Research Article

JRAD Journal of Research and Advancement in Dentistry

J Res Adv Dent 2019;10:1:67-70.

Fracture Resistance of Glass Fiber, Carbon and Zirconia Posts in Endodontically Treated Teeth: A Comparative Study

Joel G Varghese[1*] Prabhu Mahin Syed Ismail[2] Devupalli Sudhamadhuri[3] Meghna Chauhan[4] Nirban Mitra[5] Jeethu John Jerry[6]

[1]Reader, Department of Conservative Dentistry and Endodontics, Malabar Dental College and Research Centre, Eddappal, Kerala, India.
[2]Assistant Professor, Department of Conservative Dentistry and Endodontics, Al Rass Dental College and Hospital, Qassim University, Kingdom of Saudi Arabia.
[3]Professor and Head, Department of Prosthodontics, Government Dental College & Hospital, Vijaywada, India.
[4]Reader, Department of Prosthodontics, Kalka Dental College & Hospital, Partapur, Meerut, India.
[5]Senior Lecturer, Department of Prosthodontics, Mallareddy Institute of Dental Sciences, Hyderabad, Telangana, India.
[6]Reader, Department of Periodontics, Malabar Dental College and Research Centre, Eddappal, Kerala, India.

ABSTRACT

Background: Full-coronal restorations are required after endodontic treatment of teeth as there is significant loss of tooth structure. The present study was conducted to compare fracture resistance of glass fiber, carbon and zirconia posts in endodontically treated teeth.

Materials & Methods: The present study was conducted on sixty recently extracted non- carious mandibular premolars. Root canal treatment was done in all teeth and filled with gutta-percha by lateral condensation method. Teeth were divided into 3 groups of 20 each. Group I teeth were treated with glass fiber-reinforced post, group II with carbon post and group III with zirconia post. Tensile strength was measured by applying compressive load at 130° angle to the long axis of tooth with 1 mm diameter using universal testing machine.

Results: It was found that mean tensile strength in group I was 350.2 MPa, in group II was 260.6 MPa and in group III was 482.1 MPa. The difference was significant (P<0.05).

Conclusion: Zirconia post offered highest fracture resistance compared to glass fiber-reinforced and carbon posts.

Keywords: Core, Post, Zirconia.

INTRODUCTION

Endodontic treatment is widely used procedure in dentistry where infected pulp is removed and root canals are filled with restorative materials. Dental caries and fracture leads to pulpal infection resulting in significant tooth loss. Full-coronal restorations are required after endodontic treatment of teeth as there is significant loss of tooth structure. Post and core are frequently needed in these cases. There is subsequent loss of water content in root canal treated tooth, altered esthetic, and change in physical characteristics.[1]

Core is the part which enhances coronal portion while post restores radicular portion of tooth. Thus post and core act to replace missing tooth structure which aids in retention and resistance form to final restoration.[2] There have been improvements in physical properties of post and core system. There are numerous post and core in the present market. Among all, custom-made post and core were the oldest one being used in dentistry with sufficient success rate. Later on, prefabricated posts gain importance due to reduced time and feasibility.

Received: July. 17, 2019**: Accepted**: Sept. 3, 2019
***Correspondence Dr. Joel G Varghese.**
Department of Conservative Dentistry and Endodontics, Malabar Dental College and Research Centre, Eddappal, Kerala, India.
Email: joelgkalapura78@icloud.com

pISSN 2278-0076
eISSN 2321-9270

Other posts such as glass fiber post, zirconia, and composite post are also used routinely.[3] The advantage of fiber-reinforced post is that it has higher survival rate, less risk of root fracture and biomechanical properties compatible to that of dentin. Zirconia posts are newer development in esthetic prefabricated posts. Glass fiber post can bond to composite core and retain strength.[4] The present study was conducted to compare fracture resistance of glass fiber, carbon and zirconia posts in endodontically treated teeth.

MATERIALS & METHODS

The present study was conducted in the department of endodontics. It comprised of sixty recently extracted non- carious mandibular premolar. Only those teeth which were extracted for orthodontic purpose were selected. Ethical approval was obtained from institute prior to the study. All were informed regarding the study before extraction of teeth.

All the teeth were decoronated at cementoenamel junction using diamond saw. Root canal treatment was done in all teeth and filled with gutta-percha by lateral condensation method. Teeth were divided into 3 groups of 20 each. Group I teeth were treated with glass fiber-reinforced post, group II with carbon post and group III with zirconia post. Post space was prepared after removing gutta percha. Posts were cemented using dual-cure adhesive cement. Core buildup was done for all the teeth to the height of 4 mm with composite. Tensile strength was measured by applying compressive load at 130° angle to the long axis of tooth with 1 mm diameter using universal testing machine. The fracture force was measured in MPa.

Statistical analysis

Results were tabulated and subjected to statistical analyses using statistical software IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp. Results were expressed as mean± SD. Descriptive analysis was done using chi- square test, Post hoc Tukey's HSD and two way ANOVA tests. P value <0.05 was considered significant.

RESULTS

Table I, graph I shows that in group I, glass fiber-reinforced post, in group II carbon post and in group III with zirconia post was used. Table II, graph II shows that mean tensile strength in group I was 350.2 MPa, in group II was 260.6 MPa and in group III was 482.1 MPa. The difference was significant (P<0.05).

Table 1: Distribution of teeth.

Groups	Group I	Group II	Group III
Post	glass fiber-reinforced post	Carbon post	Zirconia post
Number	20	20	20

Graph 1: Distribution of teeth.

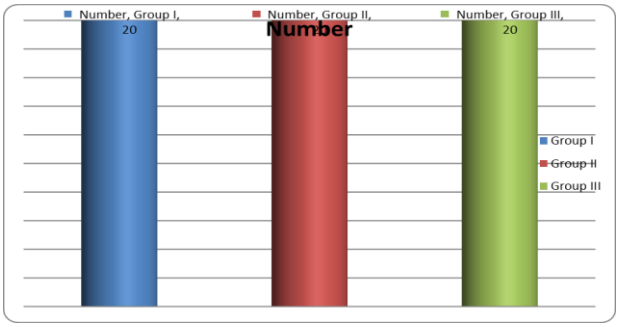
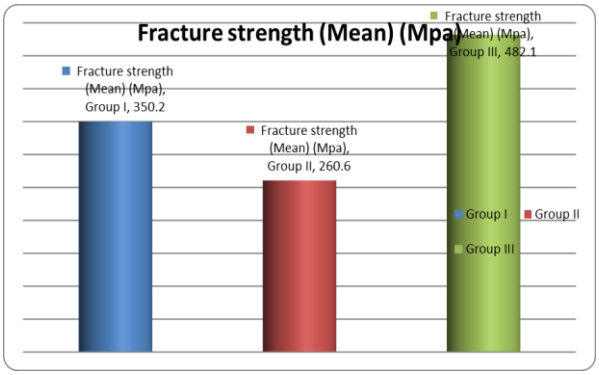


Table 2: Comparison of tensile strength in all groups.

Groups	Fracture strength (Mean) (Mpa)	SD	P value
Group I	350.2	14.5	0.012
Group II	260.6	21.5	
Group III	482.1	18.9	

Graph 2: Comparison of tensile strength among all the groups.



DISCUSSION

The management of non vital teeth is not a big thing in today's dentistry. Earlier pulpless teeth were extracted. Root canal treatment has decreased the chances of extraction.[5] Endodontic treatment followed by post placement enhances the success rate of pulp less teeth. An ideal post should be able to withstand the occlusal forces, ability to adapt to various shaped canals, demands less tooth removal. It should be biological compatible with physical properties similar to that of dentin.[6]

Various post like glass fibres posts, quartz fibre posts and zirconia posts are widely used. All have advantages and few disadvantages. These posts provide adequate retention and resistance. Their ability to withstand the forces and resistance to corrosion has made them popularized among dentists.[7] The present study was conducted to compare fracture resistance of glass fiber, carbon and zirconia posts in endodontically treated teeth.

In this study, we divided recently extracted mandibular premolars into three groups. Group I teeth were treated with glass fiber-reinforced post, group II with carbon post and group III with zirconia post. Each group had 20 teeth.

We found that mean tensile strength in group I was 350.2 MPa, in group II was 260.6 MPa and in group III was 482.1 MPa. Saritha et al[8] in their study of comparative evaluation of fracture resistance of different post systems found that zirconia endodontic post had good fracture resistance (489.2 MPa) when compared with carbon (258.4 MPa) and glass fiber-reinforced post (348.7 MPa). Fracture resistance was statistically significant between test groups $P>0.001$.

Khaledi et al[9] in their study of evaluation of retention of two different cast post-core systems and fracture resistance of the restored teeth, divided teeth into two equal groups of 40. One group was restored with Nickel-Chromium (Ni-Cr) post and core system and the other group with Non-Precious Gold alloy (NPG) system. Fracture resistance was measured in all groups. They found that although retention failure load for Ni-Cr system was lower than NPG system, there was no significant difference between the two systems (p= 0.7). However, fracture resistance of the teeth restored with Ni-Cr post and core system was significantly higher than NPG group (p= 0.000).

Panitiwat et al[10] conducted a study of effect of different composite core materials on fracture resistance of endodontically treated teeth restored with FRC posts. Forty endodontically treated lower first premolars were restored with quartz fiber posts (D.T. Light-Post) cemented with resin cement (Panavia F2.0). Samples were randomly divided into four groups (n=10). The fracture resistance was higher in the groups with CPC and MCF, which presented no statistically significant difference ($p>0.05$), but was significantly higher than in those with LCZ and TNC ($p<0.05$). The composite core with high filler content tended to enhance fracture thresholds of teeth restored with fiber posts more than others.

Fracture resistance of restoration with post is directly related to post design, post length, post diameter, core material, and type of cement used. It has been observed that core structure provides stress transmission from crown then to post core structure to remaining root dentin. Root fracture occurs when this stress transmission exceeds the withstanding resistance. Physical properties differ from one post type to other.[11]

Kilinc et al[12] conducted a study to evaluate the effects of different post morphologies and placement lengths on the fracture resistance of teeth with oval canal morphology. Extracted mandibular premolars were decoronated. Samples were randomly divided into four groups (n = 10 each). In groups C-10 and C-5, 10-mm- and 5-mm-long circular post spaces were created. In groups O-10 and O-5, 10-mm- and 5-mm-long oval post spaces were ultrasonically created. Oval posts and placement at 10-mm depth showed higher fracture resistance than circular posts and placement at 5-mm depth ($P < 0.001$). Increased post length and use of oval posts enhanced the fracture strength of teeth with oval canal morphology.

CONCLUSION

Authors suggested that post and core system has revolutionarized the field of dentistry. Zirconia post offered highest fracture resistance compared to glass fiber-reinforced and carbon posts.

CONFLICTS OF INTEREST

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

REFERENCES

1. 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.

2. 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.

3. 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.

4. 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.

5. Michael MC, Husein A, Bakar WZ, Sulaiman E. Fracture resistance of endodontically treated teeth: An *in vitro* study. Arch Orofac Sci. 2010;5:36–41.

6. 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.

7. Gopal S, Irodi S, Mehta D, Subramanya S, Govindaraju VK. Fracture resistance of endodontically treated roots restored with fiber posts using different resin cements- an *in-vitro* study. J Clin Diagn Res. 2017;11:ZC52–5.

8. Saritha MK, Paul U, Keswani K, Jhamb A, Mhatre SH, Sahoo PK. Comparative evaluation of fracture resistance of different post systems. Journal of International Society of Preventive & Community Dentistry. 2017 Nov;7(6):356.

9. Khaledi AAR., Sheykhian Sh., Khodaei A. Evaluation of Retention of two Different Cast Post-Core Systems and Fracture Resistance of the Restored Teeth. J Dent Shiraz Univ Med Sci., June 2015; 16(2): 121-128.

10. Panitiwat P, Salimee P. Effect of different composite core materials on fracture resistance of endodontically treated teeth restored with FRC posts. J Appl Oral Sci. 2017;25:203–10.

11. Zhou L, Wang Q. Comparison of fracture resistance between cast posts and fiber posts: A meta-analysis of literature. J Endod. 2013;39:11–5.

12. Kılınç HI, Aslan T, Kılıç K, Er Ö, Esim E, Yıldırım Ş, et al. Fracture resistance of teeth with oval canal morphology restored using oval and circular posts. J Oral Sci. 2016;58:339–45.