ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 2, Issue – 1, January - February - 2019, Page No. : 128 - 135

The effect of different root canal sealers on the fracture resistance of endodontically treated teeth-in vitro study.

[1]Dr. Viddyasagar Mopagar, Prof and HOD, Dept of Pediatric and Preventive Dentistry, Rural Dental College, Loni

[2]Dr. Sumit Gunjal, Post Graduate Resident, Dept of Pediatric and Preventive Dentistry, Rural Dental College, Loni

[3]Dr. Neeta Padmawar, Senior lecturer, Dept of Pediatric and Preventive Dentistry, Rural Dental College, Loni

[4]Dr. Sourabh Joshi, Reader, Dept of Pediatric and Preventive Dentistry, Rural Dental College, Loni

[5]Dr. Asha Nara, Reader, Dept of Pediatric and Preventive Dentistry, Rural Dental College, Loni

[6]Dr. Vinay H Vadvadgi, Reader, Dept of Periodontology, Rural Dental College, Loni

Corresponding Author: Dr. Sumit Gunjal, Post Graduate Resident, Dept of Pediatric and Preventive Dentistry, Rural Dental College, Loni

Type of Publication: Original Research Paper

Conflicts of Interest: Nil

Abstract

Aim of the study: To compare fracture resistance of endodontically treated teeth obturated with adhesive sealers like Endosequence BC, EndoREZ and AH plus with a thermoplasticized obturation technique.

Methodology : A total of 60 Single rooted teeth were divided into three groups. The specimens were decoronated and standardized to a working length of 14 mm. The teeth in all groups were shaped using ProFile rotary files (Dentsply Maillefer, Ballaigues, Switzerland). Thermoplasticized Gutta Percha was used for all the teeth. The first group was obturated with Epoxy-based sealer AH Plus® (Dentsply, DeTrey, Germany) . The second group was obturated with EndoREZ® sealer (Ultradent, South Jordan, UT). The third group was obturated with Bioceramic sealer (Endosequence BC®). Roots were then embedded into acrylic blocks and were then fixed into a material testing system and loaded with a stainless steel pin with a crosshead speed of 5 mm/min until fracture. Data obtained were statistically evaluated using one-way ANOVA and post hoc test (Tukey's test). The load at which the specimen fractured was recorded in Newtons.

Results : Group III (Endosequence BC) exhibited the highest fracture force than Group I (AH plus) and Group II (EndoREZ).

Conclusion : According to this study, teeth obturated with Endosequence BC sealers showed the highest fracture resistance and can be considered to be superior in terms of fracture resistance as compared to EndoREZ and AH plus sealers.

Keywords : Sealer, fracture, resistance, AH Plus, Endosequence BC, EndoREZ

Introduction

The aim of endodontic therapy is not only to eliminate microorganisms by cleaning and shaping the root canal but also to ensure that the root canal system to be fluid free and that a single block configuration is created that seals hermetically the canal space. Because of the poor adhesiveness of gutta-percha, the use of sealers has been considered mandatory.[1,2] Sealer fills the voids between

individual gutta-percha cones applied during obturation of root canal system.[3] The main function of root canal sealers are(i) forming a bond between the core of the filling material and the root canal wall and (ii) acting as a lubricant while facilitating the placement of the filling core and entombing any remaining bacteria.[4] Secondary monoblocks are those that have two circumferential interfaces, one between the cement and dentin and the other between cement and the core material. In a root canal, the C factor can be more than 1,000. Hence, any polymerizing endodontic sealer would be subjected to sizably voluminous polymerization stresses during the setting process resulting in debonding. and gap formation along the periphery of the root filling.[5] Sealers can be a cause of root canal failure due to microleakage at sealer-dentin or sealer-core material interface.[6,7] Bond strength of endodontic sealers to dentin is an important property because it minimizes the risk of filling detachment from dentin during restorative procedures or the masticatory function ensuring that sealing is maintained and consequently clinical success of endodontic treatment.[1]

Although very few materials have seriously challenged gutta-percha and sealer in majority of filling situations, research continues to find alternatives that may seal better and also mechanically reinforce compromised roots.[8] Traditionally used root canal sealers are zinc oxide eugenol, calcium hydroxide, and resin-based sealers. Newer root canal sealers are constantly being developed to provide improved properties.[9] AH plus is Epoxy resin based sealer. This two paste system is less tooth staining less toxic and highly biocompatible. Component A contains Epoxy resins, Calcium tungstate, Zirconium oxide, Silica, Iron oxide pigments. Component B contains Amines, Calcium tungstate, Zirconium oxide, Silica ,Silicone oil.[10] EndoREZ is a hydrophilic, two-component, chemical or dual-curing sealer and contains zinc oxide, barium sulfate, resins, and pigments in a matrix of urethane dimethacrylate. The sealer can be used with gutta-percha or with resin-coated gutta-percha, the latter with the objective of forming a monoblock.[11]

Endosequence BC sealer is a recently introduced bioceramic sealer based on calcium silicate composition. It is available as premixed, injectable paste containing water-free thickening vehicles and has excellent flow ability and dimensional stability.[12,13]

Thus, this study was undertaken to evaluate the fracture resistance of various root canal sealers namely AH PLUS, EndoREZ and EndoSequence Bioceramic.

Materials and Methods

The present study was carried out in the Department of Paediatric and Preventive Dentistry, Rural Dental College, Pravara Institute of Medical Science(DU) Loni. Ethical clearance for the study was obtained from the Institutional Ethical Review Board and Research Committee at Rural Dental College and Hospital, Loni. Sixty human single rooted maxillary permanent anterior teeth freshly extracted for therapeutic purpose were collected from Department of Oral Surgery and Department of Paediatric and Preventive Dentistry and used for the study. After extraction, the teeth were cleaned of debris and blood clot in running water. The teeth were stored in 0.1% thymol in distilled water solution for 24 hrs for disinfection. Calculus was removed with ultrasonic scaler and the teeth were placed in 3% sodium hypochlorite solution for two hours and finally in normal saline. All the teeth were decoronated 14 millimetres from the apex with a diamond disc using a water coolant. Access cavity was made with round bur. Following the working length, teeth were then prepared using crown-down technique with Rotary files. During filing copious irrigation was done using 3% sodium hypochlorite and 17% EDTA liquid alternatively.

Final irrigation was done with normal saline. The canals were then dried with sterile paper points.

The samples were randomly divided into 3 groups of 20 teeth each by block randomization method-

Group I: Teeth obturated using AH Plus sealer (Dentsply, De Trey Konstanz, Germany) as sealer.

Group II: Teeth obturated using EndoREZ (Sybron Endo, Korea) as sealer.

Group III: Teeth obturated using EndoSequence BC (Brasseler, Savannah, USA) as sealer.

The teeth in all the groups were obturated with warm thermoplasticised gutta percha. After obturation, the specimens were sealed with high strength glass ionomer cement. Mounting of the samples: A mix of cold cure acrylic resin was prepared and placed in moulds and single tooth was embedded in each mould. Colour coding for each group was done so as to differentiate and ease for identification.

Evaluating the Fracture Resistance of the Sealer

The specimen mounted in acrylic block was placed in the Universal testing machine. The rod of universal testing machine was held parallel to the long axis of the tooth. The load applied at cross-head speed was of 1 mm/min given vertically down the long axis of the tooth. The load was increased progressively until it got fractured. The load at which it got fractured was recorded in Newton. This load represents the fracture resistance of the sealer. The fracture resistance of all the specimens was recorded in the same manner. The data collected was tabulated accordingly and was subjected to statistical analysis.

Results

Fracture force for various groups

The distribution of mean ± standard deviation of fracture force of Group I (AH Plus) was 185.90 ± 20.55 N, Group II (EndoREZ) was 267.95 ± 27.41 N, Group III (Endosequence BC) was 342.45 ± 30.30 N.

Group III (Endosequence BC) exhibited the highest fracture force (342.45 ± 30.30 N), while Group I (AH plus) showed the lowest fracture force (185.90 ± 20.55 N).(Table 1)

Intragroup comparison

Intragroup comparison using one-way ANOVA and post hoc tests (Tukey's test) : On applying post hoc tests and setting a level of significance at 0.05, it was seen that all the groups were statistically significant with $p<0.001$.(Table 2)

Discussion

Stable adhesion to root canal dentin walls and an elastic modulus similar to dentin are the two key factors to improve the fracture resistance of an endodontically treated teeth.[14]The present study compared the fracture resistance of endodontically treated teeth obturated with different sealers. To create uniformity of the samples and to avoid difficulty in obtaining uniform fracture strength, all the controllable factors like length and size were standardized i.e. roots were kept at 14 mm and enlarged upto size F2.Many differences exist between fracture occurring intraorally and those induced by a testing machine, because forces generated intraorally vary in magnitude, speed and duration. Therefore in several studies, fracture strength was tested using the cyclic loading i.e. applying the forces from different direction to simulate the clinical conditions.[15]

The force in this study was directed at an angle of 0°, resulting in primarily a splitting stress applied above the access opening. The teeth had only 4 mm of root dentin exposed above the embedding material. This resulted in smaller stresses due to decreased bending movements and maximum stress located more cervically. This design is more relevant clinically as it efficiently simulates the

support given to healthy teeth by alveolar bone and results in less catastrophic stress build ups caused by unrealistic bending movements.[16]

The group that used Endosequence BC RCS had higher values of fracture resistance, this may be due to better bonding of bioceramic sealers. The exact mechanism of bioceramic-based sealer bonding to root dentin is unknown; however, the following mechanisms have been suggested for calcium silicate-based sealers:

(1) Diffusion of the sealer particles into the dentinal tubules (tubular diffusion) to produce mechanical interlocking bonds.[17]

(2) Infiltration of the sealer's mineral content into the intertubular dentin resulting in the establishment of a mineral infiltration zone produced after denaturing the collagen fibres with a strong alkaline sealer.[18]

(3) Partial reaction of phosphate with calcium silicate hydrogel and calcium hydroxide, produced through the reaction of calcium silicates in the presence of the dentin's moisture, resulting in the formation of hydroxyapatite along the mineral infiltration zone.[19]

EndoREZ is a hydrophilic, two-component, chemical or dual-curing sealer and contains zinc oxide, barium sulfate, resins and pigments in a matrix of urethane dimethacrylate. The sealer can be used with gutta-percha or with resin-coated gutta-percha, the latter with the objective of forming a monoblock. Deep resin tags are formed during setting of this methacrylate based sealer and provide enhance bonding and the clinical success of obturation.[20] Our study also showed better fracture resistance of EndoRez group than AH plus.

Epoxy resin based AH series of root canal sealers is popularly used in clinics due to its properties like dimensional stability, sufficient flow, good biocompability and radiopacity.AH plus is successor of AH 26 in Epoxy resin RCS and is less cytotoxic as compare to its counterpart. But when compared to Bioceramic it is more cytotoxic as it releases formaldehyde on setting. Due to better penetration in micro-irregularities, increased mechanical interlocking is observed between AH Plus and root dentin. But it was observed that the bond present between sealer and gutta percha is weak allowing fluid leakage at this interface.[21]

Patil et al has conducted an in vitro study comparing the push-out bond strength of AH Plus/gutta-percha, Resilon/Epiphany, Endorez sealer/ Endorez points and concluded that AH Plus/gutta-percha combination showed significantly highest bond strength.[22]

Guneser et al studied the vertical-fracture resistance of roots obturated with a newly developed tricalcium silicate cement (BioRoot RCS; Septodont, Saint Maur Des Fosses, France) using cold lateral compaction technique (LC) or matched taper single-cone gutta-percha technique (SC).They concluded that when used either with the LC technique or the SC technique, I Root SP, and newly developed tricalcium silicate cement; BioRoot RCS may have the potential to reinforce the instrumented teeth against vertical root fracture.[23]

Langalia et al compared and concluded that roots obturated with newer resin systems (Resilon and EndoREZ) enhanced the root strength almost up to the level of the intact roots. Similarly in our study EndoRez showed superior fracture resistance than Ah plus but Endosequence RCS showed better fracture resistance as compare to EndoRez .[24]

Sandikçi et al in their in vitro study concluded that lateral condensation performed with AH Plus sealer and Gutta-percha and the Thermafil technique were found to be more successful in comparison to Resilon/Epiphany SE vs EndoREZ sealer/EndoREZ cone.[25]

Hegde et al in an invitro study compared the fracture resistance of roots obturated with three hydrophilic

systems - novel CPoint system, Resilon/ Epiphany system, and EndoSequence BC sealer; and one hydrophobic gold standard gutta-percha/AHPlus system using universal testing machine . They concluded that hydrophilic systems showed higher fracture resistance than hydrophobic systems; among the hydrophilic systems C Point system and EndoSequence BC sealer had the highest fracture resistance. Similar results were found in our study.[26]

The push-out bond strength of Bioceramic sealer was highest followed by resin-based sealer and lowest bond strength was observed in MTA-based sealer in a study conducted by Madhuri et al.[27]

EndoREZ was reported to have minimal cytotoxic effects when freshly mixed or after setting. These findings were not supported by Bouillaguet et al and Scarparo et al. Their results indicated that EndoREZ had a more intense and longer-lasting inflammation in subcutaneous connective tissue of rats than AH Plus sealer.[28,29]

There are some major advantages associated with the use of bioceramic root canal sealers. Firstly, their biocompatibility prevents rejection by the surrounding tissues.[30]

Secondly, bioceramic materials contain calcium phosphate which enhances the setting properties and results in a chemical composition and crystalline structure similar to tooth and bone apatite materials.[31]

It improves sealer-to-root dentin bonding. However, one major disadvantage of these materials is in the difficulty in removing them from the root canal once they are set for later retreatment or post-space preparation.[32]

Results of this study showed highest fracture resistance with Endosequence BC followed by EndoRez and AH Plus. A comparative study between AH Plus, Endosequence RCS and EndoREZ sealers was carried out by Padmawar et al. They compared the apical sealing ability of these sealers and concluded that, Bioceramic sealer sealed the root canal better compared to AH Plus Sealer but the hermetic seal obtained was equivalent to that of EndoREZ. Within the limitations of this in-vitro study a better three dimensional sealing was achieved with both EndoSequence BC Sealer and EndoREZ.[33]

Future studies should include obtaining a more sizably voluminous sample size for a more significance as well as involving longer periods of evaluation. In integration, a quantitative analysis of microleakage and investigations into other characteristics of Smart-Seal System such as its ability to habituate to canal irregularities, solubility, dimensional stability, and antimicrobial properties would ameliorate assessment of the value of Smart-Seal System as an obturation material.

Tables

	Mean	**Std. Deviation**	**%**	**p value**
AH plus	185.90	20.553	**23.3%**	<0.001 (S)
EndoREZ	267.95	27.416	**33.6%**	
Endosequence BC	342.45	30.308	**43%**	

Table 1: Inter-group comparison of study variables

		Mean differences	**p value**
AH plus	**EndoREZ**	-82.05	0.000 (S)
	Endosequence BC	-156.55	0.000 (S)
EndoREZ	**AH plus**	82.05	0.000 (S)
	Endosequence BC	-74.5	0.000 (S)

Endosequence BC	**AH plus**	156.55	0.000 (S)
	EndoREZ	74.5	0.000 (S)

Table 2 : Intragroup comparison among study variables

Conclusion

According to this study, teeth obturated with Endosequence BC sealers showed the highest fracture resistance and can be considered to be superior in terms of fracture resistance as compared to EndoREZ and AH plus sealers. Hydrophilic obturations have shown to reinforce the strength of the root canal after instrumentation, and thus increasing the fracture resistance of the root to the stresses encountered.

References

1. Gurgel-Filho ED, Martins F. Comparative evaluation of push-out bond strength of a MTA based root canal sealer. Braz J Oral Sci 2014;13(2):114-17.
2. Setia P, Sikri VK, Sroa RB, Sidhu B. Apical sealing ability of two novel root canal sealers: An *ex-vivo* study. J Int Clin Dent Res Organ 2013;5(1):9-13.
3. Lee KW, Williams MC, Camps JJ, Pashley DH. Adhesion of endodontic sealers to dentin and gutta-percha. J Endod 2002;28(10):684-8.
4. A. Kaur, N. Shah, A. Logani, and N. Mishra. Biotoxicity of commonly used root canal sealers: a meta- analysis. JCD 2015 ;18(2): 83–88.
5. Tay FR, Loushine RJ, Lambrechts P, Weller RN, Pashley DH. Geometric factors affecting dentin bonding in root canals: A theoretical modeling approach. J Endod 2005;31(8):584-9.
6. Drukteinis S, Peciuliene V, Maneliene R, Bendinskaite R. In vitro study of microbial leakage in roots filled with EndoREZ sealer/EndoREZ Points and AH Plus sealer/conventional gutta-percha points. Stomatologija. 2009; 11(1):21-5.
7. Liviu S.Comparison of the interface dentin-endodontic sealer using two SEM magnifications. Rev. odonto ciênc. 2010;25(3):296-99.
8. Whitworth J. Methods of filling root canals: Principles and practices. Endod Top 2005;12(2):2-24.
9. Shokouhinejad N, Hoseini A, Gorjestani H, Shamshiri AR. The effect of different irrigation protocols for smear layer removal on bond strength of a new bioceramic sealer. Iran Endod J 2013;8(1) :10-3
10. Jenifer Martín-González , Lizett Castellanos-Cosano , Francisco Javier López-Frías ,Benito Sánchez-Domínguez , Cristina Calvo-Monroy , Luis Oscar Alonso-Ezpeleta ,Juan José Segura-Egea . Effect of the methacrylate-based endodontic sealer Epiphany on rat peritoneal macrophages viability. J Clin Exp Dent. 2011;3(3):216-21.
11. Cornelis H. Pameijer , Frederic Barnett , Osvaldo Zmener , Dr Odont and Benjamin Schein. Methacrylate Based Resin Endodontic Sealers: A Paradigm Shift in Endodontics? A Peer-Reviewed Publication. www.ineedce.com 1-11.
12. DeLong C, He J, Woodmansey KF. The effect of obturation technique on the push-out bond strength of calcium silicate sealers. J Endod 2015;41(3):385-8.
13. Shokouhinejad N, Hoseini A, Gorjestani H, Shamshiri AR. The effect of different irrigation protocols for smear layer removal on bond strength of a new bioceramic sealer. Iran Endod J 2013;8(1):10-3.
14. 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.
15. Butz F, Lennon AM, Heydecke G, Strub JR. Survival rate and fracture strength of endodontically treated maxillary incisors with moderate defects restored with

different post-and-core systems: an in vitro study. Int J Prosthodont. 2001 Jan-Feb;14(1):58-64.

16. Johnson ME, Stewart GP, Nielsen CJ, Hatton JF, Alton III. Minneapolis, Minn. Evaluation of root reinforcement of endodontically treated teeth. Oral surg Oral Med Oral Pathol Oral Radio Endod. 2000;90:360–4.
17. W. Zhang, Z. Li, and B. Peng, "Assessment of a new root canal sealer's apical sealing ability," Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2009 Jun;107(6):79-82.
18. L. Han, T. Okiji, "Uptake of calcium and silicon released from calcium silicate-based endodontic materials into root canal dentine," Int Endod J.2011;44(12):1081–87.
19. H. Zhang, Y. Shen, N. D. Ruse, and M. Haapasalo, "Antibacterial activity of endodontic sealers by modified direct contact test against Enterococcus faecalis," J Endod.2009;35(7):1051–55.
20. Pradnya V.Bansode, Reshma G Sakharkar, Seema D. Pathak ,M.B. Wavdhane, Shirish B Khedgikar. Emerging Root Canal Sealers. International Journal Of Scientific Research.2016;5(9):631-33.
21. Tay FR, Loushine RJ, Weller RN, Kimbrough WF, Pashley DH, Mak YF, et al. Ultra structural Evaluation of the Apical Seal in Roots Filled with a Polycaprolactone- Based Root Canal Filling Material. J Endod. 2005; 31(7):514-9.
22. Patil SA, Dodwad PK, Patil AA. An in vitro comparison of bond strengths of gutta-percha/AH Plus, Resilon/Epiphany self-etch and EndoREZ obturation system to intraradicular dentin using a push-out test design. J Conserv Dent 2013;16(3):238-42
23. Mehmet Burak Guneser, Melek Akman, İnci Baser Kolcu ,Ayce Unverdi Eldeniz. Fracture resistance of roots obturated with a novel calcium silicate-based endodontic sealer (BioRoot RCS), Journal of Adhesion Science and Technology.30(22): 2420-28.
24. Akshay K Langalia, Bela Dave, Neeta Patel, Viral Thakkar, Sona Sheth, Vaishali Parekh. Comparative Evaluation of Fracture Resistance of Endodontically Treated Teeth Obturated with Resin Based Adhesive Sealers with Conventional Obturation Technique: An In vitro Study. Journal of International Oral Health. 2015; 7(2):6-12.
25. T Sandikçi, RF Kaptan. Comparative evaluation of the fracture resistances of endodontically treated teeth filled using five different root canal filling systems. Nigerian Journal of Clinical Practice. 2014; 17(6): 667-72.
26. Hegde V, Arora S. Fracture resistance of roots obturated with novel hydrophilic obturation systems. J Conserv Dent. 2015 Jun;18(3):261–4.
27. Madhuri GV, Varri S, Bolla N, Mandava P, Akkala LS, Shaik J. Comparison of bond strength of different endodontic sealers to root dentin: An in vitro push-out test. J Conserv Dent. 2016 Sep-Oct;19(5):461-4
28. Bouillaguet S, Wataha JC, Lockwood PE, Galgano C, Golay A, Krejci I. Cytotoxicity and sealing properties of four classes of endodontic sealers evaluated by succinic dehydrogenase activity and confocal laser scanning microscopy. Eur J Oral Sci 2004;112(2):182–7.
29. Scarparo RK, Grecca FS, Fachin EV. Analysis of tissue reactions to methacrylate resin-based, epoxy resin-based, and zinc oxide-eugenol endodontic sealers. J Endod 2009;35(2):229–32
30. K. Koch and D. Brave, "A new day has dawned: the increased use of bioceramics in endodontics," Dentaltown 2009;10:39–43.

31. Ginebra MP, Fernández E, De Maeyer EA, Verbeeck RM, Boltong MG, Ginebra J, Driessens FC, Planell JA. "Setting reaction and hardening of an apatitic calcium phosphate cement." J Dent Res. 1997 Apr;76(4):905-12.
32. A. M. Cherng, L. C. Chow, and S. Takagi, "In vitro evaluation of a calcium phosphate cement root canal filler/sealer," Journal of Endodontics, 2001;27(10):613–15.
33. Padmawar N, Mopagar V, Vadvadgi V, Mustilwar R, Joshi S, Pawar N. Comparative evaluation of apical sealing ability of AH plus, Endosequence RCS and endorez as root canal sealers - An in vitro study. International journal of Scientific research.2018;7(4):19-22