Research Article

JRAD Journal of Research and Advancement in Dentistry

J Res Adv Dent 2021;11:2:36-39.

A Study to Compare Fracture Resistance of Endodontically Treated Teeth Restored with Glass Fiber Post and Composite Resin Cores, Customized Zirconia Posts

Y. Sravanthi[1*] Velagala L Deepa[2] Shaik RubeenaTabasum[3] Padma Sri Yadla[4] Srikanth Kasaraneni[5] Bhargavi Damaraju[6]

[1]Reader, Department of Prosthodontics, Lenora Institute of Dental Sciences, Rajanagaram, Andhra Pradesh, India.
[2]Professor, Department of Conservative Dentistry and Endodontics, Lenora Institute of Dental Sciences, Rajanagaram, Andhra Pradesh, India.
[3]Assistant Professor, Department of Conservative Dentistry and Endodontics, Sri Sai College of Dental Surgery, Vikarabad, India.
[4]Senior Lecturer, Department of Conservative Dentistry and Endodontics, Lenora Institute of Dental Sciences, Rajanagaram, Andhra Pradesh, India.
[5]Senior Lecturer, Department of Oral & Maxillofacial Surgery, St. Joseph Dental College, Duggirala, Eluru, India.
[6]Associate Professor, Department of Conservative Dentistry and Endodontics, Anil Neerukonda Institute of Dental Sciences, Andhra Pradesh, India.

ABSTRACT

Background: Endodontically treated teeth present a high risk of biomechanical failure due to the loss of tooth substance resultant on access opening, caries, and alterations of mechanical, chemical, and physical properties. The present study was conducted to compare the fracture resistance of endodontically treated teeth restored with glass fiber post and composite resin cores, customized zirconia posts.

Material and methods: A total of 60 sound, single-rooted mandibular first premolars with similar size and shape were collected for the study. 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: (a) glass fiber post group, (b) composite resin cores group, and (c) zirconia post group. A compressive load at 130° angle was applied to the long axis of tooth with 1 mm diameter using universal testing machine. The fracture force was measured in MPa. The data were tabulated, and statistical evaluation was done using statistical software IBM SPSS Statistics for Windows, version 21.0., IBM Corp., Armonk, NY, USA. P-value of <0.05 which was significant.

Results: A total of 60 sound, single-rooted mandibular first premolars were collected for the study. Later, the teeth were randomly divided into three groups of 20 samples in each group: (a) glass fiber post group, (b) composite resin cores group, and (c) zirconia post group. The mean fracture strength of glass fiber post group was 365.5 MPa, the mean fracture strength of composite resin cores group was 276.6 MPa and the mean fracture strength of zirconia post group was 498.4 MPa.

Conclusion: The present study concluded that zirconia posts and cores resisted a higher mean load when compared with other post and core systems.

Keywords: Glass fiber post, composite resin cores, zirconia, endodontically treated teeth.

INTRODUCTION

Restoration of endodontically treated teeth (ETT) is necessary for restoring aesthetics and function and preserving the remaining tooth structure.[1] As a consequence of root canal therapy (RCT), the water

Received: Sept. 12, 2020: **Accepted**: Nov. 17, 2020
*Correspondence Dr. Y. Sravanthi.
Department of Prosthodontics, Lenora Institute of Dental Sciences, Rajanagaram, Andhra Pradesh, India.
Email: Not Disclosed

pISSN 2278-0076
eISSN 2321-9270

content of the tooth is decreased, leading to an increased brittleness, and as a result, the fracture strength of the tooth declines by 69%.[2,3] Endodontically treated teeth often present with compromised crown structure, which need full-coronal restoration along with post and core restorations.[4,5] Endodontically treated teeth present with dehydration, altered esthetic, and change in physical characteristics. Hence, successful outcome of pulp-treated permanent teeth needs proper rehabilitation procedure. Post is required to restore radicular part of teeth and core to enhance coronal structure. 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.[6,7] Fracture resistance of endodontically treated teeth (ETT) is influenced by several factors, such as substance loss[8,9], ferrule design[8,10], the presence of post and cores[11], and post location[12]. The present study was conducted to compare the fracture resistance of endodontically treated teeth restored with glass fiber post and composite resin cores, customized zirconia posts.

MATERIAL AND METHODS

A total of 60 sound, single-rooted mandibular first premolars with similar size and shape were collected for the study. Teeth were stored in normal saline after clearing any blood, stain, or calculus. Teeth included were with the absence of root caries, restorations, or previous endodontic treatment. All the teeth were decoronated at cementoenamel junction using diamond saw under water coolant, 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: (a) glass fiber post group, (b) composite resin cores group, and (c) 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 (composite, glass fiber, or zirconia) was done with dual-cure adhesive cement after treatment with chelating agent. Core buildup was done for all the teeth to the height of 4 mm with composite material. All root canal filled teeth were stored in normal saline till the end of the study. Root surfaces were coated with melted wax to a depth of 0.2–0.3 mm, below the cervical margin, to create periodontal ligament space. Resin blacks were made using these prepared teeth. After removing the wax spacer, a thin layer of light-body condensation silicone impression material was allowed to flow to simulate periodontal ligament space. 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 tabulated, and statistical evaluation was done using statistical software IBM SPSS Statistics for Windows, version 21.0., IBM Corp., Armonk, NY, USA. P-value of <0.05 which was significant.

RESULTS

A total of 60 sound, single-rooted mandibular first premolars with similar size and shape were collected for the study. Later, the teeth were randomly divided into three groups of 20 samples in each group: (a) glass fiber post group, (b) composite resin cores group, and (c) zirconia post group. The mean fracture strength of glass fiber post group was 365.5 MPa, the mean fracture strength of composite resin cores group was 276.6 MPa and the mean fracture strength of zirconia post group was 498.4 MPa.

Table 1: Mean and standard deviation reading for fracture strength (MPa).

Group	Mean±SD
glass fiber post group	365.5±34.65
composite resin cores group	276.6±32.56
zirconia post group	498.4±26.32

DISCUSSION

The amount of tooth structure that remains after post space preparation correlates with the length and diameter of the posts. A deeper post-space preparation and use of long posts may jeopardize the root by removal of healthy dentin and decrease the resistance to root fracture.[13] Further, with the deeper insertion of posts, it becomes more difficult to obtain a reliable bond with the luting agent due to a reduction in a number of dentinal tubules in the apical part of the root and limited cleansing of canal walls.[13,14]

A total of 60 sound, single-rooted mandibular first premolars with similar size and shape were collected for the study. Later, the teeth were randomly divided into three groups of 20 samples in each group: (a) glass fiber post group, (b) composite resin cores group, and (c) zirconia post group. The mean fracture strength of glass fiber post group was 365.5 MPa, the mean fracture strength of composite resin cores group was 276.6 MPa and the mean fracture strength of zirconia post group was 498.4 MPa.

Leary, et al. showed that preparation for a post weakens the root considerably.[15] Isidor, et al., showed that the increase in post length when the tooth was restored with prefabricated posts did not increase the fracture resistance of endodontically treated teeth.[16] Holmes, et al, showed that increasing the post length in the tooth results in a more favorable stress distribution along the post, leading to higher fracture resistance.[17] Kurthukoti *et al.* on comparing the biologic, fiber, and zirconia posts found highest fracture resistance with biologic post followed by fiber-reinforced composite post and least with zirconia post in contrast to our results.[18]

The findings of Toksavul et al stated that the teeth reconstructed by zirconia post and cast ceramic core showed the lowest frequency of unrepairable fractures.[19]

In addition, Heydecke et al found fewer unrepairable fractures when using zirconia posts.[20]

CONCLUSION

The present study concluded that zirconia posts and cores resisted a higher mean load when compared with other post and core systems.

CONFLICTS OF INTEREST

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

REFERENCES

1. Mamoun J. Post and core build-ups in crown and bridge abutments: Bio-mechanical advantages and disadvantages. J Adv Prosthodont. 2017 Jun; 9(3):232-7.
2. Lambjerg-Hansen H, Asmussen E. Mechanical properties of endodontic posts. J Oral Rehabil. 1997 Dec;24(12):882-7.
3. Bhagat A, Mittal L, Mogla S, Kaur T, Dheeraj M, Marwah G. Impact of Root Dentin Thickness on the in vitro Compressive Strength of Teeth treated with Recent Post and Core Systems. J Contemp Dent Pract. 2017 Nov;18(11):1065-70
4. 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.
5. 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.
6. 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.
7. 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.
8. Samran A, El Bahra S, Kern M. The influence of substance loss and ferrule height on the fracture resistance of endodontically treated premolars. An in vitro study. Dent Mater. 2013;29(12):1280–6.
9. Abduljawad M, Samran A, Kadour J, Al-Afandi M1, 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;116(1):80–4.
10. Samran A, Al-Afandi M, Kadour JA, Kern M. Effect of ferrule location on the fracture resistance of crowned mandibular

premolars:An in vitro study. J Prosthet Dent. 2015;114(1):86–91.

11. Aggarwal R, Gupta S, Tandan A, Gupta NK, Dwivedi R, Aggarwal R. Comparative evaluation of fracture resistance of various post systems using different luting agents under tangential loading. J Oral Biol Craniofac Res. 2013;3(2):63–7.

12. Karzoun W, Abdulkarim A, Samran A, Kern M. Fracture strength of endodontically treated maxillary premolars supported by a horizontal glass fiber post:an in vitro study. J Endod. 2015;41(6):907–12.

13. Da Fonseca GF, De Andrade GS, Dal Piva AM, Tribst JP, Borges AL. Computer-aided design finite element modeling of different approaches to rehabilitate endodontically treated teeth. J Indian Prosthodont Soc 2018;18:329-35.

14. Mobilio N, Borelli B, Sorrentino R, Catapano S. Effect of fiber post length and bone level on the fracture resistance of endodontically treated teeth. Dent Mater J 2013;32:816-21.

15. Leary JM, Aquilino, SA, Svare CW. An evaluation of post length within the elastic limits of dentin. J Prosthet Dent. 1987;57:277-81.

16. Isidor F, Brondum K, Ravnholt G. The influence of post length and crown ferrule on the resistance to cyclic loading of bovine teeth prefabricated titanium post. Int J Prosthodont. 1999;12:79-82.

17. Holmes DC, Arnold AM, Leary JM. Influence of post dimentions on stress distribution in dentin. J Prosthet Dent. 1996;75:140-7.

18. 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.

19. Toksavul S, Toman M, Uyulgan B, Schmage P, Nergiz I. Effect of luting agents and reconstruction techniques on the fracture resistance of pre-fabricated post systems. J Oral Rehabil. 2005 Jun;32(6):433-40.

20. Heydecke G, Butz F, Hussein A, Strub JR. Fracture strength after dynamic loading of endodontically treated teeth restored with different post-and-core systems. J Prosthet Dent. 2002 Apr; 87(4):438-45.