and fiber posts through push-out tests and examined the integration among these three components through scanning electron microscopy. **Methods**: Endodontically treated extracted teeth and plastic plates were used to test the interface between luting agent and dentin and dentin and luting agent and post. **Results:** Chemical affinity between different components (luting materials and fiber posts) is extremely important in achieving high bond strength. The bond strength tests and SEM observations showed that in-vitro, composite resins perform better than resin cements. **Conclusions:** Adhesive luting of posts is an alternative technique that is comparable and in some ways superior to the traditional technique that uses resin cements. Composite resins are easy to use and ergonomically advantageous because the same material can be used to lute the post and restore the core. Particular attention should be paid to the association between translucent posts and light-cured composite resins. This technique has the

advantage of prolonged working time. Further investigation is needed to demonstrate the complete conversion of light-cured composite at different depths. **Significance:** The in vivo use of these materials may significantly reinforce residual tooth structure therefore reducing the risk for fracture and debonding. **PDF**

Phark, J-H., Welch, J., Dietschi, D., Sadan, A. **Push-out bond strength of parallel and tapered posts to dentin**. *J Dent Res. Vol 88 (Spec. Iss. A) Abstract # 973, 2009. (www.dentalresearch.org)*

Objective: to evaluate push-out bond-strength (PBS) of glass-fiber reinforced posts with two different designs using three different luting cements with and without following manufacturers' recommendations for cementing. **Methods:** 90 teeth were de-coronated, root canal treated, and divided into 15 groups. 11 mm long post-spaces were drilled into each tooth using a parallel drill for 45 samples and a tapered drill for the rest. Corresponding parallel (P; ParaPost Fiber Lux) and tapered (T; ParaPost Taper Lux) posts were cemented using two cement systems (Panavia F2.0 (PAN) and Paracore (PAR)) using their corresponding self-etching adhesives, and a self-adhesive cement, Unicem (UNI). In half of the samples cements were used according to manufacturers' recommendations (NE) in the other half dentin was etched (E) with phosphoric acid for 15 seconds before application of the adhesive. Control groups with parallel post spaces but without posts were filled with one of the three cements only. Two teeth of each group were subjected to 20,000 cycles of thermal-cycling (TC). All teeth were sectioned in 1 mm thick disks and a total of 593 disks were tested for PBS. Kruskal-Wallis tests were used with an adjusted α=0.002.

Results(PBS in MPa) :

	Before TC	**After TC**
P-PAN-NE	13.91±4.0	1 8.31±2.48
T-PAN-NE	13.99±4.21	9.50±3.20
P-UNI-NE	14.77±4.45	10.58±3.30
T-UNI-NE	16.36±4.81	11.36±4.47
P-PAR-NE	16.55±3.16	14.10±6.74
T-PAR-NE	16.08±3.13	10.88±2.69
P-PAN-E	10.32±4.17	8.39±4.53
T-PAN-E	13.51±5.02	6.34±3.36
P-UNI-E	13.23±5.09	11.06±5.41
T-UNI-E	10.72±3.07	10.29±5.24
P-PAR-E	9.85±4.56	11.51±5.62
T-PAR-E	13.66±4.55	12.81±4.88
Control-PAN-NE	13.36±9.24	10.36±3.97
Control-UNI-NE	12.25±6.02	13.04±4.59
Control-PAR-NE	20.77±7.02	11.96±4.34

Conclusion: In this study, artificial aging by TC and etching of the dentin before bonding reduced PBS significantly. Design of posts had no influence on PBS, which was also similar to control groups without posts. Paracore and Unicem achieved significantly higher PBS than Panavia F2.0.

*Potesta, F., Broome, J., O'neal, S., Givan, D., Ramp, L. **The effect of etching technique on the retention of adhesively cemented prefabricated dowels.** *J Prosthodont. 2008 Aug;17(6):445-50*

Purpose: To determine if etching technique influences the bond strength of resin cement to root canal dentin. **Methods:** Fifty-five extracted teeth were endodontically treated, dowel space prepared, and divided into five groups. Each group was treated with different etchant consistencies: acid gel, semi-gel, low-viscosity gel, liquid, and a self-etching primer. After dowel cementation, four sections were removed from each root and a push-out test was performed. **Results:** Significant effects were found for etching procedure and for location within the root canal. The apical segment produced the lowest bond strength. Self-etching primer showed the highest bond strength. **Conclusions**: The consistency of etchant material influenced the bond strength of a prefabricated dowel in the canal. **PDF**

Prisco, D., De Santis, R, Mollica, F., Ambrosio, L., Rengo, S., Nocolais, L. **Fiber post adhesion to resin luting cements in the restoration of endodontically - treated teeth**. *Operative Dentistry, 2003, 28-5, 515-521.*

Clinical Relevance: With respect to the adhesion properties of carbon fiber posts and glass fiber posts used in the restoration of endodontically - treated teeth, they perform equally well if used in combination with chemically cured luting cements or with light- activated ones. **Summary:** Fiber posts are used widely in the restoration of endodontically - treated teeth. Scientific evidence demonstrates that the mechanical performance of teeth restored with fiber posts in combination with resin luting cements is improved with respect to metallic post restorations. The post is cemented inside the root canal using low-

modulus elastic polymer resins. In this study, the mechanical resistance of four different post – cement systems (1. carbon fiber C-Post/Composipost (RTD, St Egreve, France/ Bisco Dental) with C&B chemically-cured cement (Bisco Dental), 2. carbon fiber/glass fiber Aestheti-Plus (RTD, St Egreve, France/ Bisco Dental) post with C & B cement, 3. glass fiber Aestheti-Plus Post (Bisco Dental / RTD, St Egreve, France) with C&B cement, and 4. glass fiber Light-Post (Bisco Dental / RTD, St Egreve, France) with dual-curing Duo-Link cement (Bisco Dental) was assessed by means of a micro-mechanical pull-out test assisted by a simulation using the Finite Element methodology. This *in vitro* test is specifically designed to accurately characterize the post/cement interface. The results show no significant difference among the adhesion of the various types of post – cement systems used. **PDF**

*Purton, D., Chandler, N., Qualtrough, A.. **Effect of thermocycling on the retention of glass fiber root canal posts.** *Quintessence Int. 34(5): 366-9 2003*

Objective: this study investigated the effects of thermocycling on the retention of glass fiber and resin posts. **Methods:** Forty premolar and canine tooth roots were imbedded in acrylic blocks shaped to fit into a retention device. The roots were randomly assigned to two groups of 20 to receive either Light-Posts (RTD, St Egreve, France) or Lucent Anchors (Dentatus) which were cemented into 9mm deep post spaces, with Panavia F resin cement. Each group was divided into two equal subgroups; one for thermocycling and the other to serve as a control. The thermocycled specimens were cycled 300 times between water baths at 5 degrees C and 55 degrees C, with a dwell time of 60 seconds in each. Control specimens were stored at 37 degrees C. The tensile force required to dislodge each post from its root was recorded and the data analyzed using Student's T-Tests. **Results:** There were no significant differences between the control and the thermocycled specimens. Light-Posts were significantly more retentive than the Lucent Anchor without thermocycling, but that distinction was not that apparent in the thermocycled groups. **Conclusions:** Glass-fiber-and-resin posts cemented with resin cement offer acceptable levels of retention and are not susceptible to reduced retention from thermocycling. Thermocycling should be given less emphasis in tests for the retention of root canal posts cemented with resin cements.

*Putignano, A, Poderi, G, Cerutti, A, Cury, A, Monticelli, F, Goracci, C, Ferrari, M. **An in vitro study on the adhesion of quartz fiber posts to radicular dentin.** *J Adhes Dent. 2007 Oct;9(5):463-7*

Purpose: To evaluate in vitro the bond strength at the adhesive interface between a quartz fiber post, different adhesive systems, and different composite cements. **Methods:** Thirty extracted single-rooted teeth were endodontically treated and divided into three groups (n=10). Quartz fiber posts (DT Light-Post) were cemented with the following materials: group I: Prime & Bond NT + Self Cure Activator, and Calibra as luting cement; group II: Prime & Bond NT + Self Cure Activator, and UniFil Core; group III: UniFil Bond in combination with Unifil Core. The specimens were processed for the push-out test to evaluate bond strength at the root dentin-cement-post interface. They were sectioned along the long axis of the post into 1-mm-thick slices. A total of 60 sections was obtained from group I. Group II provided 67 slices, while group III provided 69. Loading was performed at a crosshead speed of 0.5 mm/min until the post segment was dislodged from the root section. **Results:** There was no statistically significant difference between the three experimental groups. The mean bond strength obtained for group I was 9.81 +/- 5.40 MPa. For group II it was 12.06 +/- 6.25 MPa, and 9.80 +/- 5.01 MPa for group III. **Conclusions:**: All the materials tested were similar in terms of providing satisfactory bond strength when used for luting fiber posts. However, Unifil Core may be advantageous since it can also be used as a core buildup material, which simplifies the clinical procedures. **PDF**

Qualtrough, A. Chandler, N., Purton, D**. A comparison of the retention of tooth-colored posts.** *Quintessence Int 2003;34:199-201*

Objective: The aim of this in vitro study was to compare the retention of five different esthetic post systems of similar dimensions in extracted teeth using Titanium posts as controls. **Methods:** Sixty recently extracted single rooted caries-free teeth were sectioned horizontally and mounted in acrylic resin. The samples were randomly allocated into six groups of ten for post preparation. Post space preparation was carried out according to manufacturer's instructions. All posts were bonded using Panavia F. A 4mm hollow, metal sleeve was luted over the free end of each post prior to mounting in a universal testing machine, and the forces required to dislodge the posts using a crosshead speed of 5mm/min.were recorded. **Results:** It was found that the parallel-sided Light-Post (RTD, St Egreve, France) were significantly more retentive than all of the other posts. ParaPost Fiber White was more retentive than tapered DT Light-Posts (RTD, St Egreve, France) and Snow Posts. There was no significant difference between the retention of the stainless steel ParaPost and any of the other groups. **Conclusions:** Serrated, parallel-sided stainless steel posts were no more retentive than either parallel-sided or tapered tooth-colored posts in this study. Due to the nature of the bonding mechanism, the shape of the tooth-colored post may be less significant to its retention than it is for metal posts. **PDF**

Radovic, I., Mazzitelli, C., Chieffi, N., Ferrari, M. **Evaluation of the adhesion of fiber posts cemented using different adhesive approaches.** *Eur J Oral Sci. 2008 Dec;116(6):557-63.*

The aim of this study was to investigate the adhesion of fiber posts cemented with luting agents that utilize three currently available adhesive approaches: etch-and-rinse, self-etch, and self-adhesive. Forty-two intact single-rooted human premolars were used in the study. Teeth were divided into six groups. In each group, a different resin cement with its adhesive system (if needed) and a fiber post were used. The groups were classified, according to the adhesive approach, into the following three categories. (i) Etch-and-rinse groups: Calibra resin cement/XPBond adhesive + self-curing activator (SCA)/RadiX Fiber Post (Dentsply Caulk), FluoroCore 2 core build-up material/XPBond + SCA/RadiX Fiber Post (Dentsply Caulk), and MultiCore Flow luting and core build-up material/Excite DSC adhesive/FRC Postec Plus fiber post (Ivoclar Vivadent). (ii) Self-etch group: Panavia F 2.0/ED primer (Kuraray)/RadiX Fiber Post (Dentsply Caulk). (iii) Self-adhesive groups: experimental self-adhesive cement/RadiX Fiber Post (Dentsply Caulk), and RelyX Unicem/RelyX Fiber Post (3M ESPE). The adhesion between the post and the root canal walls was assessed using the 'thin-slice' push-out test. In the test arrangement used, the self-etching approach may offer less favourable adhesion to root canal dentin in comparison with etch-and-rinse and self-adhesive approaches.

***Rovatti, L., Mason, P.N., Dallari, B. , Dallari, A. Influence of carved surface on carbon and quartz posts retention** *J Dent Res. Vol 85 (Spec. Iss. C) Abstract #0554, PEF Division 2006 (www.dentalresearch.org)*

New quartz fiber endodontic posts with a carved surface have been recently marketed. Objectives: the purpose of this in vitro study is to compare the influence of different surfaces on carbon and quartz fiber posts luted into root canals. Methods: Into 20 extracted single-rooted human teeth, fiber-reinforced posts with a different surface (smooth and carved) have been luted by using a self-etching composite cement (All Bond II C & B, Bisco), so obtaining 4 groups of 5 elements each: 1) Composipost (RTD, France). 2) Composipost Retentive (RTD, France, with carved surface). 3) DT Light- Post (RTD, France). 4) DT Light-Post Retentive (RTD, France, with carved surface). In a further 5th group of 5 teeth, used as control, quartz fiber posts (DT Light-Post) etched with hydrofluoric acid 9.6 % for 15 sec have been luted with the same composite cement. Roots have been sectioned perpendicularly to long axis with a diamond wheel and the slices 2.2 mm thick so obtained have been subjected to pull-out test with Instron machine. Results: group 1: 27.12 MPa. group 2: 31.7 MPa. group 3: 29.83 MPa. group 4: 41.7 MPa. group 5: 32.4 MPa Conclusions: a) quartz fiber posts confirmed to be more retentive than carbon fiber posts. b) a carved surface leads to a higher retention both in carbon and in quartz fiber posts. c) by using quartz fiber posts (etching is uneffective on carbon fibers), the carving of the surface leads to much higher values of retention than etching with hydrofluoric acid. d) all the above suggests that a macro-retention could be the right choice to increase the resistance to dislodgment of fiber-reinforced posts adhesively luted into root canals.

*Sadek FT, Monticelli F, Goracci C, Tay FR, Cardoso PE, Ferrari M. **Bond strength performance of different resin composites used as core materials around fiber posts.** *Dent Mater. 2007 Jan;23(1):95-9.*

Objectives:: To evaluate the microtensile bond strengths of different resin composites used as core materials around fiber posts. **Methods:** Forty D. T. Light-Posts (RTD, St Egreve, France) were randomly divided into eight groups, according to the resin composite used. They included two core materials specifically developed for core build-up--Group 1: Core-Flo (Bisco Inc.) and Group 2: UniFil Core (GC Corp.); three hybrid composites--Group 3: Tetric Ceram (Ivoclar-Vivadent), Group 4: Gradia Direct (GC Corp.), Group 5: Bisfil 2B (Bisco, Inc.); and three flowable composites--Group 6: AEliteflo (Bisco, Inc.), Group 7: Filtek Flow (3M ESPE) and Group 8: UniFil Flow (GC Corp). A cylindrical plastic matrix was placed around the silanized post and filled with the respective resin composite. Each bonded post provided five to eight sticks for microtensile testing. Each stick was loaded to failure under tension at a cross-head speed of 0.5mm/min. One-way ANOVA and Tukey's test were used for statistical analysis. Scanning electron microscopy (SEM) was used to evaluate the interface of the fractured sticks. **Results:** Resin composites exhibited a significant influence on microtensile bond strength ($p<0.05$). Core-Flo showed the highest bond strength (11.00+/-0.69 MPa) although it was not statistically significantly different from all groups, except from the flowable composites. Under SEM, all the composites adapted well to the fiber post, with a variable extent of voids observed along the fractured composite interfaces. **Significance:** Although good adaptation to the post surface was achieved, bond strength to fiber post remains relatively weak. Core build-up and hybrid composites are better alternatives to flowable composites as core build-up materials. **PDF**

*Simonetti , M, Radovic, I, Vano, M, Chieffi, N, Goracci ,C, Tognini, F, Ferrari, M . **The influence of operator variability on adhesive cementation of fiber posts.** *J Adhes Dent. 2006 Dec;8(6):421-5*

Purpose: The aim of this study was to evaluate the influence of the operator's experience on the outcome of fiber post cementation using an etch-and-rinse acetone-based adhesive. **Methods:** Fifteen human anterior teeth were used in the study. One trained operator performed the endodontic procedures and prepared the roots for the insertion and cementation of the posts. At this point, teeth were divided into 3 groups and distributed to 3 operators to lute the posts: an expert operator (EO), a moderately experienced operator (ME), and an operator with a low level of experience (LE). Quartz fiber posts (D. T. Light Post #1 or #2, (RTD, St Egreve, France) were used. Posts were cemented using Prime&Bond NT Dual Cure adhesive system (Dentsply Caulk) in combination with the dual-curing resin cement Calibra (Dentsply Caulk). The post retention was assessed with the "thin-slice" push-out test. One-way ANOVA was performed to examine the effect of the operator on push-out strength, followed by post-hoc multiple comparisons using Tukey's test, with the significance level set at alpha = 95%. **Results:** The results of push-out strength testing were as follows: EO (12.44+/-3.63 MPa), ME (11.68+/-2.64 MPa), LE (11.18+/-3.12 MPa). No statistically significant differences were determined among the three groups. **Conclusions:** There was no statistically significant difference in the retention measured for fiber posts luted by operators with different levels of clinical experience. Given the parameters of this investigation, the level of operator experience in luting fiber posts does not affect post retention under laboratory conditions. **PDF**

Sterzenbach, G., Rosentritt, M., Nettesheim, T, Naumann, M. **Adhesive cements as core build-ups for postendodontic restorations.** *J Dent Res. Vol 88 (Spec. Iss. A) Abstract # 959, 2009. (www.dentalresearch.org)*

Objectives: Recently composite resin core build-up materials were introduced as cements to retent endodontic posts. Thus, the question arises whether it would be possible to place endodontic posts and built up the core in an one-stage procedure with a self-adhesive composite resin cement. The null-hypothesis tested was that a self-adhesive cement in combination with a glass fiber post for post-and-core restoration is as able to withstand functional forces during thermocycling and mechanical loading (TCML) and additional linear loading as an etch-and-rinse approach with a conventional composite resin core buid-up material. **Methods:** Human caries-free maxillary central incisors were divided into 4 groups (n=10). Teeth were endodontically treated and decoronated 2mm above the cemento-enamel junction. Specimens were restored using glass fiber posts luted with different cements and composite resins for core build-up (cement/resin; cc=chemical curing; dc=dual curing): (I) RelyX Unicem/Clearfil Core-cc, (II) RelyX Unicem/ RelyX Unicem-dc (not indicated by manufacturer), (III) RelyX Unicem/LuxaCore-dc, and (IV) LuxaCore/Clearfil-cc. A 2mm-ferrule preparation was always performed. All specimens received adhesively luted all-ceramic crowns and were exposed to TCML (1.2 million loading cycles; 6,000 thermocycles 5° / 55°C) before static loading until failure. **Results:** Three specimens of group III and two of group II and IV, respectively failed during TCML (log rank: p=0.379). For these specimens the load capabilty value was set at 0N. The median fracture load values (min/max) in [N] were: group I = 295 (209/445), II = 166 (0/726), III = 241 (0/289) and IV = 201 (0/371) (Kruskal-Wallis test: p=0.091). The group I showed the highest percentage (80%) of restorable failures followed by group II (60%) (Chi-square test: p=0,028). **Conclusion:** It appears that – even if not indicated by the manufacturer yet - in the future self-adhesive composite resins may be an alternative to conventional composite resin core materials.

*Teixeira, CS., Silva-Sousa, YTC. Sousa-Neto, MD. **Bond strength of fiber posts to adhesively restored intracanal dentin** *J Dent Res.Vol 87 (Spec Iss A) Abstract #1744, 2008 (www.dentalresearch.org)*

Objectives: This ex vivo study evaluated the influence of different light-exposure times on the interfacial bond strength of fiber posts (D. T. Light-Post, RTD, St Egreve France & Bisco Inc.) to experimentally weakened root dentin restored with composite resin (Light Core, Bisco Inc.). **Methods:** Sixty 17-mm long maxillary incisor roots were used. Twenty-four hours after obturation, the root canals were emptied up to a depth of 12 mm and 4 groups (n=15) were formed at random. In the 3 experimental groups (G1, G2 and G3), root dentin was flared to produce a 1-mm space between the fiber post and the canal walls. In the control group (G4), the roots were not experimentally weakened. The roots in the experimental groups were bulk restored with Light Core composite resin, which was light-activated through the D. T. Light-Post for either 40 s (G1), 80 s (G2) or 120 s (G3). The posts were cemented (Duo Link-Bisco Inc.) and, after 24 h, the roots were sectioned transversely at the coronal, middle and apical regions producing 1-mm-thick slices (±0.1 mm). Push-out tests were performed (0.5 mm/min, Instron 4444) and failure modes were observed under stereomicroscopy. **Results:** Means in MPa (±SD) were: GC=7.939 ±2.784; G1=10.36 ±2.99; G2=9.03 ± 2.69 and G3=10.28 ±3.16. Two-way ANOVA (□=0.05) indicated statistically significant difference among the groups ($p<0.001$), but not among the post regions ($p>0.05$). Comparing the weakened/reinforced groups, composite light-exposure time did not influence the results ($p>0.05$). There were a higher percentage of adhesive failures (in the post or dentin) in the control (73.33%) and experimental groups (85.18%). Cohesive failures occurred only in the weakened/reinforced roots (100%). **Conclusions:** Root reinforcement with composite resin and light transmitting posts provided higher bond strength to dentin than the control group, independently of the composite light-exposure time and analyzed region.

*Valandro, LF, Baldissara, P, Galhano, GA, Melo, RM, Mallmann, A, Scotti, R, Bottino, MA. **Effect of mechanical cycling on the push-out bond strength of fiber posts adhesively bonded to human root dentin.** *Oper Dent. 2007 Nov-Dec;32(6):579-88.*

This study evaluated the effect of mechanical cycling on the bond strength of fiber posts bonded to root dentin. The hypotheses examined were that bond strength is not changed after fatigue testing and bond strength does not present vast variations according to the type of fiber post. Sixty crownless, single-rooted human teeth were endodontically treated, with the space prepared at 12 mm. Thirty specimens received a quartz fiber post (Q-FRC) (D.T. Light-Post, RTD, St Egreve, France), and the remaining 30 specimens received a glass fiber post (G-FRC) (FRC Postec Plus). All the posts were resin luted (All-Bond+Duo-link), and each specimen was embedded in a cylinder with epoxy resin. The specimens were divided into six groups: G1- Q-FRC+no cycling; G2- Q-FRC+20,000 cycles (load: 50N; angle of 450; frequency: 8Hz); G3- Q-FRC+2,000,000 cycles; G4- G-FRC+no cycling; G5- G-FRC+20,000 cycles; G6- G-FRC+2,000,000 cycles. The specimens were cut perpendicular to their long axis, forming 2-mm thick disc-samples, which were submitted to the push-out test. ANOVA (alpha = .05) revealed that: (a) Q-FRC (7.1 +/- 2.2MPa) and G-FRC (6.9 +/- 2.1MPa) were statistically similar (p = 0.665); (b) the "no cycling" groups (7.0 +/- 2.4MPa), "20,000 cycles" groups (7.0 +/- 2.1MPa) and "2,000,000 cycles" groups (7.0 +/- 2.0MPa) were statistically similar (p = 0.996). It was concluded that mechanical cycling did not affect the bond strength of two fiber posts bonded to dentin.

Wang, VJ, Chen, YM, Yip, KH, Smales, RJ, Meng, QF, Chen, L. **Effect of two fiber post types and two luting cement systems on regional post retention using the push-out test.** *Dent Mater. 2008 Mar;24(3):372-7. Epub 2007 Jul 25.*

Objective: To investigate regional root canal push-out bond strengths for two fiber-reinforced post types using two adhesive systems. **Methods**: The crowns of 24 recently extracted sound maxillary central incisors were sectioned transversely 2mm coronal to the labial cemento-enamel junction, and the roots treated endodontically. Following standardized post space preparations, fiber-reinforced posts (Composipost / C-Post; Aestheti-Plus: RTD, St Egreve, France/Bisco) were placed using two adhesive systems (acid-etch One-Step Plus /C&B Cement; self-adhesive RelyX Unicem), in four equal groups. Push-out bond strength tests were performed at four sites in each root. Results were analyzed using split-plot ANOVA, with a=0.05 for statistical significance. **Results:** Aestheti-Plus quartz fiber-reinforced posts showed significantly higher push-out strengths than C-POST carbon fiber-reinforced posts (P<0.0001). The separate acid-etch adhesive system resulted in significantly higher bond strengths than the self-etch self-adhesive system (P<0.0001). Bond strengths decreased significantly from coronal to apical root canal regions (P<0.0001). **Significance:** The quartz fiber-reinforced post placed using the separate acid-etch adhesive system provided significantly better post retention than the carbon fiber-reinforced post placed using the self-etch self-adhesive system.

*Wrbas, KT, Kampe, MT, Schirrmeister, JF, Altenburger, MJ, Hellwig, E. . **Retention of fiber posts dependent on different resin cements.** *Schweiz Monatsschr Zahnmed. 2006;116(1):18-24 (article in German)*

Tooth-coloured adhesive inserted fiber posts are used to restore endodontically treated teeth. In this investigation, the tensile bond strength of two different fiber posts systems (ER DentinPost and D.T. Light Post) in combination with five different resin cements was tested. The posts were inserted into artificial root canals in bovine dentin using Clearfil Core, RelyX Unicem, Panavia 21ex, Panavia F2.0 und Calibra. Titan posts (ER-Kopfstift), inserted with zincphosphate cement served as control group. ER DentinPost inserted with Clearfil Core had significantly higher tensile bond strengths than in combination with Panavia F2.0 (221.70 +/- 17.99 N) or Calibra (212.37 +/- 45.20 N). D.T. Light Post in combination with Calibra (338.20 +/- 46.40 N), Panavia F2.0 (321.69 +/- 40.11 N) and Panavia 21ex (290.41 +/- 55.28 N) showed significantly higher tensile bond strengths compared to adhesive cementation with RelyX Unicem (211.57 +/- 32.35 N) and Clearfil Core (131.67 +/- 51.72 N). The tensile bond strength of the control group was in the upper third of the values (315.43 +/- 51.38 N). Optical analysis of the post surface after decementation demonstrated in all cases adhesive-cohesive mixed fractures. The adhesion of resin cement to the fiber posts and resin cement to root canal dentin is influenced by different factors. The combination of fiber post systems with the type of resin cement has a great influence on the tensile bond strength.

*Wrbas, KT, Altenburger, MJ, Schirrmeister, F, Bitter, K., Kielbassa, AM. **Effect of adhesive resin cements and post surface silanization on the bond strengths of adhesively inserted fiber posts** *J Endod July s2007 Volume 33, Issue 7, Pages 840-843*

Abstract: This study evaluated the tensile bond strengths and the effect of silanization of fiber posts inserted with different adhesive systems. Sixty D.T. Light-Posts Size 1 (RTD St Egreve, France) were used. Thirty posts were pretreated with silane. The posts were cemented into form-congruent artificial root canals (12 mm) of bovine dentine. Six groups were formed: G1, Prime&Bond NT/Calibra; G2, Monobond-S+Prime&Bond NT/Calibra; G3, ED Primer/Panavia 21ex; G4, Monobond-S+ED Primer/Panavia 21ex; G5, RelyX Unicem; and G6, Monobond-S+RelyX Unicem. The mean (standard deviation) tensile bond strengths (megapascals) were 7.69 (0.85) for G1, 7.15 (1.01) for G2, 6.73 (0.85) for G3, 6.78 (0.97) for G4, 4.79 (0.58) for G5, and 4.74 (0.88) for G6. G1 achieved significantly higher bond strengths than G3 and G5; G3 had significantly higher values than G5 ($P < .05$; Scheffé procedure). Silanization had no significant effect ($P > .05$, one-way

analysis of variance). Tensile bond strengths were significantly influenced by the type of resin cement. Silanization of fiber post surfaces seems to have no clinical relevance.

Ferrari, M,, Carvalho, C.A,, Goracci, C., Antoniolli, F., Mazzoni, A., Mazzotti, G., Cadenaro, M., Breschi ,L. **Influence of luting material filler content on post cementation.** *J Dent Res. 2009 Oct;88(10):951-6.*

Luting of fiber posts to intra-radicular dentin represents the worst-case scenario in terms of control of polymerization shrinkage. This study tested the hypothesis that filler content of resin cements does not influence luting of fiber posts to intra-radicular dentin, by assaying polymerization stress, push-out bond strength, and nanoleakage expression. The polymerization stress of experimental cements containing 10%, 30%, 50%, or 70% in filler content was investigated. Post spaces were prepared in endodontically treated teeth, and fiber posts were cemented with the experimental cements. A push-out test was performed, and interfacial nanoleakage expression was analyzed. Results showed that luting cements with higher filler content were related to increased polymerization stress ($p < 0.05$), decreased push-out bond strength ($p < 0.05$), and increased interfacial nanoleakage expression ($p < 0.05$). Conversely, lower-stress luting materials increased bonding of fiber posts to intra-radicular dentin. Further in vivo studies are needed to investigate the long-term clinical performance of these materials. **PDF**

*Mazzoni, A., Marchesi, G., Cadenaro, M., Mazzotti, G., Di Lenarda, R., Ferrari, M., Breschi, L. **Push-out stress for fibre posts luted using different adhesive strategies**. *Eur J Oral Sci. 2009 Aug;117(4):447-53.*

The influence of thermocycling on the bond strength of fibre posts cemented with different luting approaches was investigated. A total of 84 human incisors were selected for the study. Sixty teeth were assigned to one of the following adhesive/cement combinations for push-out bond-strength evaluation: group 1, XP Bond/CoreXFlow + **DT Light-Post;** group 2, Panavia F 2.0 + Tech 21; or group 3, RelyX Unicem + RelyX. Bonded specimens were cut into 1-mm-thick slabs and either thermocycled (40,000 cycles) or stored in artificial saliva (control specimens) before push-out bond-strength testing. Additional specimens were processed for quantitative interfacial nanoleakage analysis. Thermocycling decreased the bond strength in specimens of groups 2 and 3, but did not affect the specimens from group 1. No difference was observed among luting approaches in control specimens. Thermocycling resulted in increased silver nitrate deposition (i.e. interfacial nanoleakage) in all groups. Within the limitations of the study, the use of an etch-and-rinse adhesive in combination with a dual-cure cement to lute fiber posts is the most stable luting procedure if compared with a self-etch resin-based cement or a self-adhesive cement, as assayed by thermocycling of the bonded specimens. **PDF**

Spazzin , A.O., de Moraes, R.R., Cecchin, D., Farina, A.P., Carlini-Júnior, B., Correr-Sobrinho, L. **Morphological analysis of glass, carbon and glass/carbon fiber posts and bonding to self or dual-cured resin luting agents.** *J Appl Oral Sci. 2009 Sep-Oct;17(5):476-80.*

Objective: The aim of this study was to evaluate the morphology of glass (GF), carbon (CF) and glass/carbon (G/CF) fiber posts and their bond strength to self or dual-cured resin luting agents. **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.

B. RESINA AO PINO

*Coelho, G., Santos, G., El-Mowafy. O., Hernique Rubo, J. **Diametral tensile strength of a resin composite core with nonmetallic prefabricated posts: an in vitro study.** *J Prosthet Dent. 2004 Apr;91(4):335-41.*

Statement of problem: A number of prefabricated nonmetallic posts are currently available for use in conjunction with resin composite cores before fabrication of crowns for endodontically treated teeth. Information is needed regarding the strength of

the composite and the nature of attachment between its components. **Purpose:** The aim of this study was to determine the influence of different types of posts on the fracture resistance of a resin composite core material using the diametral tensile strength (DTS) test. **Methods:** Cylindrical specimens, 6 mm in diameter and 3 mm high, were prepared from resin composite (Tetric Ceram) and a group of prefabricated posts (n=10) as follows: resin composite only (control); Vectrispost (VTS); FiberKor (FKR); Aestheti-Plus post (ATP); Light-Post (LTP); Dentorama post (DRM), and Para-Post (PRP) as a second control. Specimens were stored for 7 days in water at 37 degrees C and then subjected to DTS test in a universal testing machine until failure occurred and load was recorded (N). Mean values and SD for DTS values (MPA) were calculated, and data were analyzed statistically with 1-way analysis of variance, followed by the Tukey test (alpha=.05). Representative specimens from each group were examined with SEM to determine nature of failure. **Results:** Mean values (SD) in MPa for DTS were as follow: Control group: 49.64 (3.36); VTS: 29.77 (3.36); FKR: 31.9 (2.39); ATP: 28.92 (2.2); LTP: 34.26 (3.37); DRM: 33.45 (2.46), and PRP: 27.90 (2.40). Analysis of variance indicated significant differences among the groups (P<.05). SEM examination indicated that for PRP failure was adhesive in nature, whereas with all nonmetallic posts, cohesive failure was more predominant. **Conclusions:** The use of posts did not result in reinforcement of resin composite core when diametral tensile force was applied. When used with the core material, LTP, DRM, and FKR resulted in the highest DTS values, whereas PRP resulted in the lowest values. **Clinical Implications:** Some non-metallic fiber-reinforced posts, when used with a resin composite core, resulted in significantly higher Diametral Tensile Strength (DTS) compared with metal prefabricated posts. These higher DTS values meet minimum accepted values as provided by the ADA specifications for direct Type II composite materials. **PDF**

*Dallari, A., Rovatti, L., Dallari, B., Mason, P. **Adhesion of different composites to carbon and quartz fiber endodontic posts: in vitro studies and preliminary reports**. *J Dent Res. Vol 82 IADR Abstract #1952, 2003 (www.dentalresearch.org)*

Objectives: Composites are used in post-endodontic core rebuildings when carbon and/or quartz fiber posts have been luted in root canals. Which composite is able to give the best clinical results in core rebuilding is still being discussed. The purpose of this study is to compare the adhesion of different composites to the surface of both carbon and quartz fiber posts. **Methods:** Two dual-curing (CoreRestore2 : Kerr & Luxacore:DMG) and two light-curing composites (Light-Core:Bisco & HelioMolar: Vivadent) were used to build a core on quartz fiber posts (Light-Post: RTD, St Egreve, France/Bisco). Posts were etched with Hydrofluoric acid 9.6% for 10 seconds. Two dual-curing (CoreRestore2 & BisCore: Bisco) and two light-curing composites (Renew: Bisco & Heliomolar) were used on carbon fiber posts (RTD/Bisco). In all, 8 groups of 10 specimens each were prepared. All the cores were built by using the same form (Composipost Core Form: RTD). Three slices (2.5mm thickness) in each specimen were obtained by using Leitz 600 device, and pull-out tests with Instron machine were performed. **Results:** on quartz fiber posts, CoreRestore 2: 393.9 N-29.02 MPa, Luxacore: 347 N-25.52 MPa, Light-Core: 313.7 N-21.31 MPa, Heliomolar: 182.4 N-13.22 MPa. On carbon fiber posts CoreRestore 2: 236.3 N-216.67 MPa, Bis-Core: 235.5 N-16.66 MPa, Renew: 234.8 N-16.61 MPa, Heliomolar: 228.6 N-16.15 MPa. **Conclusions:** The above results show that 1) the adhesion of composite resins to quartz fiber posts is higher than to carbon fiber posts, 2) on quartz fiber posts, dual-curing composites lead to a stronger adhesion that light–curing composites and 3) on carbon fiber posts, only negligible differences exist between dual and light-curing composites.

*Meador, M., Broome, J., Ramp, L. **Diametral tensile bond strength of resin composite to fiber posts**. *J Dent Res. Vol 86 (Spec. Iss. A) Abstract #0867, 2007 (www.dentalresearch.org)*

Adhesive reconstruction of endodontically treated teeth using fiber posts and resin composite materials has become increasingly popular. Recommendations include pre-treating the post with adhesive and/or silane. However, since the fiber post has a rough surface and is highly polymerized, it is questionable whether this step contributes to the bond. The diametral compression test (DCT) can be used to indirectly determine he bond of composite to a post (Santos JPD 91:335-41,2004). **Objective:** to determine the effect of various surface treatments on the bond of resin composite to fiber posts by DCT. **Methods:** Cylinders of resin composite (Z100, 3M ESPE, St. Paul, MN), were formed around the coronal end of three different fiberposts: D.T. Light-Post (Bisco/RTD, St Egreve, France), RelyX (3M ESPE) and UniCore (Ultradent). Four conditions (n=5) were tested: post surface untreated (Untx); cleaned with EtOH; cleaned and primed with All-Bond 2 (AB2); post coated with Vaseline to prevent bonding (Vas). A solid cylinder of composite (Sol) was used as a control (n=5). Samples were loaded to failure in diametral compression on an Instron Universal Testing Machine at a crosshead speed of 1 mm/min. DTS was calculated according to the formula: $2P/\pi*D*T$. Means were compared with ANOVA and Fisher's PLSD (alpha = 0.05). **Results:** Means in MPa (s.d) are given in the table. Means with the same superscript are not significantly different. Due to slight variations in size, comparisons between posts were not possible.

	Solid cylinder	AB2	Untreated	EtOH	Vaseline
DT	28.7 (5.17)a	27.8(5.75)a	27.3 (2.30)a	24.27(1.05)a	12.4(1.30)b
RelyX	28.7 (5.17)a	30.4(2.89)a	27.5(3.62)a,b	25.7(3.35)a,b	14.2 (1.84)c
UniCore	28.7 (5.17)a	26.2(3.11)a	20.0(3.14)b	18.8(2.74)b	13.6(2.34)c

Conclusions: For two of the three posts there was no statistically significant difference in bond regardless of surface treatment, but treatment of the post with a dentin bonding agent resulted in the highest bond strength to resin composite in all cases.

Saelee, D., Sooksuntisakoonchai, N., Mangkrasan, V., Jindanusorn, D. **Bond strength between quartz fibre posts and core materials**. *J Dent Res. 81 IADR Abstract # 1154; 2002 (www.dentalresearch.org)*

Objectives: The purpose of this study was to determine the modes of failure and bond strength between quartz fiber post (Æstheti-Plus, RTD, St Egreve, France) and core build up materials (light cure composite resin, Alphadent, Dental Technologies, Inc., USA). **Methods:** Sixty quartz fiber posts were placed in extracted premolar and core were built up with light cure composite resin. Specimens were classified into 6 groups due to three diameters; 1.4, 1.8 and 2.1 millimeters at different heights; 2 and 4 millimeters. Universal Testing Machine (Lloyd LR30K, Lloyd Instruments, Ltd., England) was performed at the angulation of 45 degrees to the long axis of the tooth with cross head speed 0.2 millimeters/second. Each specimen was continuously loaded until fracture occurred. **Results:** It was found that the median load that caused core fracture out until fracture out of the post diameter 1.4, 1.8, and 2.1 millimeters were 244.3 N (95% CI: 218.2 N to 300.8 N), 393.5 N (95% CI: 373.8 N to 423.4 N), and 376.6 N (95% CI: 354.6N to 433.3N) respectively. The median fracture load measured from different post diameters was significantly different (P-value <0.001) whereas the load from various post heights was not significantly different (P-value=0.459). The modes of failure occurred between composite resin and post dentine (91.7%). No fractures were found within root, coronal tooth structure and post. **Conclusions:** From this study, it could be concluded that quartz fibers posts would not cause any coronal tooth structure and/or root fracture. Post diameter 1.8 and 2.1 were recommended due to higher bond strength between post and core materials.

Wang, Y.J., Zhang, L., Chen, J.H., Goracci, C., Ferrari, M. **Influence of C-factor on the microtensile bond strength between fiber posts and resin luting agents.** *J Adhes Dent. 2008 Oct;10(5):385-91.*

Purpose: To propose an experimental model for assessing the interfacial strength between post and luting agent under clinically relevant conditions of post space diameter and cement layer thickness. **Methods:** DentinPost (Komet, DP) and GC (GC) glass fiber posts were tested. A sample of 22 posts per type was randomly subdivided into two equal groups based on the material for cementation: Panavia F 2.0 (Kuraray, PF) and MultiCore Flow (Ivoclar Vivadent, MF). Within each group, 2 subgroups were defined depending on the procedure for specimen preparation. In subgroup A (NO-M), the resin cement was incrementally stratified around a post centered within a plastic matrix until the latter was filled. In subgroup B (M), first a mold of resin cement with an artificial post space was created. Then, using the same cement, the post was luted into the dowel space. Microtensile beams were cut and loaded to measure post/cement interfacial strengths. For statistical analysis of the data, Kruskall-Wallis ANOVA was applied, followed by Dunn's Multiple Range test ($p < 0.05$). **Results:** Bond strengths in MPa were (median; 25th-75th percentile): DP/PF/M 4.5; 3.1-7.4; DP/PF/NO-M 9.2; 5.8-12.4; DP/MF/M 14.2; 10.2-20-6; DP/MF/NO-M 16.5; 13.1-21.7; GC/PF/M 7.6; 3.3-11.7; GC/PF/NO-M 7.8; 5.1-11-9; GC/MF/M 16.7; 14.3-3-22; GC/MF/NOM 20.4; 15.6-24. Irrespective of post type and of specimen preparation procedure, with or without mold, significantly higher bond strengths were measured for MF. On both post types, both cements achieved similar interfacial strengths regardless of the C-factor. **Conclusion:** The influence of a clinically relevant C-factor on the adhesion of resin cements to glass fiber posts was not statistically significant. **PDF**

*Wrbas, KT, Lenz, A, Schirrmeister, JF, Altenburger, MJ, Schemionek, W, Hellwig, E**. Bond strength of different resin composites to fiber-reinforced posts.** *Schweiz Monatsschr Zahnmed. 2006;116(2):136-41 (article in German)*

Endodontically treated teeth often have little coronal tooth tissue remaining and as such require a post to retain the core and the restoration. Therefore, tooth coloured adhesive inserted fiber posts in combination with resin based core material can be used. In this study, the tensile bond strength of core materials to fiber posts was investigated. Three different core materials, Clearfil Core, CoreRestore 2 and MultiCore Flow in combination with two different fiber posts systems, ER DentinPost and **DT Light-Post**, were tested. The posts were shortened to the lengths of 15 mm.The specimens were obtained while the upper part (3 mm) of the posts was covered with standardized cylinders of the core materials. Clearfil Core in combination with the DT Light Post (230.5 N +/- 42.2 N) and ER DentinPost (154. N +/- 33.6 N) had the highest tensile bond strengths of all groups. The tensile bond strength of CoreRestore 2 to D. T. Light-Post (149.9 N +/- 29.5 N) was higher than the tensile bond strengths of the combinations MultiCore Flow/D. T. Light-Post (140.9 N +/- 31.4 N) and Multi- Core Flow/ER DentinPost (122,. N +/-19,. N). The group Core-Restore 2TER DentinPost had the lowest tensile bond strengths (80,1 N ++/-19,4 N). The adhesion of the resin based core materials to the fiber posts is influenced by the post design and core materials. The combination of core materials with the type of fiber post has a great influence on the tensile bond strength.

*Yenisey, M, Kulunk, S. **Effects of chemical surface treatments of quartz and glass fiber posts on the retention of a composite resin.** *J Prosthet Dent. 2008 Jan;99(1):38-45*

Statement of problem: Failure of a fiber post and composite resin core often occurs at the junction between the 2 materials. This failure process requires better characterization. **Purpose:** The purpose of this study was to evaluate the effect of 2 chemical solvents, hydrogen peroxide and methylene chloride, on the shear bond strength of quartz and glass fiber posts to a composite resin. **Methods:** Twenty-four posts (3 +/-0.1 mm in length) were prepared for each quartz (Light-Post (LP)) and glass fiber (Cytec blanco (CB)) post. Posts were horizontally embedded in acrylic resin with half of the post diameter exposed. The exposed surfaces were successively ground with 400-, 800-, and 1200-grit silicon carbide papers, to ensure uniform smoothness. The specimens were divided into 3 subgroups (n=8) representing different surface treatment techniques, including application of silane for 60 seconds (S), etching with hydrogen peroxide for 20 minutes (H), and etching with methylene chloride for 5 seconds (M). Silane-treated specimens served as controls. A dual-polymerized composite resin (Tetric EvoCeram) was placed in a polytetrafluoroethylene mold (30 x 2 mm) positioned upon the post specimens and polymerized for 20 seconds with a light-emitting diode (LED) polymerization unit. The specimens were stored in water at 37 degrees C for 24 hours. Shear bond strength values (MPa) of posts and composite resin cores were measured using a universal testing machine with a crosshead speed of 0.5 mm/min. Data were analyzed by 2-way analysis of variance (ANOVA). Post hoc Tukey intervals for comparison among the 2 post materials and 3 surface treatment techniques were calculated (alpha =.05). The effect of the chemical surface treatments on glass and quartz fiber post surfaces were examined with a scanning electron microscope (SEM). **Results:** There were significant differences between the shear bond strength for LP and CB (P<.001). For all groups, the application of H showed the highest bond strength values. There was no significant difference between the S and M groups (P>.05). The SEM observations demonstrated that the fiber post surfaces were modified after chemical surface treatment techniques. **Conclusions:** The surface treatment of quartz and glass fiber posts with hydrogen peroxide significantly enhanced the shear bond strength of the composite resin tested due to its ability to dissolve the epoxy resin matrix used in each post. The lowest bond strength was obtained with M and S groups. Application of methylene chloride to the fiber post surfaces for 5 seconds was not effective in increasing the shear bond strength of the fiber post to composite resin.

Rathke, A, Haj-Omer ,D., Muche, R., Haller, B. **Effectiveness of bonding fiber posts to root canals and composite core build-ups.** *Eur J Oral Sci. 2009 Oct;117(5):604-10.*

This study investigated the effects of fiber posts, silanization, and luting agents on the interfacial strength to root dentin and composite cores. Root canals of 120 crownless human teeth were instrumented. Three different posts (opaque and translucent), with and without silane treatment, were bonded using etch-and-rinse, self-etch, and self-adhesive luting agents. The restored roots were built up with dual-curing composite. After storage in water for 24 h at 37 degrees C, 2-mm-thick slices were cut from each sample: one from the composite core and one from the restored root. Interfacial push-out bond strengths of the posts were determined in a universal testing machine. Failure modes were analyzed using scanning electron microscopy. The post type and the luting agent had significant effects on both the post-to-dentin and post-to-core strengths. Silanization did not significantly influence post-to-dentin strengths, but enhanced post-to-core strengths. With etch-and-rinse luting agents, debonding occurred predominantly between the post and the cement, while the self-etch and self-adhesive luting agents showed more failures on root dentin. No failures occurred between the composite core and the cement. The combination of translucent posts and etch-and-rinse dual-curing luting agents can positively influence the retention of fiber posts in root canals. Silanization seems to be less relevant for intra-root canal bonding, but may have beneficial effects on post-to-core strengths. **PDF**

V. Resultados Clínicos

Cagidiaco, MC, Goracci, C, Garcia-Godoy, F, Ferrari, M. **Clinical studies of fiber posts: a literature review.** *Int J Prosthodont. 2008 Jul-Aug;21(4):328-36*

Purpose: This literature review aimed to find answers to relevant questions regarding the clinical outcome of endontically treated teeth restored with fiber posts. **Methods**: All clinical studies published since 1990 in journals indexed in MEDLINE were retrieved by searching PubMed with the query terms "fiber posts and clinical studies." The reference list of the collected articles was also screened for further relevant citations. The strength of the evidence provided by the reviewed papers was assessed according to the criteria of evidence-based dentistry. **Results:** Five randomized controlled trials (RCTs) on fiber posts have been published in peer-reviewed journals. A meta-analysis is not applicable to these studies since they do not address the same specific clinical question. Retrospective and prospective trials without controls are also available. **Conclusions:** Two RCTs indicate that fiber-reinforced composite posts outperform metal posts in the restoration of endontically treated teeth. However, this evidence cannot be considered as conclusive. Longer-term RCTs would be desirable. The placement of a fiber-reinforced composite post protects against failure, especially under conditions of extensive coronal destruction. The most common type of failure with fiber-reinforced composite posts is debonding. **PDF**

*Cagidiaco, MC, Radovic, I, Simonetti M, Tay, F, Ferrari, M. **Clinical performance of fiber post restorations in endodontically treated teeth: 2-year results**. *Int J Prosthodont. 2007 May-Jun;20(3):293-8*

Purpose: This study evaluated the 2-year outcome of post-and-core restorative procedures in endodontically treated teeth. The effect of baseline factors (tooth type, number of residual coronal walls, and type of definitive restoration) on restoration failure was assessed. **Methods:** The consecutive sample design included 150 patients. A total of 162 teeth (57 anterior and 105 posterior) were restored. Sixty-nine teeth had 3 or 4 residual coronal walls, while 93 teeth had 2 or fewer walls. Crowns and direct resin composite restorations were placed in 121 and 41 teeth, respectively. After 23 to 25 months, all patients were evaluated. Logistic regression was used to identify the joint effect of variables recorded at baseline ($P < .05$). **Results:** The only failure modes observed were post debonding (4.3%, 2 in anterior teeth and 5 in posterior teeth) and endodontic failure (3.0%, 2 in anterior teeth and 3 in posterior teeth). All post debondings occurred in teeth with 2 or fewer coronal walls that were crown covered. All endodontic failures occurred in crown-covered teeth (1 failure in a tooth with 3 walls and the remaining 4 failures in teeth with 2 or fewer walls). Logistic regression found no statistical significance for any of the variables recorded at baseline. **Conclusions:** Restorations placed with the use of a fiber post (D. T. Light-Post, RTD, St Egreve, France) and core resulted in 4.3% post debondings and 3.0% endodontic failures after 2 years of clinical service. **PDF**

*Cagidiaco, MC., Garcia-Godoy, F., Vichi, A., Grandini, S., Goracci, C., Ferrari, M., **Placement of fiber prefabricated or custom made posts affects the 3-year survival of endodontically treated premolars**. *Am J Dent; 2008 21: 179-184*

Purpose: To assess whether the amount of residual coronal dentin and the placement of a prefabricated (D.T. Light-Post, RTD,St Egreve, France) (LP) or a customized fiber post (Everstick Post) (ES) have a significant influence on the 3-year survival of endodontically treated premolars. **Methods:** A sample of 345 patients provided 6 groups of 60 premolars in need of endodontic treatment. Groups were defined based on the amount of dentin left at the coronal level after endodontic treatment and before abutment build-up. Within each group, teeth were randomly divided into three Sub-groups (n=20). In Sub-group A, no root canal retention was provided for the coronal restoration. In Sub-groups B and C, LP and ES, respectively, were placed inside the root canal. All the teeth were finally restored with a single unit metal-ceramic crown. **Results:** Data were not affected by any loss of follow-up. The overall 36- month survival rate of crowned, endodontically treated premolars was 76.7%. The lowest survival rate was recorded for teeth restored without any root canal retention (62.5%). Teeth restored with LP had a survival rate higher (90.9%) than those restored with ES (76.7%). The Cox regression analysis showed that the presence of root canal retention was a significant factor for survival ($P<0.05$). The decrease in failure risk was higher in teeth restored with LP (HR=0.1;95% CI for HR=0;.09 to 0.34; $P<0.001$) than when using ES (HR= 0.5; 95% CI for HR=0.3 to 0.7; P=0.003). Teeth retaining one (HR=0.3; 95% CI for HR=0.2 to 0.7; P=0.003), two (HR=0.2; 95% CI for HR=0.1 to 0.5; $P<0.001$), or three coronal walls (HR=0.1; 95% CI for HR=0.05 to 0.3; $P<0.001$), had a significantly lower failure risk than teeth deprived even of the ferrule effect. Similar failure risks existed for teeth missing all the coronal walls, regardless of the presence or absence of a ferrule effect ($P>0.05$). Interaction terms were not significant ($P>0.05$). Post placement and the amount of residual coronal dentin affected the 3-year survival of endodontically treated premolars. **Clinical significance:** To obtain the highest success rate, endodontically treated premolars should be restored with a fiber post and a complete crown. The "ferrule" structure has a direct influence on the clinical success rate. **PDF**

*Goracci, C. ,Cagidiaco, M., Cagidiaco, E.,Vichi, A., Grandini, S., Ferrari, M.. **Effects of oral environment and occlusal wear on FRC-posts integrity**. *J Dent Res. Vol 86 (Spec. Iss. A) Abstract #0131, 2007 (www.dentalresearch.org)*

Objectives: To evaluate whether the exposure to the oral environment and occlusal wear during function affects the morphological integrity of fiber posts underlying a luted crown or a direct composite restoration. Methods: Two groups of endodontically treated teeth restored with D. T. Light- Posts (RTD, St. Egreve, France) were investigated. Group 1 included ten crowned teeth in which the abutment had the post head exposed on the surface. Group 2 included ten teeth directly restored with resin composite and presenting with the post head exposed on the occlusal surface of the restoration. For baseline evaluation, polyether impressions (Permadyne, 3M ESPE) were taken of the abutments before crown luting in Group 1, and of the restorations occlusal surfaces immediately after polishing in Group 2. Results: After a 5-year period of clinical service, polyether impressions were taken again for each experimental tooth. All the impressions were developed with epoxy resin and observed under a scanning electron microscope (Jeol, Tokyo, Japan), in order to assess whether the post surface underwent structural changes due to water uptake (Groups 1 and 2) and/or occlusal wear (Group 2) during the clinical function. Results: In neither group microscopic signs of post surface degradation due to water uptake were seen. In Group 2 wear signs were visible on the exposed post surface, as well as on the surface of the direct composite. Conclusion: Over a 5-year period, in case the fiber post surface is exposed on the top of the abutment, the seal provided by the crown effectively protects the fiber post against water uptake. When the post surface is exposed in a direct resin restoration, it does not show evident morphological changes related to water degradation, although it exhibits a loss of structure due to occlusal wear.

Fazekas, A, Menyhart, K, Bodi, K, Jako, E **Restoration of root canal treated teeth using carbon fiber posts**. *Fogorv Sz 1998 Jun;91 (6):163-70*

Abstract/conclusions: The restoration of root canal treated teeth – because of the significant loss of tooth structure- is often achieved with post and core. However, posts may generate stresses, which lead to vertical root fracture and the loss of the tooth. Since post design, materials used and post space preparation has significant influence on vertical fracture prevalence, broad investigation is in progress to find the optimal procedure. During the last decade, new prefabricated passive posts were introduced for postendodontic restorations. In order to collect information, clinical trials have been performed on the reconstruction of root canal treated teeth using Carbon fibre posts (C-POST/ COMPOSIPOST; RTD, St Egreve, France). Adhesive technique was applied to cement post in the root canal and for composite core reconstruction. The physical properties of the Carbon fibre posts and the composite are very close to those of the dentine. Post application is simple, does not require special skill and, for the patient, means minimum hazard. The position of the post was controlled by radiography. During the 24 months observation period, no failure was registered in patients treated (N=55). Hence, we attribute our good results to the homogenous reconstruction of the teeth. This procedure seems to be a good alternative to traditional cast metal dowel/cores or metal prefabricated posts.

Ferrari, M., Cagidiaco, C., Goracci, C., Vichi, A., Mason, P, N., Radovic, I., Tay, F. **Long-term retrospective study of the clinical performance of fiber posts** *.Am J Dent 2007;20:287-291.*

Purpose: To retrospectively evaluate the long-term clinical performance of three types of fiber posts after a service period of 7-11 years. **Methods:** 985 posts were included in the study: 615 Composiposts, 160 Æstethic Posts and 210 Æsthetic Plus Posts were placed into endodontically treated teeth. Four combinations of dentin adhesives/luting materials were used. Endodontic and prosthodontic results were recorded. **Results:** A 7-11% failure rate was recorded for the three types of posts. 79 failures in total were noted; 39 due to endodontic reasons, 1 root fracture, 1 fiber post fracture, 17 crown dislodgements and 21 due to post debonding. The mechanical failures were always related to the lack of coronal tooth structure. The results indicated that fiber posts in combination with bonding/luting materials may be used routinely for restoring endodontically treated teeth. Mechanical failure of restored teeth with fiber posts can be related to the amount of residual coronal structure. **PDF**

*Ferrari, M., Cagidiaco, M., Grandini, S., DeSantis, M., Goracci, C. **Post placement affects survival of endodontically treated premolars.** *J Dent Res 86(8):729-734, 2007*

Abstract: Clinical evidence is lacking regarding the influence of the amount of residual coronal dentin and of post placement on the failure risk of endodontically compromised teeth. The aim of this prospective clinical trial was to assess whether these factors significantly affect the two-year survival of restored pulpless premolars. A sample of 210 individuals provided six experimental groups of 40 premolars in need of endodontic treatment. Groups were defined on the amount of dentin left at the coronal level. Within each group, in half of the teeth selected at random, a fiber post (D. T. Light-Post, RTD, St. Egreve, France) was inserted inside the root canal, whereas in the remaining half of the premolars, no post was placed. All teeth were covered with a crown. The Cox regression analysis revealed that post placement resulted in a significant reduction of failure risk ($p < 0.001$). Failure risk was increased for teeth onder the "no ferrule" ($p < 0.001$) and "ferrule effect" conditions ($p < 0.004$). **PDF**

Ferrari, M., Vichi, A., and Garcia-Godoy, F. **Clinical evaluation of fiber-reinforced epoxy resin posts and cast post and cores.** *American Journal of Dentistry. 13: 15B-18B, 2000.*

Purpose: This retrospective study evaluated treatment outcome of cast post and core and Composipost systems after 4 yrs of clinical service. **Methods:** 200 patients were included in this study. They were divided into two groups of 100 endodontically treated teeth restored with a post. Group 1: Composipost systems were luted into root canal following the manufacturer's instructions. Group 2: Cast post and cores were cemented into root canal preparations with a traditional technique. The patients were recalled after 6 months, 1, 2 and 4 yrs and clinical and radiographic examinations were completed. Endodontic and prosthodontic results were recorded. **Results:** Group 1: 95% of the teeth restored with Composiposts showed clinical success; 3 of these samples were excluded for noncompliance and 2% showed endodontic failure. Group 2: Clinical success was found with 84% of teeth restored with cast post and core. 2% of these samples were excluded for noncompliance, 9% showed root fracture, 2% dislodgment of crown and 3% endodontic failure. Statistical evaluation showed significant differences between Groups 1 and 2 ($P<0.001$). The results of this retrospective study indicated that the Composipost system was superior to the conventional cast post and core systems after 4 years of clinical service. **PDF**

Ferrari, M., Vichi, A., Mannocci, F., and Mason, P. N. **Retrospective study of the clinical performance of fiber posts.** *American Journal of Dentistry. 13: 9B-13B, 2000.*

Purpose: To evaluate the clinical performance of C-Posts, Aestheti- Posts and Aestheti-Plus Posts (RTD, St Egreve, France) after a period of clinical service ranging from 1-6 yrs. **Methods:** 1,304 posts were included in the study: 840 Composiposts, 215 Aestheti-Posts and 249 Aestheti-Plus posts were placed into endodontically treated teeth. Four combinations of bonding/luting materials were used. The patients were recalled every 6 months and clinical and radiographic examinations were completed. Endodontic and prosthodontic results were recorded. Actuarial Life Table statistical analysis and Mantel-

Haenszel comparison of survival curve have been performed at 95% level of confidence. **Results:** The 3.2% failure rate was due to two reasons: 25 posts debonded during removal of temporary restorations, and 16 teeth showed periapical lesions at the radiographic examination. No statistically significant differences were found among the four groups. The results of this retrospective study indicate that fiber posts in combination with bonding / luting materials can be routinely used. **PDF**

*Ferrari, M, Cagidiaco, M. ,Vichi, A., Grandini, S., Goracci, C. **Post placement and residual coronal structure affect root-treated premolars' survival.** *J Dent Res. Vol 86 (Spec. Iss. A) Abstract #1385, 2007 (www.dentalresearch.org)*

Objective: to assess whether the amount of residual coronal dentin and the placement of a fiber post (D. T. Light-Post; RTD, St Egrève, France) or EverStick Post (Stick Tech, Turku, Finland) have a significant influence on the three-year survival of restored pulpless premolars. **Methods:** A sample of 345 patients provided 6 cohorts of 60 premolars in need of endodontic treatment. Cohorts were defined based on the amount of dentin left at the coronal level after endodontic treatment and before abutment build-up. Within each cohort teeth were randomly divided into three Subgroups (n=20). In Subgroup A no endocanalar retention was provided for the coronal restoration. In Subgroups B and C a fiber post (RTD) and Stick Tech fibers (ST) respectively were placed inside the root canal. All the teeth were covered with porcelain fused to metal crowns. **Results:** Data were not affected by any loss to follow-up. The overall 36-month survival rate of crowned endodontically treated premolars was 76.70%. The lowest survival rate was recorded for teeth restored without any endocanalar retention (62.5%). Teeth restored with RTD had a survival rate higher (90.9%) than those restored with ST (76.7%). The Cox regression analysis showed that the presence of an endocanalar retention was a significant factor for survival ($p<0.05$). The decrease in failure risk was higher in teeth restored with RTD than when using ST. Teeth retaining one, two, or three coronal walls had a significantly lower failure risk than teeth deprived even of the ferrule effect. Similar failure risks existed for teeth missing all the coronal walls regardless of the presence or absence of a ferrule effect. Interaction terms were not significant ($p>0.05$). **Conclusion:** Post placement and the amount of residual coronal dentin affect the 3-year survival of endodontically treated premolars.

Ferrari, M., Cagidiaco, M., Magni,E., Cadenaro, M., Breschi, L. Goracci, C. **Clinical performance of fiber post restorations: 2-year results.** *J Dent Res. Vol 88 (Spec. Iss. A) Abstract # 1015, 2009. (www.dentalresearch.org)*

Objectives: To evaluate the 2-year outcome of post-retained restorations of endodontically treated teeth. **Methods:** A consecutive sample of 45 patients was collected and 45 premolars (25 maxillary, 20 mandibular) were restored. RelyX Fiber posts (3M ESPE) were luted with RelyX Unicem (3M ESPE) following manufacturer's instructions. Filtek Flow (3M ESPE) was used to build-up the abutment, that was covered with an all-ceramic crown (Empress II, Ivoclar-Vivadent). Baseline factors such as tooth type and number of residual coronal walls were noted. After 23-25 months patients were recalled and two operators who had been previously calibrated separately performed a clinical and radiographic examination. The following events were considered as failures: post debonding, post fracture, root fracture, failure of the core portion requiring a new coronal restoration, displacement of the crown, endodontic and periradicular conditions requiring endodontic retreatment. Kaplan-Meier plots were constructed. The Cox regression analysis was applied to assess the influence of baseline factors on failure occurrence. **Results:** One patient could not be re-evaluated. Radiographic signs of periapical pathology were observed in 3 teeth, though symptoms were reported for only 1 of them. The 3 teeth showing periapical lesions also had the post de-bonded. Overall, 4 teeth with 2 residual coronal walls exhibited post de-bonding along with marginal leakage. All de-bonded posts were re-luted and the teeth were thus restored to function. The survival rate of post-retained restorations in this study was similar to the rates reported in previous clinical trials. The Cox regression analysis did not reveal any significant influence of baseline factors on failure occurrence. **Conclusions:** Restorations of endodontically treated premolars retained by fiber posts luted with a self-adhesive resin cement showed a satisfactory success rate after 2 years of clinical service. All the 4 recorded failures consisted of post de-bonding, while no irreparable failures such as root fracture occurred.

Glazer, B. **Restoration of endodontically treated teeth with carbon fibre posts - A prospective study.** *Journal of the Canadian Dental Association. 66: 613-618, 2000.*

Abstract*:* A prospective study was started in 1995 to evaluate the success of carbon fibre reinforced epoxy resin (Composipost) posts used to restore endodontically treated teeth. All the teeth in the study had lost more than 50% of their coronal structure. **Methods***:* Fifty-nine carbon fibre Composiposts (RTD, St Egreve, France) cemented with C & B Metabond and built up with Core Paste cores were placed into the teeth of 47 patients. Each tooth received a full-coverage restoration (porcelain fused to metal crown) and was followed for 6.7-45.4 months (average = 28.0 months, standard deviation = 10.7). **Results:** Results for 52 teeth in 42 patients were analyzed. There were no fractures. The overall failure rate was 7.7% and the cumulative survival rate was 89.6% at the end of the follow-up period. The only statistically significant finding ($p=0.04$) was that posts in lower premolars were at higher risk of failure. **Conclusion:** Composipost posts are among the most predictable systems available today. Composipost posts in the upper anterior teeth are associated with a higher success rate and longer life than those placed in premolars, especially lower premolars. This study contributes to the growing body of evidence that supports the use of Composipost posts in the restoration of endodontically treated teeth. **PDF**

Grandini, S., Goracci, C., Tay, F,.Grandini, R., Ferrari, M **Clinical evaluation of the use of fiber posts and direct resin restorations for endodontically treated teeth** *Int J Prosthodont 2005;18:399–404.*

Purpose: Restoration of root-treated teeth is routinely performed in clinical practice with a choice of therapeutic options, considering many factors to provide optimal mechanical properties, esthetics, and longevity. The aim of the present work was to present a preliminary clinical report on the use of fiber posts and direct resin composites for restoring root-treated teeth. **Methods:** Thirty-eight anterior and 62 posterior endodontically treated teeth were selected from 3 private prosthodontic offices. The protocol used included endodontic treatment, with translucent fiber posts (D. T. Light-Post, RTD St Egreve, France) bonded to the post-space using a '1-bottle' adhesive (One-Step, Bisco) and a dual-cure resin cement (Duo-Link, Bisco). Direct resin restorations were performed using a micro-hybrid resin composite (Gradia Direct, GC) and a layering technique. Both opaque dentin and enamel and translucent enamel shades were used. **Results:** Patients were recalled after 6, 12, 24, and 30 months, and the restorations assessed according to predetermined clinical and radiographic criteria. These clinician-mediated evaluation methods confirmed the good clinical performance of the restorations. **Conclusions:** Restoration of endodontically treated teeth with fiber posts and direct resin composites is a treatment option, that in the short term conserves remaining tooth structure and results in good patient compliance. **PDF**

Malferrari, S, Baldissara, P, Arcidiacono, A, **Translucent Quartz Fiber Posts: a 20 Month In vivo Study**. *J Dent Res. 81 IADR Abstract #2656; 2002 (www.dentalresearch.org)*

Abstract: In the attempt to achieve the best-performing post and core restoration, many post systems have been studied. In the recent past, the aesthetic fiber posts, in combination with resin luting cement, have been proposed to provide a reliable rehabilitation for the endodontically treated tooth. The new translucent fiber posts show interesting mechanical properties (comparable to the dentin) and aesthetic characteristics that enhance a final rehabilitation with an all-ceramic crown…with satisfying results. **Objectives:** The purpose of this study was to evaluate the clinical behavior of 84 endodontically treated teeth treated with translucent quartz fiber posts. Thirty four teeth recieved a Light-Post (RTD/Bisco Dental) and 50 teeth received the Endo Light-Post (RTD, St. Egreve, France). To perform the cementation, Bisco One-Step and dual – cure Duo-Link (Bisco) were utilized. The luting cement was polymerized through the translucency of the post. **Methods:** All of the core restorations were performed using Core-Flo (Bisco) or Bis-Core (Bisco) composite resin and finalized with an all-ceramic crown. In accordance with the international literature, data, useful for the longitudinal evaluations, were recorded on diagrams. The survival rate of the post and core was valuated after 2 weeks, 1, 3, 6, 12 and 20 months. Post displacement or detachment, post fracture, restoration fracture and root fracture were investigated. **Results:** No failures took place up to the present day. **Conclusions:** According to these results, and within the limitations of this study, it is possible to assume that the clinical performance of these translucent fiber posts is successful. Further data will be needed for long-term clinical evaluations of the outcome.

*Monticelli, F., Grandini, S., Goracci, C., Ferrari, M. **Clinical behavior of translucent fiber posts: a 2-year prospective study.** *Int. J Prosthodont 2003; 16:593-596*

Purpose: This study prospectively evaluated the clinical performance of three types of translucent posts over a follow-up period of between 2 and 3 years. **Methods:** Selected were 225 patients with one premolar in need of endodontic treatment, followed by restoration with a fiber post and porcelain crown. The sample was randomly divided into three groups of 75 patients each. The same type of post was used in all patients within the group: Group 1=Aestheti-Plus posts (RTD), Group 2= D. T. Light-Post (RTD, St Egreve, France), and Group 3= FRC Postec (Vivadent / Ivoclar). For bonding the posts, a light-cure adhesive (One-Step; Bisco Dental) and a dual-curing resin cement (Duo-Link; Bisco Dental) were applied in Groups 1 and 2, whereas self-curing materials ExciteDSC adhesive (Vivadent/ Ivoclar) and MultiLink resin cement (Vivadent / Ivoclar) were used with Group 3. After 6, 12 and 24 months, patients were recalled, and a clinical and radiographic examination was performed. For some patients, 30-month follow-up data were also collected. **Results:** Debonding of the post occurred in eight cases (3.5%); in another six cases, a recurrence of the periapical lesion was reported. **Conclusion:** The statistical analysis did not reveal any significant difference in the survival rate of the tested posts, suggesting that all are equally and sufficiently reliable for clinical use. **PDF**

Naumann M, Blankenstein F, Dietrich T. **Survival of glass fibre reinforced composite post restorations after 2 years-an observational clinical study.** *J Dent. 2005 Apr;33(4):305-12.*

Objectives: The aim of this study is to provide prospective clinical data for the survival of postendodontic reconstructions of teeth with varying degrees of hard tissue loss using tapered or parallel-sided post shapes. **Methods:** Eighty-three patients got 105 glass fibre reinforced posts of tapered (Luscent Anchors, Dentatus, Sweden) and parallel-sided, serrated (FibreKor, Jeneric Pentron, USA) post shape. A dual curing hybrid composite Compolute (3M ESPE, Germany) was used as luting material, EBS-Multi (3M ESPE) as adhesive system and Clearfil Core (Kuraray, Japan) for core built-up. The restorations were followed for a minimum of 24 months. The statistical analysis was performed on a random sub-sample of one restoration per subject. The Fisher exact test was used to compare frequencies of failures after 12 and 24 month. A Kaplan-

Meier-analysis was used to analyse time-to-failure in both groups. Differences of survival time between post types were tested with the log-rank test. **Result:** 3.8% of the restorations failed after 12 month, 12.8% after 24 month, respectively. The main failure type observed was post fractures. All but one failed teeth could be restored. There was no difference in failure frequency between post types after 12 or 24 months. The log-rank test showed no differences in survival between the two types of post (p=0.37). **Conclusion:** Parallel-sided and tapered glass fibre posts result after 2 years of clinical service in an equal rate of survival.

Naumann, M., Reich, S., Nothdurft, F., Beuer, F., Schirrmeister, J., Dietrich, T. **Survival of glass fiber posts restorations over 5 years.** *Am J Dent; 21:267-272.*

Purpose: To evaluate the survival of glass fiber reinforced composite post (GFP) restorations and to identify risk factors for restoration failure. **Methods:** GFPs of three consecutively placed post systems, two tapered and one parallel-sided, were adhesively luted and the core was built with a resin composite. Teeth served as abutment teeth according to the prosthetic treatment plan. 149 GFP in 121 patients (age: 53 +/- 15 year; 50 men; 71 women) were followed for 5-79 months (mean +/- SD: 50 +/- 21 months). Cox proportional hazards models were used to evaluate the association between several clinical variables and the failure rate. **Results:** After exclusion of endodontic failures (n = 3), significantly higher failure rates were found for restorations of anterior teeth compared to posterior teeth (hazard regression (HR): 2.8; 95% confidence interval (CI): 1.4; 5.8; P = 0.004). Restorations in teeth with no proximal contacts compared to at least one proximal contact, single crowns compared to fixed partial dentures and less than two remaining cavity walls had a HR of 2.4 (CI: 0.8-7.1), 2.4 (CI: 0.6-8.7), and 1.5 (CI: 0.6-3.8), respectively. However, these correlations were not statistically significant (P > 0.05). **PDF**

Schmitter, M, Rammelsberg, P, Gabbert, O, Ohlmann B. **Influence of clinical baseline findings on the survival of 2 post systems: a randomized clinical trial.** *Int J Prosthodont. 2007 Mar-Apr;20(2):173-8*

Purpose: The aim of this prospective randomized controlled trial was to evaluate the influence of clinical baseline characteristics on the survival of 2 post systems. **Methods:** One hundred patients needing a post were included. Half the patients received a glass fiber-reinforced post (FRP: ER DentinPost, Komet), and the other half received metal screw posts (MSP: BKS post, Komet). The posts were assigned randomly. In addition to demographic data, the following parameters were recorded: type of tooth (incisor/canine versus molar/premolar), length of the post in relation to root length (percentage), extent of coronal tooth destruction (percentage), ferrule height (in millimeters), type of restoration (fixed or removable partial denture), and presence of antagonistic contacts (yes/no). After at least 1 year (mean: 13.84 months), the patients were recalled. Statistical analysis was performed using the log-rank test and Cox regression analysis. **Results:** The survival rate of FRPs was 93.5%. In the MSP group, the survival rate was significantly lower (75.6%; log-rank test, P = .049). Additionally, the metal posts were associated with more unfavorable complications, for example, root fracture. The type of the tooth and the degree of coronal tooth destruction influenced the survival of MSPs, whereas no influence of these variables could be seen for FRPs. **Conclusions:** Fiber Reinforced Posts are superior to Metal Screw Posts with respect to short-term clinical performance. Especially for MSPs, clinical survival depends on several variables.

Scotti,,R., Malferrari, S., Monaco, C**.. Clinical evaluation of quartz fiber posts: 30 months results.** *J Dent Res. 81 IADR Abstract #2657; 2002 (www.dentalresearch.org)*

The usage of the aesthetic fibre posts is progressively growing for their promising clinical performances and their good aesthetic characteristics. **Objectives:** the aim of this 30 months in vivo study is to evaluate the clinical success-rate of 180 endodontically treated teeth, restored by the usage of "white" quartz fiber post and finalized with the metal-ceramic crowns and all–ceramic crowns. **Methods:** all the teeth were endodontically treated according to the recent techniques. In accordance with the international literature, to achieve clinical information, parameters were recorded in diagrams. Posts used were Aestheti-Plus (RDT, St. Egréve, France) in combination with All-Bond 2 adhesive resin (Bisco, Schaumburg, IL, USA) and C&B Resin Cement (Bisco, Schaumburg, IL, USA), the build up of the core was performed with the composite material Core-Flo (Bisco, Schaumburg, IL, USA), or Bis-Core (Bisco, Schaumburg, IL, USA). The post and core restorations were evaluated after 2 weeks, 1, 3, 6, 12, 20 (Malferrari et al., IADR abstr #11; Rome 2001) and 30 months, recording the surviving rate. **Results:** three failures were observed, one was a cohesive fracture that occurred after two weeks, involving a margin of the composite restoration and two were adhesive fractures, that occurred after a a couple of months, both located at the interface cement and dentinal walls of the canal. As all the failures occurred during removing the temporary it was possible to replace the restorations, that are still in place up to the present day. The 3 failures that occurred during this period do not show any relevance according to the statistical analysis with the Chi Square test (p=0.246). **Conclusions:** according to these results, and considering the limits of this study, the quartz posts, within a 30 months period of rehabilitation of endodontically treated teeth, clinically performed with success.

Signore, A., Benedicenti, S., Kaitsas, V., Barone, M., Angiero, F., Ravera, G. **Long-term survival of endodontically treated, maxillary anterior teeth restored with either tapered or parallel-sided glass-fiber posts and full-ceramic crown coverage.** *J Dent. 2008 Dec 15. [Epub ahead of print]*

Objectives: This retrospective study investigated the clinical effectiveness over up to 8 years of parallel-sided and of tapered glass-fiber posts, in combination with either hybrid composite or dual-cure composite resin core material, in endodontically treated, maxillary anterior teeth covered with full-ceramic crowns. **Methods:** The study population comprised 192 patients and 526 endodontically treated teeth, with various degrees of hard-tissue loss, restored by the post-and-core technique. Four groups were defined based on post shape and core build-up materials, and within each group post-and-core restorations were assigned randomly with respect to root morphology. Inclusion criteria were symptom-free endodontic therapy, root-canal treatment with a minimum apical seal of 4mm, application of rubber dam, need for post-and-core complex because of coronal tooth loss, and tooth with at least one residual coronal wall. Survival rate of the post-and-core restorations was determined using Kaplan-Meier statistical analysis. **Results:** The restorations were examined clinically and radiologically; mean observation period was 5.3 years. The overall survival rate of glass-fiber post-and-core restorations was 98.5%. The survival rate for parallel-sided posts was 98.6% and for tapered posts was 96.8%. Survival rates for core build-up materials were 100% for dual-cure composite and 96.8% for hybrid light-cure composite. **Conclusions:** For both glass-fiber post designs and for both core build-up materials, clinical performance was satisfactory. Survival was higher for teeth retaining four and three coronal walls.

VI. Remoção

*Anderson, G. Jorge Perdigao, J., Hodges, J., Bowles, W. **Efficiency and effectiveness of fiber post removal using 3 techniques.** *Quintessence Int 2007; 38:663–670*

Objective: To evaluate the speed (efficiency) and effectiveness of 3 different fiber post removal systems. **Methods:** Fiber posts (D.T. Light-Post Size no. 1 (RTD St Egreve, France /Bisco Dental) and ParaPost FiberLux no. 5 (Coltène/Whaledent) were cemented into 60 single-rooted teeth after endodontic therapy and post space preparation were completed. Three methods of fiber post removal were evaluated—D.T. Light-Post removal kit, the Kodex twist/Tenax ParaPost fiber post removal drill kit, and a combination of diamond bur/Peeso reamer. **Results:** The efficiency to remove either fiber post was not significantly different, nor was efficiency of any of the 3 post removal systems significantly different. For effectiveness, no difference was observed between post types, but effectiveness was higher with the diamond bur/Peeso reamer compared with the Kodex twist/Tenax ParaPost drills, which in turn was more effective than the D.T. Light-Post removal kit. **Conclusions:** Fiber posts are efficiently removed by all 3 methods, but effectiveness of removal is higher using the diamond bur/Peeso reamer.

de Rijk, W. G. **Removal of fiber posts from endodontically treated teeth.** *American Journal of Dentistry. 13: 19B-21B, 2000.*

Abstract/conclusions: The removal of posts from endodontically treated teeth can be a major obstacle in the retreatment of teeth that have recurrent pathology, often leading to extraction of a tooth that could have been saved with endodontic retreatment. The use of a fiber post offers the advantages of a suitable elastic modulus and good bonding between post and cement, but also the advantage of easy removal, if so indicated by clinical findings. A special removal kit for fiber posts has been developed, and its use is illustrated, and described. The removal procedure can be completed in a very short time, usually less than 5 min. The tooth can then be restored with the same type and size of fiber post as was in the tooth prior to removal. Removal kits are found to be for single use only. **PDF**

Cormier, C., Burns, D., Moon, P., **In vitro comparison of the fracture resistance and failure mode of fiber, ceramic, and conventional post systems at various stages of restoration**. *J Prosthodont 2001; 10:26-36*

Abstract/ conclusions: The fiber posts evaluated provided an advantage over a conventional post that showed a higher number of irretrievable post and unrestorable root fractures. At the stage of final restoration insertion, there was no difference in force to failure for all but the FiberKor material, which continued to be weaker than all other materials tested. The fiber posts were readily retrievable after failure, whereas the remaining post systems tested were non-retrievable. **PDF**

Frazer, R.Q., Kovarik, R., Chance, K.B., Mitchell, R. **Removal times of fiber posts versus titanium posts**. *Am J Dent 2008; 21:175-178.*

Purpose: To evaluate the time needed to remove a glass reinforced fiber post versus a titanium post. **Methods:** 40 extracted anterior teeth were mounted in acrylic blocks then treated endodontically. They were randomly assigned to three groups. The teeth wer3 sectioned horizontally, with the coronal portion removed. The fiber posts were cemented with resin cement and the titanium posts were ceneted with glass ionomer or resin cement. The fiber posts were removed by coring them out internally. The titanium posts were removed by creating a trough around the post and then vibrating with ultrasonic energy. The teeth were examined visually and radiographically to ensure complete removal of the post AND cement. Removal Time included

the time to make radiographs necessary to ensure complete removal. **Results:** Post-cement combination significantly affected the median rank of the removal time (Kruskal-Wallis test; H=12.709; P=0.002). The mean rank removal time of titanium posts cemented with resin cement were significantly higher that the mean rank of the other two post-cement combinations (Dunn's multiple comparison test; P=<0.05). There was no significant difference between the othertwo combinations. **Clinical Significance:** When removing a fiber post, there is no need to create a trough around the fiber post or to use ultrasonic vibration that may weaken the tooth. Th canal space can be cleaned and a new post placed, or the canal can be enlarged and additional retentive features added. **PDF**

Gesi, A., Magnolfi, S., Goracci, C., Ferrari, M. **Comparison of two techniques for removing fiber posts.** *JOE Vol. 29, No. 9, September, 2003*

Abstract/ conclusions: The purpose of this study was to evaluate the time needed to remove several types of fiber posts using two different bur kits. Estimates refer to the time needed to pass the fiber post until arriving at the gutta percha. Sixty extracted anterior teeth were treated endodontically. A post space with a standard depth of 10mm was prepared in each root canal. The sample was randomly divided into 3 groups of 20 specimens each. Three different types of posts were cemented: group 1, Conic 6% tapered fiber posts (Ghimas), group 2, FRC Postec posts (Ivoclar/Vivadent); and group 3, Composipost carbon fiber posts (RTD, St Egreve, France). To remove the posts, for half of each group's the burs for the RTD fiber post removal kit were used (subgroup A). For the other half of the teeth in each group (subgroup B) were removed by using a diamond bur and a Largo bur. Composipost (group 3) took significantly less time to remove that the other two types of posts ($p<0.05$). For the bur kits, the procedure involving the use of a diamond and a Largo bur (subgroup B) was significantly faster ($p<0.05$). The interaction between the type of post and the type of bur kit was not significant ($p>0.05$). **PDF**

Lindemann M, Yaman P, Dennison JB, Herrero AA. **Comparison of the efficiency and effectiveness of various techniques for removal of fiber posts.** *J Endod. 2005 Jul;31(7):520-2.*

A study was conducted to determine the efficiency and effectiveness of several techniques for fiber post removal. Four groups of 20 mandibular premolars were endodontically treated and obturated. Post spaces were prepared for the following post systems: ParaPost XH, ParaPost Fiber White, Luscent Anchors, and Aestheti-Plus. After cementation, 10 posts of each group were removed with their corresponding manufacturer's removal kit and the other 10 removed with diamond burs and ultrasonics. Removal times were recorded and the teeth were sectioned vertically and microscopically analyzed for removal effectiveness based on a 0 to 5 point scale. Removal kits removed Luscent Anchors the fastest (mean = 3.9 min) and most effectively (mean = 2.6), while Aestheti-Plus posts were removed the slowest (mean = 7.3 min) and least effectively (mean = 3.4). Diamonds and ultrasonics required an average of 10 additional minutes for each fiber post system removal, yet removal effectiveness improved half a point. The results suggest recommended removal kits were significantly more efficient, while diamonds and ultrasonics were more effective. Removal kits could be enhanced with subsequent ultrasonic instrumentation to remove remaining fibers and cement. **PDF**

Sakkal, S., **Carbon-fiber post removal technique.** *Compendium. 17: S86-1996.*

Abstract/ conclusions: In the event of endodontic failure, removal of a metal post is a time-consuming, challenging and expensive task. The Carbon fiber post (Composipost) is the first post with a proven and safe method of retrieval that takes only a matter of minutes. Chair-time is reduced and there is less chance of harming sound tooth structure during the removal process, because the entire procedure is performed using slow speed. The removal technique is described in 6 steps. **PDF**

VII. ARTIGOS GERAIS

Bitter, K, Kielbassa, AM. **Post-endodontic restorations with adhesively luted fiber-reinforced composite post systems: a review.** *Am J Dent. 2007 Dec;20(6):353-60*

Purpose: To review the literature on adhesive luting of fiber-reinforced composite posts (FRC) to provide evidence for the clinical procedure of restoring endodontically treated teeth using FRC posts. **Methods:** Data focusing on bonding behavior between root canal dentin, luting agent, and FRC post in vitro as well as in vivo performance of teeth restored with FRC posts were reported. These data were identified by searches of "PubMed", "Scopus", and "Cochrane Library" databases with the terms "post-endodontic restoration", "fiber post", "adhesive luting", "root canal dentin", "clinical study", and "pre-treatment fiber post". Papers published up to September 2007 were selected, and most relevant references were chosen. Cross-referencing of significant papers identified additional relevant articles. **Results:** FRC posts seem to have become increasingly popular for the restoration of endodontically treated teeth. Compared to metal posts, FRC posts revealed reduced fracture resistance in vitro, along with a usually restorable failure mode. Bonding behavior among FRC post, luting agents, and root canal dentin demonstrated varying results. Bond strengths between FRC posts and resin cements can be enhanced by using various pre-treatment procedures; however, bonding to root canal dentin still seems to be challenging. Most clinical studies investigating survival rates of teeth restored with FRC posts revealed promising results, but risk factors

(e.g., the loss of coronal tooth structure) have not been studied intensively. In addition, randomized controlled clinical long term trials are scarce.

Brown, P., Hicks, N., **Rehabilitation of endodontically treated teeth using the radiopaque fiber post.** *Compendium Vol. 24, No. 4, April, 2003, 275-282*

Metallic posts fall short of satisfying contemporary guidelines for ideal post / core rehabilitation. Along with technological advancements in adhesive resin cements and composite restoratives, the evolution of fiber-reinforced posts allows the rehabilitation of endodontically treated teeth with greater esthetics anv virtually no predisposition to root fracture. At least one fiber post system now complies with all of the ideal post characteristics described in the endodontic text. This article describes the potential for displacement of metal posts by low-modulus fiber posts, the differences between them and the development and clinical placement of a radiopaque, translucent, double-tapered fiber post. **PDF**

Christensen, G**.** J. **Post concepts are changing,** *JADA, Vol. 135 Sept., 2004, 1306-1310*

Recently there is a clearly observable movement toward use of fiber-reinforced resin-based composite posts used in conjunction with composite build-ups. The resin-cemented fiber posts, followed by composite build-ups were as strong as the metal posts used with composite build-ups. They do NOT impart any objectionable color to the tooth. In terms of most of the necessary post characteristics, the fiber posts are superior to metal prefabricated posts. They are easy to place, are relatively inexpensive, can be bonded to resin cement, and are easy to remove if the tooth needs to be retreated endodontically. **PDF**

*De Rijk, W., Pecora, N. **Effects of cutting methods on fiber posts, SEM evaluation**. *J Dent Res. Vol 86 (Spec. Iss. A) Abstract #2700, 2007 (www.dentalresearch.org)*

Objectives: Prefabricated fiber posts, used in the restoration of endodontically treated teeth, routinely require a reduction in length, to accommodate the individual patient. This study evaluated the effect of trimming fiber posts with either a diamond bur or a diamond disk. **Methods:** Five different post systems: 1) CF Carbon fiber post (J. Morita USA Inc), 2) DT Light-Post (Bisco Inc.), 3)FRC Postec (Ivoclar Vivadent) Parapost FW (Coltene Whaledent), 5)Twin Lucent (Dentatus USA), were trimmed with either a diamond bur (8862) or a diamond disk (911HF, Brasseler USA). Two different core systems were used CompCore AF (Premier) and Light Core (Bisco Inc). The posts were cut, once through the core material and once at 3mm above the apical end. The cut surfaces were then evaluated by SEM. The surfaces showed various degrees of resin loss between the fibers. Two investigators estimated the total surface area with resin loss. **Results:** The observed surface area (in %) with resin loss is listed below. No differences were observed between the two core materials, hence all core data have been combined.

	Disk cut		Bur cut	
Post system	Core	Apex	Core	Apex
CF Carbon Fiber	0	13	0	20
DT Light-Post	0	7	0	14
FRC Postec	25	85	70	0
Parapost FW	2	8	20	10
Twin Lucent	0	30	6	60

Conclusions: From these data we conclude that: 1) the use of a diamond disk produces less resin loss from the fiber post, when compared to a diamond bur, and 2) that for those fiber posts, for which by design the coronal part of the post is to be trimmed, the post should be trimmed after the post and the core material have been placed. The materials for this study have been provided by the various manufacturers, and their support is hereby acknowledged.

Dietschi, D., Romelli, M., and Goretti, A. **Evaluation of post and cores in the laboratory: Rationale for developing a fatigue test and preliminary results.** *Compendium. 17: S65-S73, 1996.*

Abstract/conclusions: Prosthetic treatment failures related to the biomechnical deficiencies of post and cores still represent a problem of clinical significance. To overcome the difficulties of clinical studies, numerous in vitro methods were developed to address specific properties of post-and-core restorations. Most of them, however, were based on an oversimplified mechanical testing of the restored tooth. Experience proved that the fatigue of the restored materials was a primordial factor in clinical failures. Therefore, special devices were built that simulate the physiological masticatory cycle. Tests performed with adhesive post-and-core systems seem to indicate that materials placed in the tooth should have physical properties as close as possible to those of natural tissues. New carbon-epoxy posts (Composipost) appear to offer a promising solution for restoring the endodontically treated tooth. **PDF**

Dietchi, D., Duc, O., Krejci, I., Sadan, A. **Biomechanical considerations for the restoration of endodontically treated teeth: A systematic review of the literature-Part 1**. **Composition and macro-structure alterations**. *Quintessence Int 2007; 38:733-743.*

The specific biomechanical alterations related vitality loss or endodontic procedures are confusing issues for the practitioner and have been controversially approached from a clinical standpoint. The aim of part 1 of this literature review is to present an overview of the current knowledge about composition changes, structural alterations, and status following endodontic therapy and restorative procedures. The basic search process included a systematic review of the PubMed/Medline database between 1990 and 2005, using single or combined key words to obtain the most comprehensive list of references; a perusal of the references of the relevant sources completed the review. Only negligible alterations in tissue moisture and composition attributable to vitality loss or endodontic therapy were reported. Loss of vitality followed by endodontic therapy proved to affect tooth biomechanical behavior only to a limited extent. Conversely, tooth strength is reduced in proportion to coronal tissue loss, due to either caries lesion or restorative procedures. Therefore the best current approach for restoring endodontically treated teeth seems to (1) minimize tissue sacrifice, especially in the cervical area so that a ferrule effect can be created, (2) use adhesive procedures at both radicular and coronal levels to strengthen remaining tooth structure and optimize restoration stability and retention, and (3) use post and core materials with physical properties close to those of netural dentin, because of the limitations of current adhesive procedures.

Dietschi, D, Duc, O, Krejci, I, Sadan, A. **Biomechanical considerations for the restoration of endodontically treated teeth: a systematic review of the literature, Part II (Evaluation of fatigue behavior, interfaces, and in vivo studies.** *Quintessence Int. 2008 Feb;39(2):117-29*

Objective: The restoration of endodontically treated teeth has long been guided by empirical rather than biomechanical concepts. Part I of this literature review presented up-to-date knowledge about changes in tissue structure and properties following endodontic therapy, as well as the behavior of restored teeth in monotonic mechanical tests or finite element analysis. The aim of the second part is to review current knowledge about the various interfaces of restored, nonvital teeth and their behavior in fatigue and clinical studies. **Review method:** The basic search process included a systematic review of articles contained in the PubMed/Medline database, dating between 1990 and 2005, using single or combined key words to obtain the most comprehensive list of references; a perusal of the references of the references completed the review. **Conclusions:** Nonvital teeth restored with composite resin or composite resin combined with fiber posts resisted fatigue tests and currently represent the best treatment option. In comparison to rigid metal and/or ceramic posts, when composite resin or composite resin/fiber posts fail, the occurrence of interfacial defects or severe tooth breakdown is less likely. Adhesion into the root, however, remains a challenge because of the unfavorable ovoid canal configuration, as well as critical dentin microstructure in the deepest parts of the canal. Thus, specific combinations of adhesives and cements are recommended. The clinical performance of post-and-core restorations proved satisfactory overall, in particular with a contemporary restorative approach using composite resin and fiber posts. However, the clinical literature does not clearly isolate or identify exact parameters critical to success. This, in turn, emphasizes the importance and relevance of in vitro studies to further improve the quality and long-term stability of prosthetic foundations. **PDF**

Ferrari, M, Mannocci, F. **A one-bottle adhesive system for bonding a fibre post into a root canal: an SEM evaluation of the post-resin interface.** Int. Endodontic Journal, *33, 397-400, 2000.*

Abstract / conclusions: This report presents a case in which a "one-bottle" adhesive system (ONE-STEP) was used in combination with proprietary resin cement for bonding a fibre post. The fibre post was placed into the root canal of a fractured root under clinical conditions and then extracted 1 week later. Using Scanning Electron Microscopy, half of the root was evaluated for hybrid layer formation and the other half for assessing resin tags. The investigation demonstrated that the one-bottle system can infiltrate and create a mechanical interlocking with etched root dentine. **PDF**

Glazer, B. **Endodontic post evolution: from metal to quartz** *Oral Health, May, 2002 43-45*

Abstract/conclusions: The Light-Post is a 15-year evolution of post research at RTD. Its genesis began with the carbon fiber Composipost/ C-POST, transformed into the AesthetiPlus, made of white quartz fiber, and finishing with the Light-Post, made ouit of translucent quartz fiber. This transition from Carbon to Quartz was completed without any compromise in strength, modulus of elasticity, resistance to fatigue or the ability for re-treatment. The Light-Post offers clinicians significant aesthetic and clinical advantages due to its translucency. **PDF**

Pitel, M. L., Hicks, N. L. **Evolving technology in endodontic posts**. *Compendium 24 13-29, 2003*

Abstract/conclusions: This article provides a brief overview of important, recent changes in the philosophy, materials and technology that have impacted significantly on the art and science of endodontic post placement. The growing interest in esthetic dental restorations and adhesion dentistry has driven both manufacturers and dentists to create some innovative new post materials and techniques for restoring the endodontically treated tooth. Although metal posts were used extensively for many years, their popularity is currently in the decline. With more than 10 years of proven clinical success, there is now widespread interest in the use of non-metallic post materials and techniques. Over the last decade, in vitro and in vivo testing has demonstrated that some fiber-reinforced endodontic posts can dramatically reduce the incidence of root fracture, tissue discoloration and allergic reaction. If endodontic re-treatment is necessary, most fiber posts can be removed from a root canal with ease and predictability when necessary without compromising their only true function; core retention. Today's marketplace offers the dentist many choices in size, radiopacity and designs to fit the needs of the specific tooth and clinical application. The use of a highly translucent post not only can serve to enhance esthetics in the final restoration, but can also be useful as an instrument in the light-curing process. **PDF**

Radovic, I, Monticelli, F, Goracci, C, Vulicevic, ZR, Ferrari, M. **Self-adhesive resin cements: a literature review.** *J Adhes Dent. 2008 Aug;10(4):251-8*

Purpose: To summarize research conducted on self-adhesive cements and provide information on their properties, based on the results of original scientific full-length papers from peer-reviewed journals listed in PubMed. **Methods:** The search was conducted using the term "self-adhesive cement OR (trade names of currently available products)". **Results:** Only in vitro studies that investigated two commercially available self-adhesive cements have been published so far. The results were summarized into the following categories: adhesion to tooth substrates (enamel, dentin, root dentin), adhesion to restorative materials (endodontic posts, ceramics, titanium abutments), marginal adaptation, microleakage, mechanical properties, biocompatibility, chemical adhesion and fluoride release, and ratings in clinical use. **Conclusions:** The majority of available literature data is based on studies that investigated one of the self-adhesive cements that are currently available to clinicians. According to the in vitro results, self-adhesive cement adhesion to dentin and various restorative materials is satisfactory and comparable to other multistep resin cements, while adhesion to enamel appears to be a weak link in their bonding properties. Long-term clinical performance of these materials needs to be assessed prior to making a general recommendation for their use. **PDF**