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Effect of Different Intraorifice Barriers on the Fracture Resistance of Endodontically Treated Teeth: A Review

Dr.Pradnya V. Bansode[1], Dr. M. B. Wavdhane[2],Dr.Seema,D. Pathak[3]
Dr. Laxman D Phad [4],

1-Professor and Head of Department of Conservative Dentistry and Endodontics. Govt Dental College & Hosp, Aurangabad
2 - Asso. Professor, 3- Asso. Professor, 4- Post Graduate Student
Corresponding Author: Dr.Pradnya V. Bansode

Abstract
Introduction: The purpose of this review was to compare the effects of different materials used as intraorifice barriers on the fracture resistance of endodontically treated roots obturated with gutta-percha.
Material and methods: Electronic searches were performed in the Pubmed and Scopus databases using relevant keywords. Textbook searching was also applied. Following selection, articles were fully reviewed to ensure that they met inclusion/ exclusion criteria.
Results: The root reinforcement abilities of a wide variety of restorative materials used as intraorifice barriers have been investigated, assessed and compared within the dental literature.
Conclusion:The placement of an intra-orifice barrier can be regarded as beneficial for the reinforcement of an endodontically treated teeth.

Keywords: *Intra-orifice barriers,Endodontically treated teeth, fracture resistance Composite resin, Glass ionomer.*

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I. Introduction

Endodontically treated teeth are more susceptible to fracture than vital teeth because of excessive loss of tooth tissue, dehydration of the dentin, and pressure during obturation procedures. Previous clinical studies have shown that 11-13% of extracted teeth with endodontic treatment are associated with vertical root fractures, rendering it the second most frequent identifiable reason for loss of root-filled teeth.[1,2]

Furthermore, Bender and Freedman also reported the increased incidence of vertical fractures in teeth that have undergone endodontic therapy. [3]

The main aim of root canal treatment is to clean and disinfect the root canals from the bacteria to obtain a three-dimensional fluid impervious obturation along the root canal from the coronal intra-orifice to the apical constriction. [4] There is a lack of conclusive evidence for the weakening of endodontically treated teeth, thus the aforementioned facts indicate that the main goal for endodontic therapy should be reinforcement of residual tooth structure. [5]

Bonded composite restorations can be considered as the first choice for coronal restorations as they play a vital role in increasing the fracture resistance of endodontically treated teeth.[4] Furthermore, it has been shown that direct and indirect cusp coverage adhesive restorations can significantly increase the fracture resistance of endodontically treated teeth.[5] Bonding endodontic obturation materials to radicular dentin is another approach to increase fracture resistance.[6,7] Use of sealers and lateral condensation technique significantly strengthen the roots as compared to canals, which are instrumented but not obturated.[8]

In-order to reinforce the roots, stress concentrations at dentin - material interface should be minimized by utilizing materials that have modulus of elasticity similar to dentine i.e. 14 - 16 gigapascals. [6] Root canal filling materials such as Resilon and gutta percha have low modulus of elasticity compared to dentine and thus have little or no capacity for root reinforcement. [7]

Roghanizad and Jones suggested removal of 3mm of gutta percha from the orifice of the root canal and replacing it with a restorative material to reduce coronal leakage. [29]

Studies have advocated the use of intracoronal barriers in preventing coronal microleakage.[9] Through the use of restorative materials with elastic moduli similar to the dentin, it might be logical to assume that intraorifice barriers can also provide stiffness against forces that generate root fractures.

Very few studies have assessed the reinforcing effect of intraorifice barriers placed over root canal fillings. [24] Hence, the aim & objective of this review is to compare the effects of different materials used as intraorifice barriers on the fracture resistance of endodontically treated roots obturated with gutta-percha.

II. Material And Methods

Electronic searches were performed in the Pubmed and Scopus databases using the keywords: intraorifice barriers, root reinforcemet, fracture resistace of endodontically treataed teeth, Composite resin, Glass-ionomer. Textbook searching was also applied for relevant information. Articles were first selected according to titles and abstracts, and they were then fully reviewed to ensure that they met the inclusion/exclusion criteria.

Inclusion criteria

Studies with all designs that used different materials and or techniques included. The study should refer to intracoronal orifice and fracture resistance of endodontically treataed teeth significance. Searches were limited to papers written in English and published between 1999 and 2018.

Exclusion criteria

All studies that failed to meet the inclusion criteria. If a study did not refer to the intraorifice barrier or explain its relation with fracture resistance endodontically treated teeth, it was discarded. Studies that discussed a coronal barrier were also rejected.

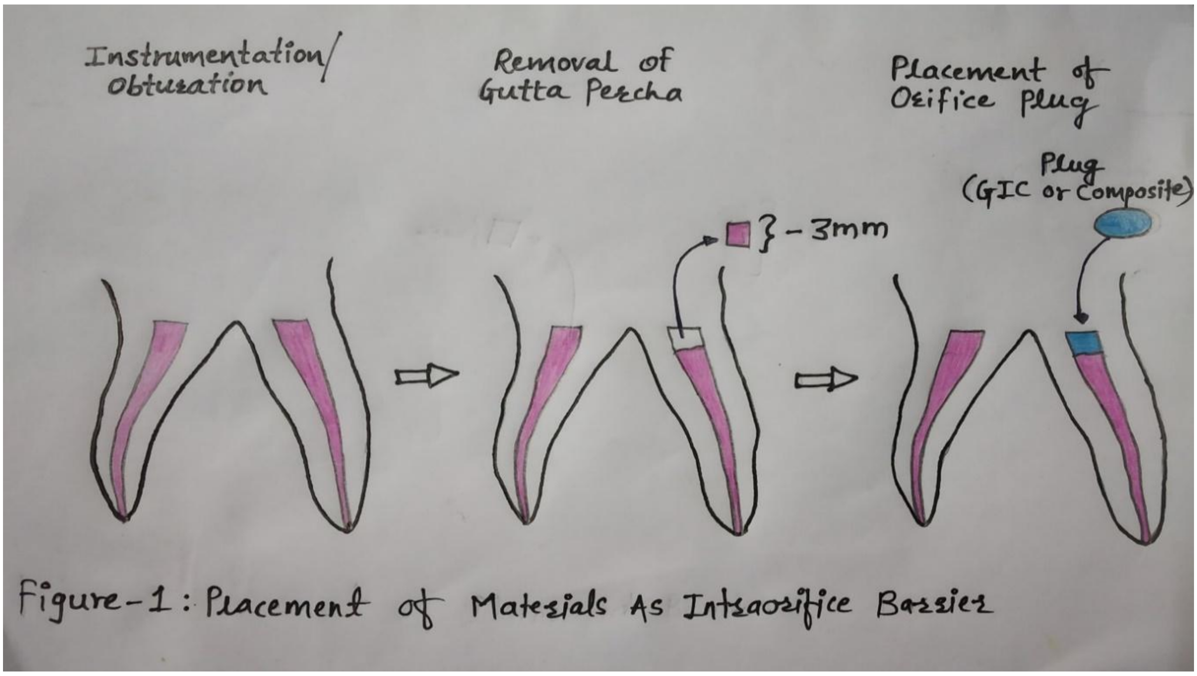
III. Results:

Definition of anintra-orifice barrier, intraorifice root reinforcing material and their importance:

The intra-orifice barrier is an effective treatment used in endodontically treated teeth by introducing an additional material into the canal orifice immediately after removal of the coronal portion of gutta-percha and sealer.[29]

The following criteria have been proposed by Wolcott et al. for an intracoronal barrier:

(a) Easily placed by the specialist,
(b) Bonds to tooth structure (retentiveness),
(c) Effectively seals against microleakage,
(d) Easily distinguishable from natural tooth structure and
(e) Does not interfere with the final restoration of the access preparation.



Endodontically treated roots are susceptible to fracture because of their weakened structure. Thus, one of the goals of root canal treatment is to reinforce the endodontically treated root. [9] As well as intra‑ orifice barriers have been popular in recent years to obtain reduced coronal leakage. [10‑ 14] root canal treatment with an intra‑ orifice barrier in comparison without barrier can increase the fracture resistance.[9]

Amalgam, composite resin, glass ionomer cement and are commonly used materials.[12,13]The use of colored materials is recommended so they can be easily identified in cases of retreatment or post restoration.11

Examples include the flowable composite resins PermaFlo® Pink or Purple (Ultradent), Flow-It® dark red (Pentron) or dark blue (DenMat).

The reinforcing ability of commonly used postendodontic materials such as glass ionomer cement, resin-modified glass ionomer cement (RMGIC), fiber-reinforced composite (FRC), and nanohybrid composite (NC),Luxacore Z (Dual Automix, DMG America), Light cure glass ionomer cement (GC Light cure GIC), Tetric - N - Flow (Nano hybrid flowable composite) and MTA have been investigated, assessed and compared.

Emre Nagas et al. ***(2016)*** concluded that theIncorporation of 5 wt% AR glass fiber can significantly improve the reinforcement effect of Pro-Root MTA and Biodentine when used as intraorifice barriers. [25]

E Yasa, H Arslan et al. ***(*****2016)** concluded thatglassionomer cement, nano‑ hybrid composite resin, short fiber‑ reinforced composite, and bulk‑ fill flowable composite increased the force required to fracture roots compared to the control groups. MTA placement (MTA Angelus or Micro Mega MTA) as an intra‑ orifice barrier did not significantly increase the fracture resistance of endodontically treated roots compared to the control groups, however Biodentine did. [26]

Abhishek Gupta ***et al. (2016)*** concluded that the endodontically treated roots with an intraorifice barrier are more resistant to fracture compared with those without ones. Fracture resistance of roots was significantly affected by the type of intraorifice barrier. RMGIC and FRC followed by NC significantly increases the fracture resistance of endodontically treated teeth. RMGIC yielded the highest fracture resistance followed by FRC, NC, and MTA. MTA is not suitable for root reinforcement.[30]

Renuka Nadar et al. (2018**)**concluded that the endodontically treated teeth with an intra-orifice barrier are more resistant to fracture compared with those without a barrier. LuxaCore Z followed by light cure glass ionomer and Tetric N Flow significantly increased the fracture resistance of endodontically treated teeth. LuxaCore Z yielded highest fracture resistance as an intra-orifice barrier as a result of enhanced physical properties and dual cure setting mechanism.[28]

IV. Discussion

Much of the fracture susceptibility of endodontically treated teeth is intrinsic to the root canal morphology, dentin thickness, canal shape, and size and curvature of the external root;[10] thus, special attention should be given for securing sufficient remaining dentin. However, enlargement of the coronal third of the root canal space is considered important to support root canal length measurement, debris removal, effective irrigation, and canal obturation. However, extensive use of rotary instruments during preparation of the root canal space by cutting the dentin to gain straight lines access weakens the root structure. Desiccation and dehydration of the dentin are also a few of the causes that may predispose to the weakening of tooth. Rundquist *et al*. (2006) stated that with increasing taper, root stresses decreased during root filling but tended to increase for masticatory loading, resulting fracture originating in the cervical portion.[11]

Although bonded obturation materials might increase the fracture resistance of root-filled teeth, the current endodontic obturation systems are not suitable to obtain this goal. In the present study, the core material (gutta-percha) combined with the tested endodontic sealer (AH Plus) was not able to increase the root fracture resistance significantly in all the groups including the control group. Zandbiglari *et al*. (2006) also observed that roots get significantly weakened with the use of greater taper instruments and obturation with AH Plus sealer was not able to increase the fracture resistance.[12]

Based on this premise, in our article reinforcing ability of commonly usedpostendodontic materials glass ionomer cement, resin-modified glass ionomer cement (RMGIC), fiber-reinforced composite (FRC), and nanohybrid composite (NC) Luxacore Z (Dual Automix, DMG America), Light cure glass ionomer cement (GC Light cure GIC), Tetric - N - Flow (Nano hybrid flowable composite) MTAhave been investigated, assessed and compared.

The presence of intraorifice barriers strengthen the fracture resistance of endodontically treated teeth as compared to endodontically treated teeth without intraorifice barriers. The fracture strength values of the test groups revealed that fracture resistance of the roots was significantly affected by the type of intraorifice barrier used. To reinforce endodontically treated tooth, stress concentrations at the dentin material interface should preferably be minimized by using materials with a modulus of elasticity similar to that of the dentin, which is about 14-16 GPa.[6] Both RMGIC and FRC significantly increased the fracture resistance of the root specimens. NC have higher filler content which further strengthens and improves elastic modulus with less shrinkage. Aboobaker *et al*. (2015) also have reported RMGIC and flowable resin to be an effective intraorifice barrier with significantly high resistance. [13]

MTA provides a superior seal against microleakage when used as an intracanal medicament.Nagas *et al*., results of study also showed the lowest values for fracture resistance for MTA among all the tested groups.[14] Low fracture resistance may be attributed to its lack of bonding to the dentin, high stiffness in compression, and little strength in tension.

Composites bond to the tooth structure micromechanically and thus, provide good marginal seal, reinforcement of remaining tooth structure,[15] and conservation of tooth structure. Composite resins reportedly absorb and distribute forces in a uniform manner, thereby increasing resistance to fracture and providing an improved prognosis. Incorporation of fibers increases the elastic modulus of nonreinforced resin from 6-9 GPa to 9-15 GPa, which is close to the dentin,[16] thus resulting in higher values of fracture resistance for FRC than conventional resin composite. Moreover, fibers used in FRC have a unique, patented interpenetrating polymer network structure, which can be reactivated even after the final polymerization, resulting in superior anchorage.

RMGIC shows superior performance as an acceptable coronal seal due to water sorption by the material, resulting in setting expansion.[17] RMGIC has high flexural strength and modulus of elasticity (10-14 GPa) close to the dentin.[18] Thus, the material can withstand a large amount of stress before transmitting the load to the root.[19] Moreover, it chemically bonds with the dentinal surface, rendering more strength at the dentin cement interface.[20] All these properties might have resulted in RMGIC being the most fracture-resistant material.

Both FRC and RMGIC have high flexural strength and high modulus of elasticity;[20] with values that are similar to dentin, both materials can withstand large amounts of stress before transmitting the load to the root.[21] Moreover, both materials exhibit good adhesive properties to the dentin,[22] which might have significantly contributed to the greater fracture resistance values.

An array of materials had been utilized as intra - orifice barriers in earlier studies such as bonded amalgam, Mineral trioxide aggregate (MTA), calcium enriched mixture cement, resin modified glass ionomer cement, flowable composite, etc. Bonded amalgam, MTA, calcium enriched mixture cement although have been routinely used for restorative procedures due to good sealing capacity, but poor physical properties. [22]

Root reinforcement with the tested intraorifice barriers did not totally reduce the susceptibility of roots to fracture. However, within the limitations of this study, the reinforcement of obturated roots with FRC or RMGIC as intraorifice barriers can be regarded as a viable choice to reduce the occurrence of postendodontic root fractures. Further laboratory research with different materials coupled with clinical trials is necessary.

However, more studies with simultaneous testing of both microleakage and fracture resistance are needed including more materials and parameters.

V. Conclusion

Endodontically treated roots with an intraorifice barrier are more resistant to fracture compared with those without ones. Fracture resistance of roots was significantly affected by the type of intraorifice barrier.

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Conflicts of interest

There are no conflicts of interest.

References

[1]. Fuss Z, Lustig J, Tamse A. Prevalance of vertical root fractures in extracted endodontically treated teeth. Int Endod J. 1999;32:283–6.
[2]. Caplan DJ, Weintraub JA. Factors related to loss of root canal filled teeth. J Public Health Dent. 1997;57:31–9.
[3]. KarapinarKazandag M, Sunay H, Tanalp J, Bayirli G. Fracture resistance of roots using different canal filling systems. Int Endod J. 2009;42:705–10.
[4]. Monga P, Sharma V, Kumar S. Comparison of fracture resistance of endodontically treated teeth using different coronal restorative materials: An *in vitro* study. J Conserv Dent. 2009;12:154–9.
[5]. Bassir MM, Labibzadeh A, Mollaverdi F. The effect of amount of lost tooth structure and restorative technique on fracture resistance of endodontically treated premolars. J Conserv Dent. 2013;16:413–7.
[6]. Gesi A, Raffaelli O, Goracci C, Pashley DH, Tay FR, Ferrari M. Interfacial strength of Resilon and gutta-percha to intraradicular dentin. J Endod. 2005;31:809–1
[7]. Ribeiro FC, Souza-Gabriel AE, Marchesan MA, Alfredo E, Silva-Sousa YT, Sousa-Neto MD. Influence of different endodontic filling materials on root fracture susceptibility. J Dent. 2008;36:69–73.
[8]. Jhamb S, Nikhil V, Singh V. Effect of sealers on fracture resistance of endodontically treated teeth with and without smear layer removal: An *in vitro* study. J Conserv Dent. 2009;12:114–7.
[9]. Pisano DM, DiFiore PM, McClanahan SB, Lautenschlager EP, Duncan JL. Intraorifice sealing of gutta-percha obturated root canals to prevent coronal microleakage. J Endod. 1998;24:659–62.
[10]. 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.
[11]. Rundquist BD, Versluis A. How does canal taper affect root stresses? Int Endod J. 2006;39:226–37.
[12]. Zandbiglari T, Davids H, Schäfer E. Influence of instrument taper on the resistance to fracture of endodontically treated roots. Oral Surg Oral Med Oral Pathol Oral RadiolEndod. 2006;101:126–31.
[13]. Aboobaker S, Nair BG, Gopal R, Jituri S, Veetil FR. Effect of intra-orifice barriers on the fracture resistance of endodontically treated teeth — an *ex-vivo* study. J Clin Diagn Res. 2015;9:ZC17–20.
[14]. Nagas E, Uyanik O, Altundasar E, Durmaz V, Cehreli ZC, Vallittu PK, et al. Effect of different intraorifice barrier on the fracture resistance of roots obturated with Resilon or gutta-percha. J Endod. 2010;36:1061–3.
[15]. Andreasen JO, Munksgaard EC, Bakland LK. Comparison of fracture resistance in root canals of immature sheep teeth after filling with calcium hydroxide or MTA. Dent Traumatol. 2006;22:154–6.

[16]. Suprabha BS, Sudha P, Vidya M. A comparative evaluation of sealing ability of restorative materials used for coronal sealing after root canal therapy. J Indian Soc PedodPrev Dent. 2001;19:137–42.
[17]. Xie D, Brantley WA, Culbertson BM, Wang G. Mechanical properties and microstructures of glass-ionomer cements. Dent Mater. 2000;16:129–38.
[18]. Goldberg F, Kaplan A, Roitman M, Manfré S, Picca M. Reinforcing effect of a resin glass ionomer in the restoration of immature roots *in vitro*. Dent traumatol. 2002;18:70–2.
[19]. Trope M, Ray HL., Jr Resistance to fracture of endodontically treated roots. Oral Surg Oral Med Oral Pathol. 1992;73:99–102.
[20]. Bae JM, Kim KN, Hattori M, Hasegawa K, Yoshinari M, Kawada E, et al. The flexural properties of fiber-reinforced composite with light-polymerized polymer matrix. Int J Prosthodont. 2001;14:33–9.
[21]. Kwon OH, Park SH. Evaluation of internal adaptation of dental adhesive restorations using micro-CT. Restor Dent Endod. 2012;37:41–9.
[22]. Johnson ME, Stewart GP, Nielsen CJ, Hatton JF. Evaluation of root reinforcement of endodontically treated teeth. Oral Surg Oral Med Oral Pathol Oral RadiolEndod. 2000;90:360–4.
[23]. 23.Aboobaker S, Nair BG, Gopal R, Jituri S, Veetil FR. Effect of Intra-Orifice Barriers on the Fracture Resistance of Endodontically Treated Teeth–An Ex-Vivo Study. Journal of clinical and diagnostic research: JCDR. 2015 Feb;9(2):ZC17.
[24]. Elemam RF, Majid ZS. Critical Review on Glass Ionomer Seal under Composite Resin of Obturated Root Canals. International Journal of Contemporary Medical Research.
[25]. Nagas E, Cehreli ZC, Uyanik O, Vallittu PK, Lassila LV. Reinforcing Effect of Glass Fiber–incorporated ProRoot MTA and Biodentine as Intraorifice Barriers. Journal of endodontics. 2016 Nov 1;42(11):1673-6.
[26]. Yasa E, Arslan H, Yasa B, Akcay M, Alsancak M, Hatirli H. The force required to fracture endodontically roots restored with various materials as intra orifice barriers. Nigerian journal of clinical practice. 2017;20(10):1237-41.
[27]. Uzunoglu-Özyürek E, Eren SK, Karahan S. Effect of root canal sealers on the fracture resistance of endodontically treated teeth: a systematic review of in vitro studies. Clinical oral investigations. 2018 Jun 27:1-1.
[28]. Nadar R, Palekar A, Biradar B, Kalyan S, Pawar S, Thorat DC. Effect of intra-orifice barriers on the fracture resistance of endodontically treated teeth–An Ex-Vivo study. Pravara Medical Review. 2018 Mar 1;10(1).
[29]. Roghanizad N, Jones J. Evaluation of coronal microleakage after endodontic treatment. J Endod.1996;22(9):471–3.
[30]. Gupta A, Arora V, Jha P, Nikhil V, Bansal P. An in vitro comparative evaluation of different intraorifice barriers on the fracture resistance of endodontically treated roots obturated with gutta-percha. Journal of conservative dentistry: JCD. 2016 Mar;19(2):111.

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