Original Article

DOI: 10.17354/ijss/2016/24

Comparative Evaluation of Fracture Resistance of Tooth after Lateral and Vertical Obturation Filled with Gutta-Percha and Resilon Obturating Material: An *In Vitro* Study

Supratim Tripathi[1], Mubashir Baig Mirza[2], Mohammed Zaheer Kola[3]

[1]Assistant Professor, Department of Conservative Dentistry and Endodontics, Career Post Graduate Institute of Dental Sciences, Lucknow, Uttar Pradesh, India, [2]Faculty, Department of Conservative Dentistry and Endodontics, College of Dentistry, Prince Sattam Bin Abdul Aziz University, Alkharj Kingdom of Saudi Arabia, [3]Faculty, Department of Prosthodontics, College of Dentistry, Prince Sattam Bin Abdul Aziz University, Alkharj Kingdom of Saudi Arabia

Abstract

Introduction: Since long the obturating material and techniques have been discussed. The prime target of the material has always been to provide a three-dimensional obturation providing a monoblock concept thus strengthening the tooth.

Aim: The aim of the study was to evaluate the fracture toughness of the root canal treated teeth after being oturated with Gutta-Percha and Resilon by lateral and vertical compaction techniques.

Materials and Methods: A total of 75 human mandibular premolar teeth were taken and endodontically treated. All the teeth were divided into five groups with 15 samples in each. Access opening of all the teeth was done, and the cleaning and shaping were done up to 40 number file size. The samples were obturated with two materials which are Gutta-Percha and Resilon. All the teeth were subjected to compressive loading till the fracture occurred, and the readings were taken and compared. It was found that the teeth obturated with Resilon showed higher fracture resistance and that the obturating technique had no effect on fracture resistance.

Result: This study shows the relevant difference between the two groups and that the group with Resilon showed better fracture toughness when applied with universal testing machine.

Conclusion: This study concluded that Resilon is a better obturating material and that vertical condensation is better than lateral condensation.

Key words: Fracture resistance, Resilon, Vertical compaction and lateral compaction

INTRODUCTION

Endodontically treated teeth are widely considered to be a more susceptible to fracture than are vital teeth.[1,2] The reasons most often reported have been the water loss and loss of collagen cross-linking,[3,4] excessive pressure during obturation and the removal of tooth structure during endodontic treatment.[5,6] The strength of an endodontically treated tooth is related directly to the method of canal preparation and to the amount of remaining sound tooth structure.[7] It is commonly believed that the loss of dentin creates an increased susceptibility to fracture.[7] Resin-based dental materials have been proposed as a means to reinforce an endodontically treated tooth in the form of adhesive sealers in the root canal system. Dentin thicknesses, the radius of canal curvature and external root morphology have been proposed as factors potentially influencing fracture susceptibility.[8,9] This study deals with the fracture resistance of the tooth after being obturated with lateral and vertical obturating technique with Gutta-Percha and Resilon as two different

Access this article online

www.ijss-sn.com

Month of Submission : 12-2015
Month of Peer Review : 12-2015
Month of Acceptance : 01-2016
Month of Publishing : 01-2016

Corresponding Author: Dr. Supratim Tripathi, Department of Conservative Dentistry and Endodontics, Career Post Graduate Institute of Dental Sciences, Lucknow, Uttar Pradesh, India. Phone: +91-7800302984. E-mail: t.supratim@yahoo.com

materials. The thinner the dentin, the more likely the tooth is to fracture.[10] However, bonding agents and resins studied to date as root filling materials had problems in working properties, radiopacity, and lack of re-treatability when used for endodontic purposes.[11] A low radius of canal curvature can act as a stress raiser area, which makes the root more susceptible to fracture.[11] In this study, the compressive load was subjected at a crosshead speed of 1 mm/min until the fracture of root occurred with a Universal testing Machine. The study was done in the Department of Conservative Dentistry and Endodontics, Career Post Graduate Institute of Dental Sciences, Lucknow, Uttar Pradesh, India, between December 2014 and March 2015.

MATERIALS AND METHODS

About 75 freshly extracted human mandibular premolars with fully formed apices, free of apical root resorption and caries were collected from the Department of Oral and Maxillofacial Surgery, Career Post Graduate Institute of Dental Sciences, Lucknow, Uttar Pradesh, India and were stored in 10% formalin.

List of materials used is as follows:

- Micro motor cord and straight piece
- Diamond disks
- Stainless steel files (10-40)
- Disposable syringe
- 5.25% sodium hypochlorite
- 17% EDTA
- Gates glidden drills
- Spreaders
- Plungers
- Lentulo Spiral
- Gutta-Percha
- AH 26 root canal sealer
- Resilon obturating materials (Pentron Clinical Technologies, Llc Wallingford, Ct).

The collected samples were cut at the cementoenamel junction (CEJ) with a diamond disk. The working length was established with 10 number file, 1 mm short to the apex. A crown down preparation technique was carried out in all the teeth. Preparations were irrigated between uses of each succeeding file with sodium hypochlorite (5.25%). After preparation the entire specimen were flushed with the EDTA, to remove smear layer and canal will be dried with paper points. Teeth were divided into 5 groups with 15 each. The canals were prepared up to 40 (k).

Group and its subgroups:

- A0: Control group. This group received no obturation; the canal opening was sealed with a temporary filling material (cavit).
- A1: Lateral condensation with Gutta-Percha. AH 26 sealer was used as a sealer. The cavity was sealed with cavit.
- A2: Vertical condensation with Gutta-Percha. Obtura II warm Gutta-Percha system was used with size 40 Gutta-Percha master cone point dipped in AH 26 sealer. The cavity was sealed with cavit.
- A3: Lateral condensation with Resilon. The primer was applied using paper point. Then, the sealer is mixed according to manufacturer's instructions. Resilon sealer was placed with a lentulo. After placing the master cone to the working length, accessory cones were placed dipped in Resilon sealer for the lateral condensation. The cavity was sealed with cavit.
- A4: Vertical condensation with Resilon. Vertical condensation was done using the heated pluggers and Obtura II warm Gutta-Percha system using a size 40 Resilon master cone dipped in resin sealer. The sealer was placed with a lentulo. After placing the master cone to the working length, we used heated pluggers to remove the Gutta-Percha point about 4 mm from the apex and for the vertical compression. After this procedure, the material was cured in the root canal for 30 s. The cavity was sealed with cavit.

The collected samples were cut at the CEJ with diamond disk. The working length was established with 10 no file, 1 mm short to the apex. Then, all the teeth were enlarged to the size 40 number. Preparations were irrigated between uses of each succeeding file with sodium hypochlorite (5.25%).

Preparation for Mechanical Testing

The root specimens were then prepared for mechanical testing. Apical root ends were embedded individually in phenolic rings with acrylic resin, living 9 mm of each root exposed, this was done so as to eradicate any chance of overfilling and to make sure that the obturating material did not come out of the apical foramen. Carbide bur was used to remove temporary material and to shape the root canal access to accept the loading fixture. Mounted cylinders were vertically aligned in the testing machine one at a time. Cylinders were mounted and aligned on the machine which has a fixed top standardizing the mounting. The compressive load was applied with a loading fixture with a spherical tip ($r = 2$ mm) at a crosshead speed of 1 mm/min until the fracture of root occurred. This load was applied at the canal opening. The amount of load obturated teeth can take was noted and it was evaluated which group of teeth can take maximum loads.

RESULTS

Fracture resistance of tooth in groups is measured, and the mean and standard deviation values of the applied force (mpa) according to groups are given in Tables 1-4 (Figure 1).

Table 1: Difference between the fracture resistance

Groups	Means	Standard deviation
A0	36.74	1.01
A1	31.82	0.61
A2	31.58	0.38
A3	32.19	0.63
A4	32.15	0.43
Total	32.90	2.05

Table 2: Comparison of five groups (A0, A1, A2, A3, and A4) with respect to applied force by one-way analysis of variance

SV	DF	SS	MSS	*F* value	*P* value	Significant
Between groups	4	242.90	60.7251	143.6443	0.0000	S
Within groups	60	25.36	0.4227			
Total	64	268.27				

Table 3: Pairwise comparison of five groups by Duncan's multiple comparison tests procedure

Groups	A0	A1	A2	A3	A4
Means	36.7380	31.8220	31.5850	32.1920	32.1540
A0	-				
A1	0.0001*	-			
A2	0.0000*	0.3567	-		
A3	0.0001*	0.1756	0.0315*	-	
A4	0.0001*	0.1976	0.0377*	0.8807	-

*Indicates significant at 5 level of significance (P<0.05)

Table 4: Pairwise comparison of five groups by student's unpaired *t*-test

Group	Mean	SD	*t* value	*P* value	Significant
A0	36.7385	1.0096	15.0430	0.0000	S
A1	31.8215	0.6080			
A0	36.7385	1.0096	17.2239	0.0000	S
A2	31.5846	0.3805			
A0	36.7385	1.0096	13.7715	0.0000	S
A3	32.1923	0.6304			
A0	36.7385	1.0096	15.0777	0.0000	S
A4	32.1538	0.4274			
A1	31.8215	0.6080	1.1911	0.2453	NS
A2	31.5846	0.3805			
A1	31.8215	0.6080	−1.5264	0.1400	NS
A3	32.1923	0.6304			
A1	31.8215	0.6080	−1.6122	0.1200	NS
A4	32.1538	0.4274			
A2	31.5846	0.3805	−2.9757	0.0066	S
A3	32.1923	0.6304			
A2	31.5846	0.3805	−3.5867	0.0015	S
A4	32.1538	0.4274			
A3	32.1923	0.6304	0.1821	0.8571	NS
A4	32.1538	0.4274			

SD: Standard deviation

Comparison between materials:

- As compared to A0, A1, A2, A3, A4 by the tests; there is a significant difference in fracture resistance of the root ($P < 0.05$).

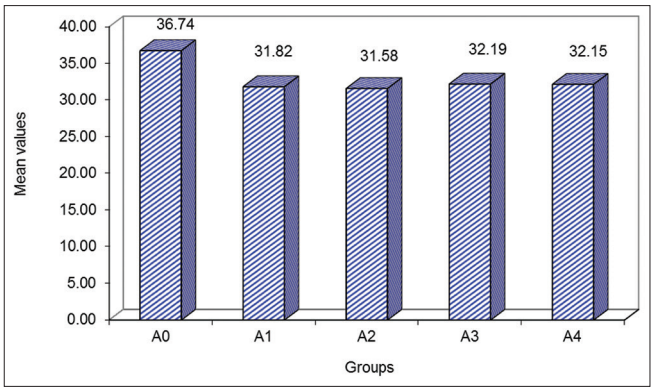

Figure 1: Comparison of five groups with respect to mean scores of applied force

- Overall result showed that Resilon increases the fracture resistance of the root compared to Gutta-Percha obturation.

DISCUSSION

In this study, the force was applied along the long axis of the root with a rounded punch, which produced root fracture when contact was made between the punch and walls of the canal opening and the force is applied. The roots used were narrower, and the standardization was done by doing the biomechanical shaping up to file size 40.[12,13] While going through results, we saw no differences between the lateral condensation and vertical condensation groups using the same material.[14,15] Many studies have suggested that as removal of tooth structure increases, fracture resistance of the tooth decreases. Root canal instrumentation is an unavoidable step in endodontic treatment.[16] However, it is understood that as dentin is removed during the instrumentation phase, a weakening effect on the root is inevitable. If we add the wedging forces of the spreader during lateral condensation or perform excessive dentin removal to facilitate pluggers for vertical condensation, the potential for root fracture is very real.[17] The concept of dentin bonding in restorative dentistry has been introduced in endodontic treatment, and promising results have been reported in methyl methacrylate tributylborane, or mma/tbb, - based resin sealer.[18] The resin composed of 4-methacryloxyethyl trimellitate anhydride, or 4-meta, and mma-tbb–which is known commercially as super bond c&b or c&b metabond has been reported to produce consistently high bond strengths and has been successfully used clinically for 15 years.[19] Some studies have suggested that the root canal sealer, especially glass ionomer cement, might strengthen root dentin.[2] Few studies have evaluated the potential of using dentin bonding agent and resins as obturation materials in nonsurgical root canal treatment.[20] Reasons for not using resins have centered on questionable results, difficult and

unpredictable methods of delivery into the root system and the inability to retreat the canal if necessary. However, these materials may have the potential to enhance the endodontic seal by reducing microleakage from both apical and coronal directions, thereby contributing to the success of orthograde endodontic treatment.[8-10] Trope and Roy, using maxillary and mandibular canine roots, showed that ketacendo strengthened roots weakened by canal instrumentation.[6] Lertchirakarn *et al.* suggested that ketac endo strengthened endodontically treated roots and may be used for weak roots, which are likely to be susceptible to vertical root fracture.[21]

CONCLUSION

This *in vitro* comparison study of fracture resistance of root filled with Resilon and Gutta-Percha with lateral and vertical obturation in the same diameter of the canal.

The vertical obturating technique is better than the lateral obturating technique. Resilon increases the fracture resistance as compared to the Gutta-Percha and AH 26. Under the conditions of this study, Resilon with vertical condensation technique performs better than Gutta-Percha and AH 26 sealer and to the lateral condensation technique.

REFERENCES

1. Lee KW, Williams MC, Camps JJ, Pashley DH. Adhesion of endodontic sealers to dentin and gutta-percha. J Endod 2002;28:684-8.
2. Pitt Ford TR. The leakage of root fillings using glass ionomer cement and other materials. Br Dent J 1979;146:273-8.
3. Zmener O, Dominguez FV. Tissue response to a glass ionomer used as an endodontic cement. A preliminary study in dogs. Oral Surg Oral Med Oral Pathol 1983;56:198-205.
4. Powis DR, Follerås T, Merson SA, Wilson AD. Improved adhesion of a glass ionomer cement to dentin and enamel. J Dent Res 1982;61:1416-22.
5. Weiger R, Heuchert T, Hahn R, Löst C. Adhesion of a glass ionomer cement to human radicular dentine. Endod Dent Traumatol 1995;11:214-9.
6. Trope M, Ray HL Jr. Resistance to fracture of endodontically treated roots. Oral Surg Oral Med Oral Pathol 1992;73:99-102.
7. Johnson ME, Stewart GP, Nielsen CJ, Hatton JF. Evaluation of root reinforcement of endodontically treated teeth. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2000;90:360-4.
8. Zidan O, ElDeeb ME. The use of a dentinal bonding agent as a root canal sealer. J Endod 1985;11:176-8.
9. Leonard JE, Gutmann JL, Guo IY. Apical and coronal seal of roots obturated with a dentine bonding agent and resin. Int Endod J 1996;29:76-83.
10. Teixeira FB, Teixeira EC, Thompson JY, Trope M. Fracture resistance of roots endodontically treated with a new resion filling material. J Am Dent Assoc 2004;135:646-52.
11. Harvey TE, White JT, Leeb IJ. Lateral condensation stress in root canals. J Endod 1981;7:151-5.
12. Reeh ES, Messer HH, Douglas WH. Reduction in tooth stiffness as a result of endodontic and restorative procedures. J Endod 1989;15:512-6.
13. Huang TJ, Schilder H, Nathanson D. Effects of moisture content and endodontic treatment on some mechanical properties of human dentin. J Endod 1992;18:209-15.
14. Saw LH, Messer HH. Root strains associated with different obturation techniques. J Endod 1995;21:314-20.
15. Lertchirakarn V, Palamara JE, Messer HH. Load and strain during lateral condensation and vertical root fracture. J Endod 1999;25:99-104.
16. Sedgley CM, Messer HH. Are endodontically treated teeth more brittle? J Endod 1992;18:332-5.
17. Baugh D, Wallace J. The role of apical instrumentation in root canal treatment: A review of the literature. J Endod 2005;31:333-40.
18. Sathorn C, Palamara JE, Palamara D, Messer HH. Effect of root canal size and external root surface morphology on fracture susceptibility and pattern: A finite element analysis. J Endod 2005;31:288-92.
19. Stuart CH, Schwartz SA, Beeson TJ. Reinforcement of immature roots with a new resin filling material. J Endod 2006;32:350-3.
20. Sathorn C, Palamara JE, Messer HH. A comparison of the effects of two canal preparation techniques on root fracture susceptibility and fracture pattern. J Endod 2005;31:283-7.
21. Lertchirakarn V, Timyam A, Messer HH. Effects of root canal sealers on vertical root fracture resistance of endodontically treated teeth. J Endod 2002;28:217-9.

How to cite this article: Tripathi S, Mirza MB, Kola Z. Comparative Evaluation of Fracture Resistance of Tooth after Lateral and Vertical Obturation Filled with Gutta-Percha and Resilon Obturating Material: An *In Vitro* Study. Int J Sci Stud 2016;3(10):119-122.

Source of Support: Nil, **Conflict of Interest:** None declared.