Research Article

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Comparative Evaluation of Fracture Resistance of Three Different Post Systems: An Invitro Study

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ABSTRACT

Background: Endodontically treated teeth are known to present a higher risk of biomechanical failure compared to vital teeth. Posts are required for restoring such endodontically treated teeth to retain a core for definitive restoration. The prime objectives of post and core procedure are to build missing coronal structure as well as to provide sufficient retention and resistance form to final restoration.

Material and method: After an informed consent obtained from the cases regarding the use of extracted teeth for the study a total of 60 human premolars were selected as sample in the present study. Teeth were stored in normal saline after clearing any blood, stain or calculus. the teeth were randomly divided into three groups of 20 samples in each group: 1) carbon post group, 2) glass fiber-reinforced post group, and 3) zirconia post group. after all preprations, a compressive load at 130° angle was applied to the long axis of tooth with 1 mm diameter using universal testing machine until visible or audible evidence of fracture was observed. The fracture force was measured in MPa.

Results: Zirconia endodontic post presented with best results showing fracture resistance of 492.4 MPa. This was followed by glass fiber-reinforced post which showed a fracture resistance of 362.8 MPa and least resistance was seen for carbon post group which showed value of 246.6 MPa.

Conclusion: Zirconia endodontic post presents with best results and highest fracture resistance in comparision to glass fiber and carbon posts. They can hence be used in endodontically-treated teeth to enhance their strength.

Keywords: Carbon, zirconia, glass fibre, compressive force, fracture resistance.

INTRODUCTION

Endodontically treated teeth are known to present a higher risk of biomechanical failure compared to vital teeth. Restoration of these mutilated endodontically treated tooth (ETT) is a subject that has been evaluated and discussed widely in dental literature. Endodontically treated teeth present with dehydration, altered esthetic, and change in physical characteristics. Which are decreased proprioception and moisture, leading to reduced dentin fracture resistance.

Posts are required for restoring such endodontically treated teeth to retain a core for definitive restoration. The prime objectives of post and core procedure are to build missing coronal structure as well as to provide sufficient retention and resistance form to final restoration.[1,3] In earlier days, custom-made post and core restoration was one of the popular methods to restore endodontically treated teeth. Later on, prefabricated posts gain importance due to reduced time and feasibility.[3] The ideal post and core

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material should have physical properties such as modulus of elasticity, compressive strength and coefficient of thermal expansion similar to those of dentin. [4]

In modern days of dentistry, various tooth-colored posts are gaining popularity due to improved asthetics. Commonly known tooth coloured posts are glass fiber post, zirconia, and composite post. Use of fiber-reinforced post has reduced the risk of root fracture with higher survival rate and has biomechanical properties compatible to that of dentin.[5]

Glass fiber posts have an elastic modulus similar to that of dentin,[6] consequently reinforcing the tooth structure.[7] This property has been reported to reduce catastrophic root fracture and provide better stress distribution.[8] Glass fiber post can bond to composite core and retain strength and provides the most esthetic results and transmits light, require less dentin removal, and can be bonded to dentin.

Previously used prefabricated steel post or custom posts were non estheic and has higher failure rates due to internal stress.[9] Newer to the list of prefabricated posts are the Zirconia posts which provide better in esthetics.

In the present study we evaluate the fracture resistance of three commonly used different posts – carbon, glass fiber, and zirconia posts in endodontically treated teeth.

MATERIAL AND METHODS

Freshly extracted intact human mandibular premolars (for orthodontic purpose) without caries, with anatomically similar roots were selected after taking prior ethical clearance from institutional commette. The teeth were examined with a stereomicroscope under 10× magnification to detect craze lines or cracks, which were excluded from the study, resulting in 80 specimens.

After an informed consent obtained from the cases regarding the use of extracted teeth for the study a total of 60 human premolars were selected as sample in the present study. Teeth were stored in normal saline after clearing any blood, stain or calculus.

All the teeth were decoronated at cementoenamel junction and the length of all the teeth was adjusted to 14 mm. Then, teeth were endodontically treated and obturated with gutta-percha by lateral condensation method. Later, the teeth were randomly divided into three groups of 20 samples in each group: 1) carbon post group, 2) glass fiber-reinforced post group, and 3) zirconia post group. Post space was created by removing gutta-percha using peeso reamer and leaving 4 mm of apical gutta-percha obturated material. Cementation of selected post (carbon, glass fiber, or zirconia) was done with dual-cure adhesive cement after treatment with chelating agent (Glyde, Germany). Core buildup was done for all the teeth to the height of 4 mm with composite material (3M ESPA).All root canal filled teeth were stored in normal saline till the end of the study. Then after all preprations, a compressive load at 130° angle was applied to the long axis of tooth with 1 mm diameter using universal testing machine until visible or audible evidence of fracture was observed. The fracture force was measured in MPa.

The data were collected and tabulated, and statistical evaluation was done using statistical software IBM SPSS Statistics for Windows, version 21.0., IBM Corp., Armonk, NY, USA, using one-way analysis of variance for analysis of difference and Bonferroni *post hoc* test.

RESULTS

Our results showed that on evaluation and comparision of fracture resistance among all the three posts under study, Zirconia endodontic post presented with best results showing fracture resistance of 492.4 MPa. This was followed by glass fiber-reinforced post which showed a fracture resistance of 362.8 MPa and least resistance was seen for carbon post group which showed value of 246.6 MPa. The results are tabulated in table 1.

Further on comparision of all the groups among themselves it was seen that the difference in means of all the three groups with each other were statistically significant.($P < 0.001$).

Table1: Mean and standard deviation readings for fracture strength (MPA)

STUDY GROUPS	NUMBER OF CASES (N)	FRACTURE RESISTANCE (MEAN ±SD)
GROUP 1: Carbon post group	20	246.6 ± 10.25 MPa
GROUP 2: Glass fiber-reinforced post group	20	362.8± 25.24 MPa
Group 3: Zirconia post group	20	492.4±24.3 MPa

Table 2: Group comparisions for fracture strength (MPA).

GROUP COMPARISION	P value
Group 1 V/S group 2	<0.001
Group 1 V/S group 3	<0.001
Group 2 V/S group 3	<0.001

DISCUSSION

Successful endodontic treatment depends on three-dimensional obturation and maintaining the tooth in a nonpathological and functional state. Obtaining all these parameters during tooth rehabilitation of endodontically-treated pulpless teeth has always been challenging.

Posts can be classified as custom made or prefabricated, metallic or nonmetallic, flexible or stiff, esthetic or nonesthetic types. Post and core interface is the most common site for tooth fractures. Fracture resistance of restoration with post is directly related to post design, post length, post diameter, core material, and type of cement used

Nonmetallic posts are esthetically acceptable and have been observed by many studies to possess good physical properties. Glass fiber reinforced and quartz fiber posts are composed of glass fibers embedded in an epoxy resin matrix, which distributes stress in a broader surface area, and thus reduces root fracture which provides more esthetic result and transmits light.[10,11] Carbon fiber posts are composed of pyramidal carbon fibers embedded in an epoxy resin matrix, and are fatigue and corrosion resistant with good biocompatibility, however, they have the disadvantage of being dark in color.[11]

In the present study, Zirconia endodontic post presented with best results and highest fracture resistance of 492.4 MPa. While glass fiber-reinforced post which showed a fracture resistance of 362.8 MPa and least resistance was seen for carbon post group which showed value of 246.6 MPa.

In similarity to our study Raju *et al*. observed in their study that quartz fiber posts had higher flexural strength as compared to glass and composite-reinforced fiber posts. They also suggested that flexural properties of fiber posts are responsible for root fracture prevention.[13]

Other authors like Tortopidis *et al*. observed highly esthetic result with fiber-reinforced composite post with all ceramic crown.[14] Abduljawad *et al*. observed improved fracture resistance with glass fiber post in endodontically-treated teeth.[15]

In yet another studies, carbon posts presented with lower failure load compared to glass and quartz posts. However, it has higher flexural strength compared to glass fiber posts.[3] Ceramic posts are reported to be rigid and transmit more stress to root canal, resulting into root damage as they have modulus of elasticity of range 170–213 GPa, which is around 14 times that of dentin.[14]

In a study by Kurthukoti *et al*. on comparing the biologic, fiber, and zirconia posts, he reported that highest fracture resistance with biologic post followed by fiber-reinforced composite post and least with zirconia post in contrast to our results.[16]

From our results we can say that Carbon post is nonesthetic post with comparatively lower fracture resistance in comparision glass fiber and zirconia posts. Hence, these esthetically prefabricated posts can be safely used in endodontically-treated teeth with improvement in retention and resistance.

Limitation of the present study is lower sample size and thermal changes in oral environment, and masticatory forces were not applied and it was *in vitro* study. Further studies are required to evaluate the fracture resistance of different metal and esthetic posts in oral environment for successful postendodontic procedures.

CONCLUSION

Zirconia endodontic post presents with best results and highest fracture resistance in comparison to glass fiber and carbon posts. They can hence be used in endodontically-treated teeth to enhance their strength.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

REFERENCES

1. Padmanabhan P. A comparative evaluation of the fracture resistance of three different pre-fabricated posts in endodontically treated teeth: An *in vitro* study. J Conserv Dent 2010;13:124-8.

2. Sonkesriya S, Olekar ST, Saravanan V, Somasunderam P, Chauhan RS, Chaurasia VR, *et al.* An *in vitro* comparative evaluation of fracture resistance of custom made, metal, glass fiber reinforced and carbon reinforced posts in endodontically treated teeth. J Int Oral Health 2015;7:53-5.

3. Vadavadagi SV, Dhananjaya KM, Yadahalli RP, Lahari M, Shetty SR, Bhavana BL, *et al.* Comparison of different post systems for fracture resistance: An *in vitro* study. J Contemp Dent Pract 2017;18:205-8

4. Cheung WA. Review of the management of endodontically treated teeth. Post, core and the final restoration. J Am Dent Assoc 2005;136:611-9.

5. Kivanç BH, Alaçam T, Ulusoy OI, Genç O, Görgül G. Fracture resistance of thin-walled roots restored with different post systems. Int Endod J 2009;42:997-1003

6. Stricker EJ, Göhring TN. Influence of different posts and cores on marginal adaptation, fractures resistance, and fracture mode of composite resin crowns on human mandibular premolars: An in vitro study. J Dent 2006;34:326–335. DOI: 10.1016/j.jdent.2005.07.007.

7. Newmann MP, Yaman P, et al. Fracture resistance of endodontically treated teeth restored with composite posts. J Prosthet Dent 2003;89:360–367. DOI: 10.1067/mpr.2003.75.

8. Silva NR, Castro CG, et al. Influence of different post design and composition on stress distribution in maxillary central incisor: Finite element analysis. Indian J Dent Res 2009;20(2):153–158.

9. do Valle AL, Pereira JR, Shiratori FK, Pegoraro LF, Bonfante G. Comparison of the fracture resistance of endodontically treated teeth restored with prefabricated posts and composite resin cores with different post lengths. J Appl Oral Sci 2007;15:29-32.

10. Sonkesriya S, Olekar ST, Saravanan V, Somasunderam P, Chauhan RS, Chaurasia VR. An *in vitro* comparative evaluation of fracture resistance of custom made, metal, glass fiber reinforced and carbon reinforced posts in endodontically treated teeth. J Int Oral Health 2015;7:53-5.

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

12. Raju SR, Kilaru KR, Haridas KK, Naik B, Shetty K, Venkata SS. Evaluation of the flexural strength of carbon, quartz, and glass fiber-based posts. Saudi Endod J 2014;4:109-14.

13. Tortopidis D, Kourtis S, Kountouras K. Restoration of Endodontically Treated Anterior Teeth with Cast Metallic Post or Prefabricated Fibre Post Placement: 2 Case Reports and Critical Literature Review. Balk J Dent Med, 2015;19:86-91.

14. Abduljawad M, Samran A, Kadour J, Al-Afandi M, Ghazal M, Kern M. Effect of fiber posts on the

fracture resistance of endodontically treated anterior teeth with cervical cavities: An in vitro study. J Prosthet Dent 2016;pii: S0022-3913(16) 00030-5.

15. Sharma S, Attokaran G, Singh KS, Jerry JJ, Ahmed N, Mitra N, *et al.* Comparative evaluation of fracture resistance of glass fiber reinforced, carbon, and quartz post in endodontically treated teeth: An *in-vitro* study. J Int Soc Prev Community Dent 2016;6:373-6.

16. Kurthukoti AJ, Paul J, Gandhi K, Rao DB. Fracture resistance of endodontically treated permanent anterior teeth restored with three different esthetic post systems: An *in vitro* study. J Indian Soc Pedod Prev Dent 2015;33:296-301.