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Comparison of fracture resistance of endodontically treated teeth restored with two different fiber posts

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Abstract
Background: The aim of this study was to determine and compare the fracture resistance of endodontically treated teeth restored with two different glass fiber posts.
Materials and methods: Thirty extracted intact human premolar teeth were selected for the study. All the teeth were decoronated maintaining root length of 15mm from apex. Root canals were enlarged using protaper rotary file. Obturated with gutta-percha using AH 26sealer, specimens were divided into 3 groups (n-10). In group1 Ever Stick posts was luted into the root canals using dual cure resin cement variolink II, in group2 Hi-rem posts were luted into the root canals, group 3 did not receive any posts. In group 1 and group 2 gutta-percha was removed, and post space was prepared using peso reamers. Fracture loading was accomplished using an universal testing machine at a cross head speed of 1mm/min in compression mode.
Results: Group3 showed highest mean fracture resistance value (795 N), followed by group 1 (Ever Stick post) with mean value (715.40 N) and group2 (Hi-rem) with mean value (476N).
Conclusion: Teeth restored with Ever Stick post has better fracture resistance value than Hi-rem posts.

Keywords: Endodontically treated teeth, fracture resistance, ever stick posts, hi-rem posts

Introduction
Endodontically treated teeth potentially exhibit a high fracture risk against masticatory forces and may fracture more easily than vital teeth [1]. Studies indicated that these teeth are more brittle because of loss of tooth structure from caries, trauma, and removal of dentine during treatment procedures [2]. Further more endodontically treated teeth dessicate over time and experience changes in collagen cross linking to dentin leading to structural changes [3, 4]. To improve fracture resistance of endodontically treated teeth, researchers have tried to enhance new materials with greater physical properties. Post and core systems have been used for decades as foundation material to support the final restoration of endodontically treated teeth with extensive loss of tooth structure [5-7]. Custom made and prefabricated posts have been utilized for post endodontic restorations [8, 9]. For many years metal posts, particularly custom made cast post and core were the restoration of choice. Disadvantage with these posts are poor retention of post, potential for post and root fracture and a risk of corrosion [10, 11] when different metals were used and esthetic considerations. These reasons paved way for the wide array of prefabricated posts system that are available in todays market [12].
Christensen and federick [13]. Reported that a post and core procedure is necessary when less than half of the coronal tooth structure remain on a pulpless tooth. The main purpose of this procedure is to provide retention to the core which replaces the lost tooth structure. Although some authors have shown that posts strengthen the root of devitalized teeth, other studies have demonstrated that tooth fracture resistance has a direct relationship with the amount of remaining coronal tooth structure [14, 15]. Variables such as tooth type and position within the dental arch in relation to the occlusal forces [16, 17]. Presence of proximal contacts, and the type of the final restoration [18-20] has been found to have an effect on the longevity of root canal treated teeth. Additionally, the amount of coronal residual structure has been recognized as critical to the survival probability of pulpless teeth [21, 22].
An ideal post and core material should have optimal physical properties similar to those of dentin to achieve the best results [15]. Fiber-reinforced posts are being used in restorative dentistry because of their superior properties, such as dentin-like rigidity. Furthermore, the

elastic modulus of fiber posts is similar to that of dentin. These posts have higher aesthetic properties, requires less dentin removal [16]. glass fiber posts have been suggested as a superior alternative to cast or prefabricated metal posts due to development of adhesive technologies in last few decades [13, 14]. One of the disadvantages of fiber posts is difficulty in retrieving the posts during retreatment in failed root canal cases. Hence fiber posts which are easily re-trievable are being introduced into the market. Ever Stick post and Hi-rem posts have the advantages of easy removal of the post during retreatment [23-25].

Ever Stick posts is a flexible, resin impregnated, uncured glass fiber post with an interpenetrating polymer network (IPN) resin matrix, which can be cured to the anatomic shape of the root canal also it has an advantage of retrieval of the post using the stick resin in case of failure of root canal treatment. Hi-rem posts is a newly introduced glass fiber posts, which has an central longitudinal axis made up of blue colored soft polymer macro fiber. This provides and advantage in the removal of the posts in cases of re-treatment. And the surface of the posts is extremely rough and retentive in order to maximize the adhesion of cement.

Hence the aim of this in-vitro study was to compare the fracture resistance of endodontically treated teeth restored with two different glass fiber posts.

Materials and methods

Thirty freshly extracted human mandibular premolar with relatively straight root, similar root size, Single canal, free of caries and fracture were selected for the study. All external debris was removed with an ultrasonic scaler and teeth were stored in normal saline until use. All the teeth were decoronated maintaining a tooth length of 15mm from root apex, using diamond disc (HI-DI Diamond precision tools Ltd. London U. K) in a slow speed hand piece under copious water spray. The decoronated root surfaces were then polished with 600- grit, fine grade silicon carbide paper (moyco precision abrasives inc. mongomeryville, pa). The root canal of all specimens were instrumented sequentially upto size 30(6%) Pro taper file rotary nickel titanium instrument (Dentsply Tulsa dental, Tulsa usa), in a crown down manner. During instrumentation, 10ml of 3% sodium hypochlorite solution (Prime dental products Pvt. ltd India) was delivered as an irrigant into the canals using 27-gauge needle between use of each succeeding file. After completion of instrumentation of root canal all the specimens were irrigated with 10ml of 17% EDTA (RC help, prime dental products Pvt. Ltd. India) followed by 10ml of sodium hypochlorite solution to remove smear layer. A final rinse of 10ml saline was used for irrigation. The root canals were obturated with corresponding size gutta-percha (Dentsply Maillefer, Switzerland) using AH plus sealer. In all the specimens gutta-percha was removed from the root canals to a constant depth of 10mm from the coronal root portion, maintaining an apical seal root canal filling of at least 5mm. All the specimens were divided into 3 groups each containing (n-10) group I (Ever stick post), group II (Hi-rem posts), group III (Received no posts).

Group 1-Ever Stick posts

In group 1, post space were prepared with size 4 (1.3mm in diameter) peso reamer (Maniinc. tochigi). The post spaces were then cleaned with 17% EDTA for 30 seconds followed by 3% sodium hypochlorite solution for 30 seconds. The post spaces were then rinsed with 10ml of saline and dried using paper points. Each Ever Stick post were precut to the desired length, trial fitted into root canal, and initially light cured for 20 seconds. Anastralis 3 light curing unit (Ivoclarvivadent, schaanliechtenstien) was used throught the study. The posts were then removed from their respective canal with locking forceps and again thoroughly light cured on all sides for 40 sec. the posts were coated with a layer of stick resin (stick tech ltd turuku, finland) which was light cured immediately before cementation for 10 seconds. The post space were etched with 37% phosphoric acid (Total etching gel, Ivoclarvivadent, schaan Liechtenstein) for 15 sec, rinsed with water spray and gently air dried. The excess moisture was blotted dry with paper points. Excite dsc (Ivoclarvivadent, schaan Liechtenstein) was used as the bonding agent. Variolink II resin luting cement (Ivoclar vivadents chaan liechtensein) was mixed according to manufacturer instructions and carried into the posts space using a paste carrier (maniinc. tochigi japan). Each post was gently seated into root canal and light cured for 40 sec. The excess post was cut flush with the root cervical surface with diamond bur under copious water supply.

Group II – hi-rem posts

The post spaces were prepared using the size 4 (1.3mm) diameter peeso reamer (maniinc. tochigi japan).The posts spaces were etched rinsed and bonded as in group I.

Group III – no post

Control group comprised of ten specimens which were only root canal treated but received no posts.

Preparation for mechanical testing

A spherical metal specimen holder was custom made and the roots were embedded vertically in the specimen holder using araldite resin, leaving 10mm of each root exposed.

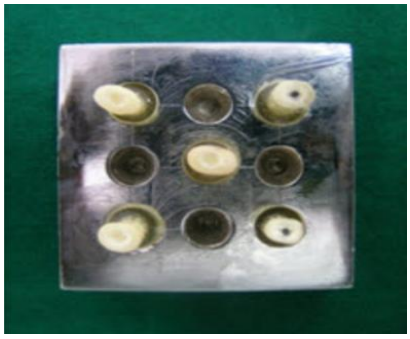

Fig 1: Metal specimen holder

The loading fixture aligned vertically with the centre of the root canal in a universal testing machine. Fracture loading was accomplished at a cross head speed of 1mm/min in compression mode.

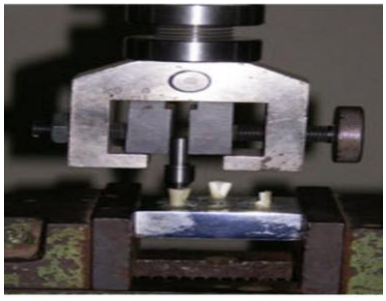

Fig 2: Universal testing

Statistical analysis

All specimens were mounted on spherical metal specimen holder and subjected to the compressive force at 1 mm/min diameter using Instron Universal Testing Machine. The force at fracture was measured in MPa. Data were tabulated and statistically analyzed using one way ANOVA.

Results

Table 1: comparison of fracture resistance between the study groups

	N	Mean	SD	Min	Max	ANOVA	
						F	p-value
Group 1	10	715.40	16.50	688	734	321.358	<0.001*
Group 2	10	476.00	34.85	403	501		
Group 3	10	795.00	32.96	746	843		

*p<0.05 statistically significant,
p>0.05 Non significant,

Group III (795 N) showed a significantly higher mean fracture resistance compared to Group I and Group II. The mean fracture resistance of group I (715.40 N) was significantly higher than that of Group II (476 N). (p< 0.05) (Table -1)

Table 2: Pairwise comparison of fracture resistance between the study groups

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	p-value	95% Confidence Interval	
					Lower Bound	Upper Bound
Group 1	Group 2	239.40	13.09	<0.001*	206.92	271.88
	Group 3	-79.60	13.09	<0.001*	-112.08	-47.12
Group 2	Group 3	-319.00	13.09	<0.001*	-351.48	-286.52

p<0.05 statistically significant,
p>0.05 Non significant, NS

When group 1 was compared with group 2 the difference in the mean fracture resistance value was 239.40, Comparison between group 1 and group 3 showed mean difference value of -79.60, In comparison of group 2 with group 3 mean difference value was -319.

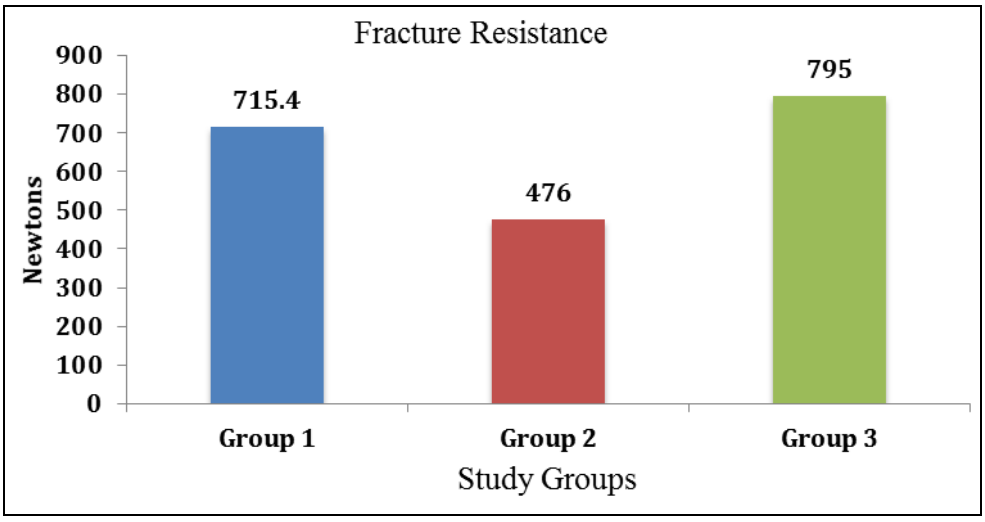

Fig 3: Bar graph showing, group I mean score (715.4 N), had a significantly higher fracture resistance compared with group II.

Discussion

Reconstruction of endodontically treated teeth is a great challenge in restorative dentistry, especially when tooth crown is totally or partially lost by caries, trauma, previous restorations and endodontic access. Posts are indicated in such cases. Ideal post system should have physical properties similar to dentin, maximum retention with little removal of dentin, distribution of functional stresses evenly along root surface, esthetic compatibility with the definitive restoration and surrounding tissue, minimal stress during placement and cementation, resistance to displacement, good core retention, easy retrievability and material compatibility with core [15, 16, 17]. Traditionally cast post have been used to restore endodontically treated teeth. They are not favored because of its rigidity, high modulus of elasticity, uneven stress distribution, requires more appointments and laboratory procedures and also possible problems resulting from corrosion of the post. The use of non-metallic posts reinforced with materials such as glass fibre, quartz or silica have gained interest in restoration of endodontically treated tooth because of their properties like less rigidity, esthetically acceptable, modulus of elasticity values similar to dentin. This characteristic may result in better distribution of stress and may help to prevent root fracture over long term [27]. The objective of monoblock restoration ie, achievement of a single biomechanical complex by adhesion between the tooth structure and reconstruction materials (post, luting agent, filling material with similar mechanical properties as the remaining dentin structure) is also accomplished. Ever stick and hi-rem posts were recently introduced. Apart from being

esthetic, these posts have the added advantage of easy retreivability, thus these posts were selected for this study to check the impact of this property of the post on its fracture resistance [28]

In this *in vitro* study, the control group (group3) exhibited the highest fracture with mean value of (795 N). This is because of the remaining amount of tooth structure. It has been suggested that remaining dentin thickness is a critical factor in resisting fractures. Between the test groups teeth restored with Ever Stick posts showed highest resistance to fracture (715 N) and Hi-rem posts showed the least fracture resistance with mean value (476N). A study by Cormier CJ *et al* compared fracture resistance and failure mode of fiber, ceramic and cast post systems [28, 29]. The results showed that fiber posts gave better fracture resistance values than the other test groups. And Toksavul *et al* compared fracture resistance of zirconia posts, glass fiber reinforced post and Ever Stick posts. The results showed Ever Stick post gave better fracture resistance values. These results is in direct correlation with the present study [25, 14, 29, 30]. Ever Stick post showed better fracture resistance values, this could be attributed to the IPN structure of the post that results in an inter-diffusion bonding phenomenon enabling the stick resin to penetrate the post, as well as establish a strong bond to dentin via the resin cement A study done by S. Vidhya *et al* compared fracture resistance of teeth restored with three different fiber posts, (Ever Stick, fiber reinforced composite postec plus post, mirafit carbon fiber post) Ever Stick posts recorded the second best fracture resistance values (715.40 N) compared with carbon fiber post, which is higher than other glass fiber posts tested [13].

Maccari at al evaluated the fracture strength of teeth with flared canals that were restored with different pots system (Two different fiber posts and a cast post) results of this study showed, the fracture resistance of teeth restored with cast post was higher than teeth with glass or quartz fiber reinforced resin posts which exhibited similar behaviour [12] Rosentritt *et al*, evaluated the fracture strength of ceramic metallic and fiber reinforced posts and cores compared to cast gold post and core restorations [25-27]. The fracture strength of post system with composite cores was determined to be higher than that of control gold alloy post and core. These conflicting results were due to variations in the Methodology, chemical, and physical properties of the materials used in the study canal morphology and the biochemical composition of extracted human teeth.

In this study, Hi-rem posts recorded the lowest mean fracture resistance value (476 N) but still within range of other glass fiber post. The central longitudinal axis of these posts is made of soft polymer macro fiber which might have been the factor for the low fracture resistance values compared with Ever Stick group. There are no studies reported in the literature regarding the hi-rem post [28, 29].

Ferrario at al. assessed the bite force of teeth from 52 healthy young adults and reported that single tooth bite forces ranged from 178 to 291 N in premolar teeth. The mean fracture resistance values reported in this study were higher than the measured mean bite force of premolar teeth [23].

After the post placement the teeth were loaded in an universal testing machine and loading to fracture represented a worst case scenario. Although it does not replicate what takes place in oral environment, when teeth are subjected to forces of mastication that over a long period of time may cause fatigue resulting in tooth fracture [17].

The results of the present study favours the non -metallic post (Ever Stick), must be interpreted with caution. In oral environment, restored teeth are subjected to variety of challenges in addition to masticatory load, including prolonged exposure to moisture, temperature and pH fluctuations with intake of different foods and exposure to variety of bacteria and enzymes. Collectively these factors may have detrimental effects on the strength of bonding between post and root dentin, which may in turn have clinical consequences. Further studies taking these challenges into account are needed. However given the naturally protected location of bond interface within the root portion of tooth, such challenges may play minor role in weakening intra-radicular bond [30] Therefore endodontically treated premolar teeth restored with Ever Stick and Hi-rem posts were able to resist normal occlusal forces [26]. Long term clinical observations of the performance of these non metallic posts should be studied.

Conclusion

Within the limitations of this in-vitro study, Teeth restored with Ever Stick posts recorded the highest fracture resistance values than those restored with hi-rem posts.

References

1. Hansen EK, Asmussen E, Christiansen NC. *In vivo* fractures of endodontically treated posterior teeth restored with amalgam. Dental Traumatology. 1990; 6(2):49-55.
2. Gutmann JL. The dentin-root complex: anatomic and biologic considerations in restoring endodontically treated teeth. The Journal of prosthetic dentistry. 1992; 67(4):458-67.
3. Helfer AR, Melnick S, Schilder H. Determination of the moisture content of vital and pulpless teeth. Oral Surgery, Oral Medicine, Oral Pathology. 1972; 34(4):661-70.
4. Rivera EM, Yamauchi M. Site comparisons of dentine collagen cross-links from extracted human teeth. Archives of oral biology. 1993; 38(7):541-6.
5. Qing H, Zhu Z, Chao Y, Zhang W. *In vitro* evaluation of the fracture resistance of anterior endodontically treated teeth restored with glass fiber and zircon posts. The Journal of prosthetic dentistry. 2007; 97(2):93-8.
6. King PA, Setchell DJ. An *in vitro* evaluation of a prototype CFRC prefabricated post developed for the restoration of pulpless teeth. Journal of Oral Rehabilitation. 1990; 17(6):599-609.
7. Teixeira EC, Teixeira FB, Piasick JR, Thompson JY. An *in vitro* assessment of prefabricated fiber post systems. The Journal of the American Dental Association. 2006; 137(7):1006-12.
8. Sahafi A, Peutzfeldt A, Asmussen E, Gotfredsen K. Retention and failure morphology of prefabricated posts. International Journal of Prosthodontics. 2004; 17(3).
9. Nergiz I, Schmage P, Özcan M, Platzer U. Effect of length and diameter of tapered posts on the retention. Journal of oral rehabilitation. 2002; 29(1):28-34.
10. RUD J, OMNELL KA. Root fractures due to corrosion diagnostic aspects. European Journal of Oral Sciences. 1970; 78(1-4):397-403.
11. Stockton LW. Factors affecting retention of post systems: a literature review. The Journal of prosthetic dentistry. 1999; 81(4):380-5.
12. Qualtrough AJ, Mannocci F. Tooth-colored post systems: a review. Operative Dentistry. 2003; 28(1):86-91.
13. Fredriksson M, Astbäck J, Pamenius M, Arvidson K. A retrospective study of 236 patients with teeth restored by

carbon fiber-reinforced epoxy resin posts. The Journal of prosthetic dentistry. 1998; 80(2):151-7.
14. Ferrari M, Vichi A, Mannocci F, Mason PN. Retrospective study of the clinical performance of fiber posts. American journal of dentistry. 2000; 13(Spec No):9B-13B.
15. Fernandes AS, Shetty S, Coutinho I. Factors determining post selection: a literature review. The Journal of prosthetic dentistry. 2003; 90(6):556-62.
16. Lassila LV, Tanner J, Le Bell AM, Narva K, Vallittu PK. Flexural properties of fiber reinforced root canal posts. Dental Materials. 2004; 20(1):29-36.
17. Mitsui FH, Marchi GM, Pimenta LA, Ferraresi PM. *In vitro* study of fracture resistance of bovine roots using different intraradicular post systems. Quintessence international. 2004; 35(8).
18. Christensen GJ. Posts and cores: state of the art. Journal of the American Dental Association (1939). 1998; 129(1):96-7.
19. Federick DR. An application of the dowel and composite resin core technique. The Journal of prosthetic dentistry. 1974; 32(4):420-4.
20. Christensen GJ. Post concepts are changing. Journal-American Dental Association. 2004; 135(9):1308-10.
21. Naumann M, Blankenstein F, Dietrich T. Survival of glass fibre reinforced composite post restorations after 2 years—an observational clinical study. Journal of dentistry. 2005; 33(4):305-12.
22. Naumann M, Blankenstein F, Kießling S, Dietrich T. Risk factors for failure of glass fiber-reinforced composite post restorations: a prospective observational clinical study. European journal of oral sciences. 2005; 113(6):519-24.
23. Caplan DJ, Kolker J, Rivera EM, Walton RE. Relationship between number of proximal contacts and survival of root canal treated teeth. International endodontic journal. 2002; 35(2):193-9.
24. Aquilino SA, Caplan DJ. Relationship between crown placement and the survival of endodontically treated teeth. The Journal of prosthetic dentistry. 2002; 87(3):256-63.
25. Ferrari M, Vichi A, Mannocci F, Mason PN. Retrospective study of the clinical performance of fiber posts. American journal of dentistry. 2000; 13(Spec No):9B-13B.
26. cheung GS, chan TK. long term survival of primary root canal treatment carried out in a dental teaching hospital. IntEndod J. 2003; 36:117-28
27. Isidor F, Brøndum K. Intermittent loading of teeth with tapered, individually cast or prefabricated, parallel-sided posts. International Journal of Prosthodontics. 1992; 5(3).
28. Torbjörner A, Karlsson S, Ödman PA. Survival rate and failure characteristics for two post designs. The Journal of Prosthetic Dentistry. 1995; 73(5):439-44.
29. de Amorim Demarchi MG, Sato EF. Leakage of interim post and cores used during laboratory fabrication of custom posts. Journal of endodontics. 2002; 28(4):328-9.
30. Sorensen JA, Martinoff JT. Intracoronal reinforcement and coronal coverage: a study of endodontically treated teeth. The Journal of prosthetic dentistry. 1984; 51(6):780-4.