International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 10; Issue 05 (B); May 2021; Page No.24355-24358
DOI: http://dx.doi.org/10.24327/ijcar.2021.24358.4831

Research Article

COMPARATIVE EVALUATION OF FRACTURE RESISTANCE OF ENDODONTICALLY TREATED TEETH USING RESIN BASED SEALER AND BIOCERAMIC SEALER WITH VARIOUS IRRIGATION PROTOCOLS-AN *IN VITRO* STUDY

Naveen Kumar K[1]., Krishna Prasada L[2] and Manjusha Govind G[3]*

[1,2]Department of Conservative and Endodontics, K.V.G Dental College and Hospital, Kurunjibagh, Sullia-574327
[3]Department of Conservative Dentistry and Endodontics, K.V.G Dental College and Hospital, Kurunjibagh, Sullia-574327

A R T I C L E I N F O

Article History:
Received 15th February, 2021
Received in revised form 7th March, 2021
Accepted 13th April, 2021
Published online 28th May, 2021

Key words:

Passive ultrasonic irrigation, bioceramic sealer, fracture resistance

A B S T R A C T

Aim: The purpose of this study is to compare the fracture resistance of endodontically treated teeth using two different sealers AD seal (resin-based) and CERASEAL (bioceramic sealer) with various irrigation protocols.
Material and Method: 32 single-rooted teeth were distributed in 2 groups characterized by the different cleansing system used: conventional endodontic needle irrigation and Passive ultrasonic irrigation (PUI). Root canal preparation was carried out using ProTaper rotary files and 3% sodium hypochlorite. After preparation, the specimens were subdivided into four groups. Group I A: needle irrigation and obturated with AD seal, group IB: needle irrigation and obturated with Ceraseal, Group IIA: PUI and obturated with ADseal, group IIB: PUI and obturated with Ceraseal. A vertical load was applied to each specimen using a universal testing machineuntil the roots fractured.
Results: The result shows that the group which was obturated using ceraseal and activated with PUI showed better fracture resistance. This was followed by group II A and group IB. However, the results among the four groups were not statistically significant.
Conclusion: The highest fracture resistance was offered by Bioceramic Sealer activated with PUI when compared with resin based sealer

INTRODUCTION

Endodontically treated teeth are susceptible to root fracture. Several hypotheses have been formulated to explain this weakness. Studies shows it is because of the dehydration of dentin after endodontic therapy, excessive pressure during obturation, and the removal of tooth structure during endodontic therapy.[1] The decrease in flexural strength is clinically relevant because it indicates that less force is necessary to cause the failure of the dentin structure. Studies have shown a reductionin elastic modulus and flexural strength of dentin after root canal irrigation with NaOCl at concentrations of 2.5, 3, 5, 3, and 9%, at time points from 24 minutesto 2 hours.[2]

The effectiveness of irrigation depends not only on the solution used but also on the irrigation method, as some methods generate greater stress on the dentin surface. The most traditional method is irrigation with Positive Apical Pressure, in which irrigation is performed with a plasticsyringe and the syringe is introduced into the root canal.

Corresponding author:* **Manjusha Govind G
Department of Conservative Dentistry and Endodontics, K.V.G Dental College and Hospital, Kurunjibagh, Sullia-574327

Studies indicate that this method removes debris considerably less efficiently than do irrigation with negative apical pressure, Passive ultrasonic irrigation using continuous flushing (PUI); The literature describes two types of ultrasonic irrigation, a combination of simultaneous irrigation and ultrasonic instrumentation; the other works without simultaneous instrumentation and is known as PUI.

The first option is seldom used in clinical practice due to the difficulty of controlling the dentin cut and final shape of the channel, which may cause deformities in the root canal. Thus, ultrasound is recommended for passive irrigation.[3,4,5]

There is a clinical impression that endodontically treated teeth can fracture easily. To reinforce the instrumented teeth against fracture, sealers are used in conjunction with a core filling material.[6] It would be advantageous if the root canal obturation, in addition to providing an adequate seal, could contribute to the reduction in the incidence of tooth fractures.

The properties of an ideal root filling material include the ability to adhere to dentine, seal the root canal system, must not be toxic, and should have dimensional stability, insoluble, and unaffected by the presence of moisture.[7]So to strengthen

the root, bonding of root canal sealer to dentin may be required.

The purpose of this study is to compare the fracture resistance of endodontically treated teeth using different irrigation protocols and two different sealers- resin-based root canal sealer (ADSEAL) and recently introduced bioceramic sealer (META CERASEAL).

MATERIALS AND METHODS

A total number of 32 extracted human single rooted premolars were used in the present study. The collected teeth were checked for fractures, multiple canals, calcifications by preoperative radiographs. All the samples were uniformed to a length of 15 mm. The teeth were randomly divided into two groups:

Group I: Syringe irrigation

Group II: Passive ultrasonic irrigation

Biomechanical preparation of the root canals was done till 14 mm using Protaper rotary instrument till F3 file. After eachuse of the file, the canals were irrigated for 30 seconds with 2.5 mL of 3% NaOCl. After preparation, the specimens were randomly subdivided into four groups.

Group I A*:* was treated with three cycles of preparation and conventional irrigation with saline and obturated using F3 size Protaper gutta-percha points and ADSEAL sealer

Group I B: was treated with three cycles of preparation and conventional irrigation with saline and obturated using F3 size Protaper gutta-percha points and CERASEAL

Group II A: was irrigated with 2.5 mL of 3% NaOCl. The solution was continuously deposited and activated using an ultrasonic tip. The irrigation time was standardized to three cycles of 30 seconds each. Obturation was done using F3 size Protaper gutta-percha points and ADSEAL sealer

Group II B: was irrigated with 2.5 mL of 3% NaOCl. The solution was continuously deposited and activated using an ultrasonic tip.Obturation was done using F3 size Protaper gutta-percha points and CERASEAL

The solution remained in contact with the root canal for the same period of time in all groups. The volume of solution was standardized to 2.5 mL per cycle in all groups. Suction was performed duringirrigation to ensure that the solution did not drip onto the outer surface of the tooth. All groups received final irrigation with 10 mL of saline for 5 minutes to remove any remaining irrigation solution from the root canal. The canals were dried with absorbent paper points.

Later, the obturation was done, using F3 size Protaper gutta-percha points and ADSEAL (resin-based root canal sealer) and CERASEAL (bioceramic sealer) according to their respective groups. The samples were set aside for 24 h in 100% humidity. The teeth were fixed in resin blocks vertically about 2 mm below cementoenamel junction. The root samples were tested for resistance in universal testing machine. To apply force to the root for vertical rootfracture, a 2.2 mm diameter steel rod (cylindrical) with a pointed tip was attached to the upper part of the universal testing machine. Load (at a speed of 0.5 mm/min) was exerted vertically. This was carried out till fracture of the root takes place. The force was recorded in Newton.

Statistical Analysis

To examine the forces of root fracture, one‑way analysis of variance (ANOVA), was used. Tukey's multiple *post hoc* test was used to compare the groups. Finally, at confidence level of 95%, statistical analysis was carried out.

RESULTS

The readings were recorded in a master chart, and the data analysis was carried out statistically using one‑way ANOVA. The mean force required to fracture the CERASEAL activated with PUI was higher (245.033 MPa) compared to all other groups. [Table 1]. From the results [Table 2], significant difference was observed between groups (F = 12.205, P < 0.05) at 5% level of significance. The mean fracture resistance values for CERASEAL with PUI was higher than CERASEAL with syringe irrigation but was not statistically significant. AD seal with syringe irrigation showed lesser resistance to fracture when compared to CERASEAL with syringe irrigation but statistically not significant. Analysis of variance and Tukey's significance difference *post hoc* tests were run on the data to determine differences between the groups at $P < 0.05$. Hence, there was no notable difference between all the four groups.

Table 1 Descriptive statistics of the four groups Descriptives Fracture resistance (MPa)

	n	MEAN	SD
Group I A	8	184.755	44.7728
Group I B	8	205.16	62.148
Group II A	8	220	72.8798
Group II B	8	245.033	93.7178

SD: Standard deviation

Table 1 *P* value for fracture resistance among the groups using *post hoc* test

	95% CI for mean Lower bound	Upper bound	P	*F*
Group I A	163.801	205.709	0.074	12.205
Group I B	190.327	261.32	0.000	
Group II A	220.823	220.823	0.024	
Group II B	275.112	343.329	0.074	

CI: Confidence interval; ***F***= One way ANOVA TEST.* P< 0.005

DISCUSSION

Reinforcing the remaining tooth structure is also one of the primary goals of endodontics and not just treating the diseased pulp.[8] There is also a change in the mechanical properties of the tooth following endodontic treatment. The materials used in root embedment in *vitro* fracture resistance tests must combat the compressive and tangential forces, imitate bone, and absorb masticatory loads.[9] When periodontal ligament is simulated, the stresses are transferred all along the root surface. Stress isnot concentrated in one particular area. The simulation of artificial periodontal ligament might have an effect on fracture resistance as was proposed by Mandava *et al*. Their study used silicone paste and polystyrene resin blocks for simulation of periodontal ligament and alveolar bone.[10,11]

Here, mandibular premolars were preferred as they are fracture prone due to their crown size, anatomy, crown/root ratio, and function. Also because of their placement in the dental arch, they are exposed to both shear and compressive forces. [12]

Preparing the canals with round cross-section results in decreased root fracture due to the equal distribution of stress in

roots during filling. For this purpose, root canal preparation was performed by rotary files. [13]

Cleaning, shaping, and filling of root canals are critical steps in root canal therapy. During these phases, excessive removal of dentinal tissue, extended contact of root canal irrigants to dentine, and the application of excessive force throughout the filling of the root canal may change the root's mechanical properties and weaken it. NaOCl was used for irrigation in all groups evaluated. Although this product is known to be important for the success of endodontic treatment, it can also cause physical and chemical changes in dentin, leading to deproteinization and dentinary dissolution and changes in the elastic modulus and flexural strength of the tooth.[14,15]
The PUI group had higher fracture resistance than the conventional syringe irrigation.

The constant replacement of the solution in the root canal prevented heating of the solution during ultrasound activation, thus preserving the dentin and the fracture resistance of the tooth. PUI activation of EDTA and hypochlorite solutions for 1 min per solution did not alter the mineral level of root dentin surface. [16,17]

Epoxy resin-based sealers have been shown to have deeper permeation into dentinal tubules and greater bond to root canal dentine than glass ionomer–based and zinc oxide-eugenol-based sealers. Retention of the root filling material is enhanced due to the mechanical interlocking between the sealers in epoxy resin based sealers and the canal walls, which ultimately increases fracture resistance.[18]

In this study, bioceramic sealer showed better fracture resistance compared to resin based sealer. This can be due to the production of hydroxyapatite throughout the setting, Bioceramic formulates a bond (chemical) in the presence of dentine. Also because of its hydrophilic nature, it has a lowcontact angle, thereby allowing an easy spread over the canal walls. This imparts a strong and healthy hermetic seal. [19]
Several mechanisms have been suggested for bioceramic-based sealer bonding to root dentine. Zhang *et al*. suggested that it is a mechanical interlocking bond through the dispersion of the sealer molecules into the dentinal tubules Han and Okiji stated that permeation of the sealer's mineral content into the intertubular dentine results in denaturing the collagen fibers and the formation of a mineral infiltration zone. Others suggested that hydroxyapatite is formed along the mineral infiltration zone due to the partial reaction of phosphate with calcium silicate hydrogel and calcium hydroxide .[20]

The physicochemical communication between filling material, sealer, and root canal wall, leads toadherence between resin‐based sealers, and dental structures.[21] The inclination of the dentinal wall, sealant, and resin core, gave them the capacity to strengthen the walls againstfracture.[22]As adherence of Bioceramic to root dentin is greater than AD seal, might be the reason for the result in the present study which showed that Cerasealsealer has higher fracture resistance than AD seal.

However, it is recommended to evaluate the long‐term ability of all the sealers to enhance the resistance tofracture of the endodontically treated teeth.

CONCLUSION

The fracture resistance of teeth varies with the use of different irrigation protocols. Teeth subjected toirrigation with PUI had high fracture resistance. The highest fracture resistance within the sealer groups was shown by the Bioceramic sealer. However, the result among the four groups was notstatistically significant.

References

1. Langalia AK, Dave B, Patel N, Thakkar V, Sheth S, Parekh V. 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*: JIOH. 2015 Feb;7(2):6.
2. Baechtold M, da Cunha L, Souza E, Gabardo M, de Oliveira K, Baratto-Filho F, Leonardi D. Effect of Endodontic Irrigation Protocols on Crown Fracture Resistance. *The journal of contemporary dental practice*. 2018 Jul 1;19(7):768-72.
3. Haapasalo M, Shen Y, Qian W, Gao Y. Irrigation in endodontics Dent Clin North Am 2010 Apr;54(2):292-312.
4. Pascon FM, Kantovitz KR, Sacramento PA, Nobre-dos-Santos M, Puppin-Rontani RM. Effect of sodium hypochlorite on dentin mechanical properties. *A review. J Dent* 2009 Dec;37(12): 903-908.
5. Ahuja P, Nandini S, Ballal S, Velmurugan N. Effectiveness of four different final irrigation activation techniques on smear layer removal in curved root canals: a scanning electron microscopy study. *J Dent (Tehran)* 2014 Jan;11(1):1-9.
6. Miletić I, Anić I, Pezelj-Ribarić S, Jukić S. Leakage of five root canal sealers. *Int Endod J* 1999;32:415-8.
7. Magne P. Immediate dentin sealing: A fundamental procedure for indirect bonded restorations. *J Esthet Restor Dent* 2005;17:144-54.
8. Langalia AK, Dave B, Patel N, Thakkar V, Sheth S, Parekh V, *et al.* Comparative evaluation of fracture resistance of endodontically treated teeth obturated with resin based adhesive sealers with conventional obturation technique: An *in vitro* study. *J Int Oral Health* 2015;7:6‐12.
9. Bier CA, Shemesh H, Tanomaru‐Filho M, Wesselink PR, Wu MK. The ability of different nickel‐titanium rotary instruments to induce dentinal damage during canal preparation. *J Endod* 2009;35:236‐8.
10. Soares CJ, Pizi EC, Fonseca RB, Martins LR. Influence of root embedment material and periodontal ligament simulation on fracture resistance tests. *Braz Oral Res* 2005;19:11‐6.
11. Mandava J, Chang PC, Roopesh B, Faruddin MG, Anupreeta A, Uma CH, *et al.* Comparative evaluation of fracture resistance of root dentin to resin sealers and a MTA sealer: An *in vitro* study. *J Conserv Dent* 2014;17:53‐6.
12. Kala M, Shaktidar PR, Allappanavarkeerti S, Gupthanagendra VR. A comparative evaluation of fracture resistance of endodontically treated teeth obturated with AH plus with gutta percha, guttaflow

with gutta percha and resilon epiphany‐ an *in vitro* study. *IOSR J Dent Med Sci* 2014;13:54‐8.
13. Hu T, Cheng R, Shao M, Yang H, Zhang R, Gao Q, Guo L. Application of finite element analysis in root canal therapy. Finite Element Analysis. 2010 Aug 17:103.
14. Hülsmann M, Heckendorff M, Lennon A. Chelating agents in root canal treatment: mode of action and indications for their use. *Int Endod J* 2003 Dec;36(12):810-830
15. Vinhorte MC, Suzuki EH, de Carvalho MS, Marques AA, Sponchiado Júnior EC, Garcia LF. Effect of passive ultrasonic agitation during final irrigation on cleaning capacity of hybrid instrumentation. Restor Dent Endod 2014 May;39(2):104-108
16. Dogan H, Qalt S. Effects of chelating agents and sodium hypochlorite on mineral content of root dentin. *J Endod* 2001 Sep;27(9):578-580.
17. Akcay M, Arslan H, Mese M, Sahin NN. The effect of photon-initiated photoacoustic streaming, ultrasonically and sonically irrigation techniques on the push-out bond strength of a resin sealer to the root dentin. Clinical oral investigations. 2015 Jun;19(5):1055-61.
18. Chandra SS, Shankar P, Indira R. Depth of penetration of four resin sealers into radicular dentinal tubules: a confocal microscopic study. *Journal of endodontics*. 2012 Oct 1;38(10):1412-6.
19. Melo MA, Cheng L, Zhang K, Weir MD, Rodrigues LK, Xu HH. Novel dental adhesives containing nanoparticles of silver and amorphous calcium phosphate. Dental Materials. 2013 Feb 1;29(2):199-210.
20. Raghavendra SS, Jadhav GR, Gathani KM, Kotadia P. Bioceramics in endodontics–a review. *Journal of Istanbul University Faculty of Dentistry*. 2017;51(3 Suppl 1):S128.
21. Saleh IM, Ruyter IE, Haapasalo MP, Ørstavik D. Adhesion of endodontic sealers: scanning electron microscopy and energy dispersive spectroscopy. *Journal of endodontics*. 2003 Sep 1;29(9):595-601.
22. Sousa-Neto MD, Silva Coelho FI, Marchesan MA, Alfredo E, Silva-Sousa YT. Ex vivo study of the adhesion of an epoxy-based sealer to human dentine submitted to irradiation with Er: YAG and Nd: YAG lasers. *International endodontic journal*. 2005 Dec;38(12):866-70.

How to cite this article:

Naveen Kumar K *et al* (2021) 'Comparative Evaluation of Fracture Resistance of Endodontically Treated Teeth Using Resin Based Sealer And Bioceramic Sealer With Various Irrigation Protocols-An *In Vitro* Study', *International Journal of Current Advanced Research,* 10(05), pp. 24355-24358. DOI: http://dx.doi.org/10.24327/ijcar.2021. 24358.4831

****