ejpmr, 2024, 11(10), 200-205

SJIF Impact Factor 7.065

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Research Article

ISSN 2394-3211

EJPMR

COMPARATIVE EVALUATION OF FRACTURE RESISTANCE OF ROOTS OBTURATED WITH GUTTA PERCHA ALONG WITH FOUR DIFFERENT TYPES OF ROOT CANAL SEALERS – AN INVITRO STUDY

Dr. Kiran J. Kasti[1], Dr. Yuva Rani P.*[2], Dr. Ananthakrishna S.[3], Dr. Pradeep P. R.[4], Dr. Sameer Mohideen Gani[5], Dr. Akshata M. H.[6]

[1]Reader Department of Conservative Dentistry and Endodontics M.R. Ambedkar Dental College and Hospital Bangalore.

[2]Post Graduate Student Department of Conservative dentistry and Endodontics M.R. Ambedkar Dental College and Hospital Bangalore.

[3]Professor and HOD Department of Conservative Dentistry and Endodontics M.R. Ambedkar Dental College and Hospital Bangalore.

[4]Principle and Professor Department of Conservative Dentistry and Endodontics M.R. Ambedkar Dental College and Hospital Bangalore.

[5]Post Graduate Student Department of Conservative Dentistry and Endodontics M.R. Ambedkar Dental College and Hospital Bangalore.

[6]Post Graduate Student Department of Conservative Dentistry and Endodontics M.R. Ambedkar Dental College and Hospital Bangalore.

***Corresponding Author: Dr. Yuva Rani P.**

Post Graduate Student Department of Conservative Dentistry and Endodontics M.R. Ambedkar Dental College and Hospital Bangalore.

Article Received on 01/08/2024 **Article Revised on 21/08/2024** **Article Accepted on 11/09/2024**

ABSTRACT

Aim: In this study we are evaluating the fracture resistance of roots filled with AH plus, metaceraseal, sealapex and MTA fillapex sealers. **Materials and Methods:** Forty teeth with single roots were chosen. Then these samples were randomly distributed among four groups. Group I (n=10): root canals obturated with F4 protaper point using AH plus. Group II (n=10): root canals obturated with F4 protaper point using sealapex. Group III (n=10): root canals obturated with F4 protaper point using MTA fillapex. Group IV (n=10): root canals obturated with F4 protaper point using metaceraseal. The coronal 1 mm of the obturation material was cut, and the roots were coronally sealed with temporary filling material. Fracture resistance was tested using a universal testing machine The maximum force applied to fracture each root was logged in Newton (N). **Inferential statistics:** One-way ANOVA test followed by Tukey's post hoc analysis will be used to compare the fracture resistance of roots filled with AH plus, metaceraseal, sealapex and MTA fillapex sealers. The level of significance [P-Value] will be set at $P<0.05$. **Results:** The mean Fracture Resistance was significantly highest in MTA Fillapex & Metaceraseal group followed by Sealapex group and least in AH Plus group. **Conclusion:** It can be concluded that root canal sealers increased the fracture resistance of endodontically treated teeth, Highest fracture resistance within the sealer groups was shown by MTA Fillapex & Metaceraseal group followed by Sealapex group, and least in AH Plus group.

INTRODUCTION

At present, the gold standard materials for filling root canals are gutta-percha along with sealer. The primary function of a root canal sealer is to adapt the gutta-percha cones to the canal walls and to fill the spaces in between the gutta-percha cones. It also acts as a lubricant during the placement of the gutta-percha. Root canal treated teeth are perceived as weaker and disposed to fracture more when compared to vital teeth. This is because of increased stresses during instrumentation procedures, post preparation ad placement. Therefore, the roots will be more prone to fracture and the resistance of root canals to loads may reduce.

MATERIALS AND METHODS

Forty teeth with single roots were chosen and kept in 0.1% thymol solution until the beginning of the experiment.

Pre-operative radiographs were taken for all specimens in both buccolingual and mesiodistal directions, to ensure the existence of a single canal.

Any calcifications, fractures or teeth with incompletely formed apices or larger than a #25 K-type file, and previous root canal treatment were excluded.

Teeth with severe curvature, dilacerated root, or with internal or external root resorption, and caries were excluded.

Decoronation was done using a fissure diamond bur under copious water irrigation to yield 13-mm long roots. A digital caliper was used to measure the bucco-lingual and the mesio-distal diameter of the coronal planes for standardization.

Initial working length was taken with size 15 K-file by inserting the file until its tip appeared at the apical foramen, then deducting 1 mm from its length.

All root canals were instrumented by protaper files till F4 (size 40 taper 0.06).

Irrigation was performed using 3 ml of sodium hypochlorite (5.25% NaOCl), between each file size.

After instrumentation, the canals were flushed with 17% EDTA solution to eradicate the smear layer, then rinsed with 10 mL distilled water before drying with paper points

Then these samples were randomly distributed among four groups.

- Group I (n=10): root canals obturated with F4 protaper point using AH plus.
- Group II (n=10): root canals obturated with F4 protaper point using sealapex
- Group III (n=10): root canals obturated with F4 protaper point using MTA fillapex.
- Group IV (n=10): root canals obturated with F4 protaper point using metaceraseal.

Periapical radiographs were taken mesiodistally and buccolingually to ensure complete filling.

Finally, the coronal 1 mm of the obturation material was cut, and the roots were coronally sealed with temporary filling material.

Mechanical testing

A 0.2-0.3 mm thickness of wax material was used to cover 5 mm of all roots apically to mimic a periodontal membrane.

A digital caliber was used to gauge the uniform thickness of the wax.

The samples were affixed in self-curing resin cylinders (15 mm in height and 20 mm in diameter) in a vertical direction, embedding 5 mm of the root length.

The roots were separated from the resin as soon as the acrylic resin started polymerization, and the wax was removed

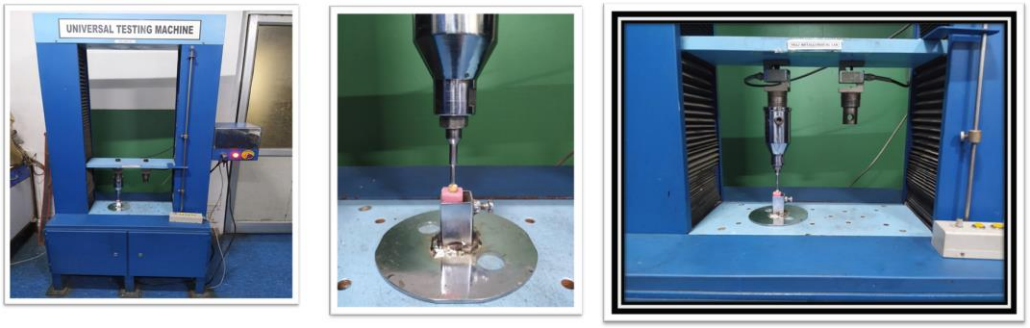
The root surfaces were covered by a thin layer of polyvinylsiloxane impression material and then returned into the acrylic resin.

Fracture resistance was tested using a universal testing machine “Instron Corp., MA, USA”. The acrylic blocks were positioned on the lower plate of the instrument.

The upper plate consists of a 2.8 mm diameter spherical steel tip.

The tip compressed the center of the canal and exerted vertical load (1 mm/min) until fracture took place. The maximum force applied to fracture each root was logged in Newton (N).

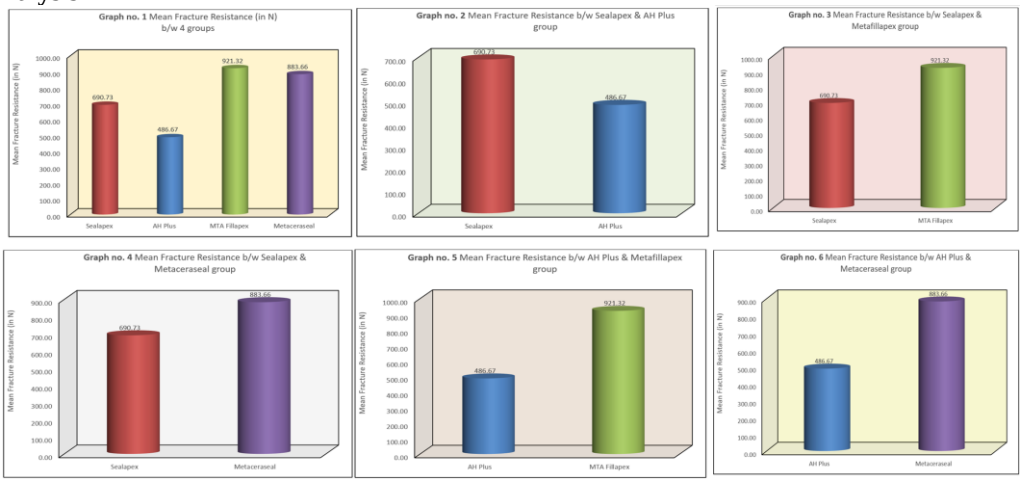
Universal testing machine

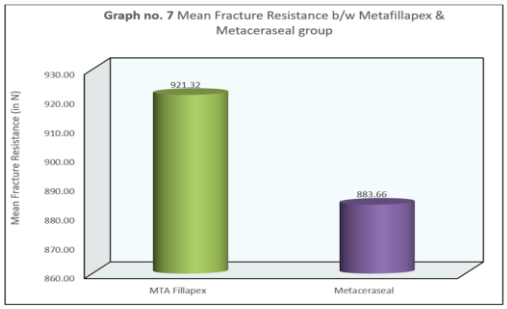


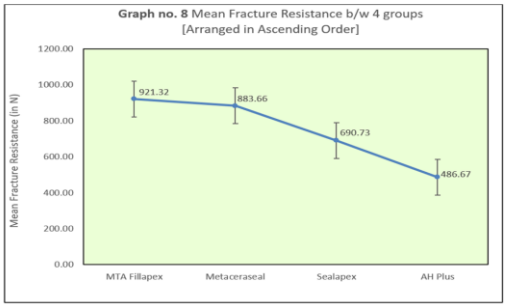
RESULTS

Sl	Fracture Resistance (in N)			
	Sealapex	AH Plus	MTA Fillapex	Metaceraseal
1	630.0	534.0	812.0	825.0
2	705.5	480.0	1057.5	845.0
3	759.0	574.0	942.0	1048.0
4	855.0	437.5	888.0	967.0
5	643.5	486.5	968.5	860.5
6	679.8	484.9	1051.3	944.6
7	658.2	524.6	772.1	704.8
8	751.0	432.8	988.7	905.3
9	594.3	363.5	967.8	828.0
10	631.0	548.9	765.3	908.4

Statistical analysis







Comparison of mean Fracture Resistance (in N) b/w 4 Sealer groups using One-way ANOVA Test

Groups	N	Mean	SD	Min	Max	p-value
Sealapex	10	690.73	78.50	594.3	855.0	<0.001*
AH Plus	10	486.67	63.00	363.5	574.0	
MTA Fillapex	10	921.32	107.74	765.3	1057.5	
Metaceraseal	10	883.66	93.87	704.8	1048.0	

* - Statistically Significant

The mean Fracture Resistance for Sealapex group was 690.73 ± 78.50, Group 2 was 486.67 ± 63.00, Group 3 was 921.32 ± 107.74 and for Group 4 was 883.66 ± 93.87. This difference in the mean Fracture Resistance between 4 groups was statistically significant at p<0.001. [Refer Graph no. 1]

Multiple comparison of mean diff. in mean Fracture Resistance (in N) b/w 4 Sealer groups using Tukey's Post hoc Test

(I) Groups	(J) Groups	Mean Diff.(I-J)	95% CI for the Diff		p-value
			Lower	Upper	
Sealapex	AH Plus	204.06	98.80	309.32	<0.001*
	MTA Fillapex	-230.59	-335.85	-125.33	<0.001*
	Metaceraseal	-192.93	-298.19	-87.67	<0.001*
AH Plus	MTA Fillapex	-434.65	-539.91	-329.39	<0.001*
	Metaceraseal	-396.99	-502.25	-291.73	<0.001*
MTA Fillapex	Metaceraseal	37.66	-67.60	142.92	0.77

Statistically significant

Multiple comparison of mean difference between groups revealed that the AH Plus group showed significantly least mean Fracture Resistance as compared to Sealapex, MTA Fillapex & Metaceraseal and the mean differences were statistically significant at p<0.001 respectively. This was then followed next by Sealapex which showed signicantly lesser Fracture Resistance as compared to MTA Fillapex & Metaceraseal groups and the mean differences were statistically significant at p<0.001 respectively. However, no significant difference was observed in mean Fracture Resistance between MTA Fillapex & Metaceraseal group [p=0.77]. This infers that the mean Fracture Resistance was significantly highest in MTA Fillapex & Metaceraseal group followed by Sealapex group, and least in AH Plus group. [Refer Graph no. 2 to 8]

DISCUSSION

- Gutta-percha, in combination with a sealer, is the most commonly used root canal filling material; however, Guttapercha has a low elastic modulus than dentin, therefore has a little effect in reinforcing roots after root canal treatment.

Hence, the use of sealer with the ability to bond to the root canal dentin surface will strengthen the remaining tooth structure, thus increasing resistance to fracture.

The root canal sealer with the property of strengthening the tooth against root fracture would be of obvious value AH Plus –Epoxy resin-based sealer AH Plus is characterized by very good mechanical properties, high radiopacity, low polymerization shrinkage and solubility.

It has better flow properties because of its viscosity and has a better penetration into the micro-irregularities because of its creeping property and long polymerization period, which increases the mechanical interlocking between the sealer and root dentin.

Sealapex is a polymeric calcium hydroxide based root canal sealer which has the ability to induce hard tissue formation at the apex after root canal obturation.

Meta cera seal is a calcium silicate based materials with physical and biological properties such as alkaline pH, chemical stability within the biological environment and lack of shrinkage.

MTA Fillapex is a mineral trioxide aggregate (MTA) based sealer. This formulation has the advantages of MTA, a material with biocompatibility, antimicrobial activity, and good sealing ability.

In the current study, MTA-Fillapex and metaceraseal showed higher fracture resistance.

MTAFillapex sealer by the formation of hydroxyapatite, having a compressive elastic modulus (14,000–18,600 MPa) similar to dentin, should be able to strengthen the roots.

The apatite formed by MTA-Fillapex is deposited among collagen fibrils, resulting in a controlled increase in the formation of inorganic nucleations on the dentin, which are seen as an interfacial layer with tag-like features.

As adherence of Bioceramic to root dentin is greater than MTA Fillapex and AH Plus, might be the reason Bioceramic has significantly higher fracture resistance than MTA Fillapex and AH Plus.

Due to the production of hydroxyapatite throughout setting, it formulates a bond (chemical) in the presence of dentine. Also because of its hydrophilic nature, it has low contact angle, thereby allowing an easy spread over the canal walls.
This impart a strong and healthy hermetic seal.

These results are similar with the studies done by Buraksagsen et al. (2012) and Mandava et al. However, MTA Fillapex did not strengthen the root as much as Bioceramic did in the present study. This could be due to low bonding of MTA to dentin.

Jainaen et al. stated that reduced fracture resistance of AH plus was due to the reduced compressive and tensile strength of AH Plus in comparison with dentin.

This result is agreed with the previous study of Nagas., et al,[18] where they found that MTA-Fillapex, iRoot SP had the highest adhesion and can't be detached from the rootOn the groundwork of the findings presented.

It may be concluded that:

1. The highest fracture resistance within the sealer groups was shown by Bioceramic, followed by MTA Fillapex, sealapex and AH Plus
2. MTA Fillapex showed reasonable fracture resistance values in comparison with AH Plus, despite the lower bond strength compared to Bioceramic dentin when com- pared with AH Plus.

CONCLUSION

- It can be concluded that root canal sealers increased the fracture resistance of endodontically treated teeth.
- Highest fracture resistance within the sealer groups was shown by MTA Fillapex & Metaceraseal group followed by Sealapex group, and least in AH Plus group.

REFERENCES

1. Sornkul E, Stannard JG. Strength of roots before and after endodontic treatment and restoration. J Endod, 1992; 18(9): 440–443. DOI: 10.1016/ S0099-2399(06)80845-9.
2. Sedgley CM, Messer HH. Are endodontically treated teeth more brittle? J Endod, 1992; 18(7): 332–335. DOI: 10.1016/S0099- 2399(06)80483-8.
3. Reinhardt RA, Krejci RF, Pao YC, et al. Dentin stresses in postreconstructed teeth with diminishing bone support. J Dent Res, 1983; 62(9): 1002–1008. DOI: 10.1177/00220345830620090101.
4. Trope M, Ray Jr HL. Resistance to fracture of endodontically treated roots. Oral Surg Oral Med Oral Pathol, 1992; 73(1): 99–102. DOI: 10.1016/0030-4220(92)90163-K.
5. Bhat SS, Hegde SK, Rao A, et al. Evaluation of resistance of teeth subjected to fracture after endodontic treatment using different root canal sealers: an in vitro study. J Indian Soc Pedod Prev Dent, 2012; 30(4): 305–309. DOI: 10.4103/0970-4388.108926
6. Trope M, Ray HL Jr. Resistance to fracture of endodontically treated roots Oral Surg Oral Med Oral Pathol, 1992; 73: 99–102.
7. Sornkul E, Stannard JG. Strength of roots before and after endodontic treatment and restoration J Endod, 1992; 18: 440–3.
8. Johnson JK, Schwartz NL, Blackwell RT. Evaluation and restoration of endodontically treated posterior teeth J Am Dent Assoc, 1976; 93: 597–605.
9. Tagger M, Katz A, Tamse A. Apical seal using the GPII method in straight canals compared with lateral condensation, with or without sealer Oral Surg Oral Med Oral Pathol, 1994; 78: 225–31.
10. Reeh ES, Messer HH, Douglas WH. Reduction in tooth stiffness as a result of endodontic and restorative procedures J Endod, 1989; 15: 512–6.
11. Karapinar Kazandag M, Sunay H, Tanalp J, Bayirli G. Fracture resistance of roots using different canal filling systems Int Endod J, 2009; 42: 705–10.

12. Sagsen B, Er O, Kahraman Y, Akdogan G. Resistance to fracture of roots filled with three different techniques Int Endod J, 2007; 40: 31–5.
13. Doyle MD, Loushine RJ, Agee KA, Gillespie WT, Weller RN, Pashley DH, et al Improving the performance of EndoRez root canal sealer with a dual-cured two-step self-etch adhesive. I. Adhesive strength to dentin J Endod, 2006; 32: 766–70.
14. Yendrembam B, Mittal A, Sharma N, Dhaundiyal A, Kumari S, Abraham A: Relative assessment of fracture resistance of endodontically treated teeth with epoxy resin-based sealers, AH Plus, MTA Fillapex, and Bioceramic Sealer: an in vitro study. Indian J Dent Sci, 2019; 11: 46-50. 10.4103/IJDS.IJDS_45_18
15. Gervini MJ, Pacheco-Yanes J, Gonçalves LS, Lopes HP, Vieira VTL, Siqueira JF, Neves MAS: Fracture resistance of roots filled with either a bioceramic or an epoxy resin-based sealer. Endod Prac, 2018; 12: 119-23.
16. Varghese R, Koshy M, Anirudhan S, Roja J, Srinivas VC, Parthasarathy A: A comparative evaluation of fracture resistance of teeth obturated with a novel sealer: Chitra CPC with Endosequence BC Sealer, MTA Fillapex and AH Plus. J Pharm Res Int, 2022; 34: 14-20. 10.9734/jpri%2F2022%2Fv34i21a35835
17. Patil P, Banga KS, Pawar AM, Pimple S, Ganeshan R: Influence of root canal obturation using gutta-percha with three different sealers on root reinforcement of endodontically treated teeth. An in vitro comparative study of mandibular incisors. J Conserv Dent, 2017; 20: 241-4.
18. Tavanafar S, Karimpour A, Karimpour H, Mohammed Saleh A, Hamed Saeed M: Effect of different instrumentation techniques on vertical root fracture resistance of endodontically treated teeth. J Dent (Shiraz), 2015; 16: 50-5.
19. Baysan A, Shahid S: Root canal obturation materials. Biomaterials in Endodontics. Khurshid Z, Zafar MS, Najeeb S (ed): Woodhead Publishing, 2022; 83-97. 10.1016/B978-0-12-821746-7.00017-6
20. Lim M, Jung C, Shin DH, Cho YB, Song M: Calcium silicate-based root canal sealers: a literature review. Restor Dent Endod, 2020; 45: e35. 10.5395/rde.2020.45.e35
21. Ghoneim AG, Lutfy RA, Sabet NE, Fayyad DM: Resistance to fracture of roots obturated with novel canal-filling systems. J Endod, 2011; 37: 1590-2. 10.1016/j.joen.2011.08.008