Journal Homepage: - www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/17136
DOI URL: http://dx.doi.org/10.21474/IJAR01/17136

RESEARCH ARTICLE

APICAL MICROLEAKAGE EVALUATION OF CONVENTIONAL AND CONTEMPORARY ENDODONTIC SEALERS - AN INVITRO STUDY

Dr. Aasima Ishaq[1], Dr. Nowsheen Yaqoob[2], Dr. Payal Jain[3] and Dr. Roshini Agarwal[4]

1. MDS, Conservative Dentistry and Endodontics, Pacific Dental College and Hospital, Udaipur, Rajasthan.
2. MDS, Oral Pathology and Microbiology, Pacific Dental College and Hospital, Udaipur, Rajasthan.
3. Senior Lecturer, Department Of Conservative and Endodontics, R.R Dental College and Hospital, Udaipur, Rajasthan.
4. Third Year Pg, Department Of Conservative and Endodontics, Pacific Dental College and Hospital, Udaipur, Rajasthan.

Manuscript Info

Manuscript History
Received: 25 April 2023
Final Accepted: 28 May 2023
Published: June 2023

Key words:-
Apical Leakage, Ceraseal, Root Canal Treatment, Microleakage, Sealers

Abstract

Root canal sealers are well known for filling the accessory canals, voids, and irregularities in the root canals, lubricate the obturation process, and seal the space between the dentinal wall and the root filling material creating a perfect hermetic seal. Thus the main aim of our study was to compare the ability of three different root canal sealers in providing a better sealing ability by evaluating their penetration depth.

Material And Methodology: 30 extracted teeth were obtained and divided into three groups according to the type of sealer used. In group 1 zinc oxide eugenol sealer, in group 2 AH plus sealer and in group 3 ceraseal bioceramic sealer was used. Root canal preparation and obturation was done using a single technique in all the samples. Micro-leakage was evaluated using methylene blue dye penetration method. Each tooth was split and dye penetration evaluations were done under stereomicroscope (20X magnification).

Results: the data was collected and analyzed using ANOVA one way test and found that dye penetration was least for group 2 and group 3 when compared to group 3. Suggesting ceraseal and AH plus sealer to be equally efficient when compared to zinc oxide eugenol sealer.

Conclusion: within the limitations of the study it can be concluded that the newer sealers like calcium based and epoxy based sealers can proved to be much better than the conventional zinc oxide eugenol sealers. Though, a complete leakage from the apical margins is unavoidable.

Introduction:-

The principal aim of endodontic therapy is to create a tight seal that helps in repairing the periapical tissues, prevents apical periodontitis and protects against root canal re-infection. Obturation is one important step to achieve a hermetic seal and to stop further entry of micro-organisms and tissue fluids into the root canal.[1]There are various factors that lead to the failure of endodontic therapy include improper canal disinfection, inadequate and

Corresponding Author:- Dr. Aasima Ishaq
Address:- MDS, Conservative Dentistry and Endodontics, Pacific Dental College and Hospital, Udaipur, Rajasthan.

overextension of root filling materials, iatrogenic errors and improper coronal and apical seal. Apical leakage is the entry of micro-organisms or leakage of tissue fluids into the canal space.[2]Microleakage is the chief concern that can lead to the root canal failure. The use of root canal sealers plays an essential role in providing hermetic seal that prevents microleakage and root canal failure. Different sealers with different physical characteristics and properties have been marketed that include zinc oxide- eugenol, salicylate, fatty acid, glass ionomer, silicone, epoxy resin, tricalcium silicate, and methacrylate resin sealer systems.[3]

The zinc oxide-eugenol (ZOE) sealer formula was developed by Rickert and Dixon in 1931 popularly known as kerr sealer. ZOE sealers contain zinc oxide powder and eugenol liquid, an essential oil derived from cloves. Some of the properties that make Zoe a popular sealer include slow set, antibacterial and low cost.[4] Epoxy resin-based sealers, such as AH 26 and AH Plus (DentsplySirona, Konstanz, Germany), are composed of low molecular weight epoxy resins and amines and set by addition reaction between epoxide groups attached to epoxy resins and amines to form polymer.[3] Tricalcium silicate based sealer like Ceraseal (Meta biomed korea) is a one paste system contains calcium silicates, zirconium oxide and thickening agent. Thus, our present in-vitro study compared the apical microleakage of three different sealers namely ZOE, AH –Plus and Cera seal.

Material And Methodology:-

The study was conducted in the department of Conservative and Endodontic for which 30 maxillary incisor teeth were obtained from the department of oral and maxillofacial surgery of Pacific Dental College and Hospital Udaipur. The teeth obtained should free from any fracture, any carious lesion or coronal restorations below the cement-enamel junction, teeth with complete root formation and no signs of external or internal resorption were included in the study. Teeth where K files #10 and #15 couldn't pass beyond 11mm from cement enamel junction into the canal were excluded from the study.

Procedure:

All the extracted teeth were submerged in 1000ml of 5.25% of sodium hypochlorite for atleast 24 hours followed by their storage in 0.9% sterile saline at room temperature until the beginning of procedure. Diamond disc and a high speed hand piece (NSK, Tokyo, Japan) with water coolant were used to cut teeth near the cement-enamel junction to achieve a length of 12mm for all samples. Micro-motor system (E-connect pro eigteeth) and rotary Pro-taper gold files with single length technique were used for root canal preparation. This was followed by use of #30 paper points for complete drying of the root canal. All the prepared samples were then randomly divided into three experimental groups according to the type of sealer used. In Group 1 (n=10) ZOE based sealer ENDOSEAL (Prevest Denpro) was used, in Group 2 (n=10) Resin based sealer AH plus (Dentsply Sirona) and in Group 3(n=10) Tricalcium silicate based sealer Ceraseal (Meta-biomed, Korea) was used.

All the sealers used were prepared according to the instructions of the manufacturer. Upon their preparation, sealers were placed in the syringe which helped in convenient placement of the material in the canal at an approximate length of 11mm from the cement-enamel junction. Assurance for complete filling of the canal at the apical region, visible sealer extrusion from the apical foramen was noted. The syringe was gradually drawn back from the canal allowing the proper filling of the canal with the sealer until discharged from the orifice. A standardized F2 cone (Dentsply Malliefer) was placed in the canal at the length of 11mm with the help of forceps. The root canal orifice was eventually sealed with the wax glue and a double layer of nail polish was applied over the teeth leaving 1mm of the root tip. The same procedure was repeated for all the specimens and after completion the specimens were placed in an incubator at a controlled temperature of 37°C with 100% humidity for a maximum of 10 days. The samples were then immersed in methylene blue for 3 days following which measurement of microleakage was done.

Measurement Of Microleakage:

Sectioning of the teeth was done using a disc on a high speed handpiece placed closed to the center of the canal. The specimens were observed under Stereomicroscope with 2x magnification for dye penetration from the apex to the highest amount of the dye penetration in micrometers (2, 4 and 6mm).

Statistical Analysis:

The measurements obtained for the teeth were then recorded in Microsoft excel sheet under the specific headings of the sealer group followed by analysis using SPSS software version 20.0. The inter and intragroup comparisons were done using one way ANOVA test with p value of less than 0.05 as being statistically significant.

Results:-

According to the results of our study, comparable results of lowest rates of microleakage between group 2 and group 3 were observed with highest in group 1 with sealers containing zinc oxide eugenol. Statistically significant results were obtained at a depth of 4mm and 6mm of dye penetration in all the three groups. ANOVA test represented statistically significant differences in rate of apical leakage between three different types of sealers used (table 2, graph 1).

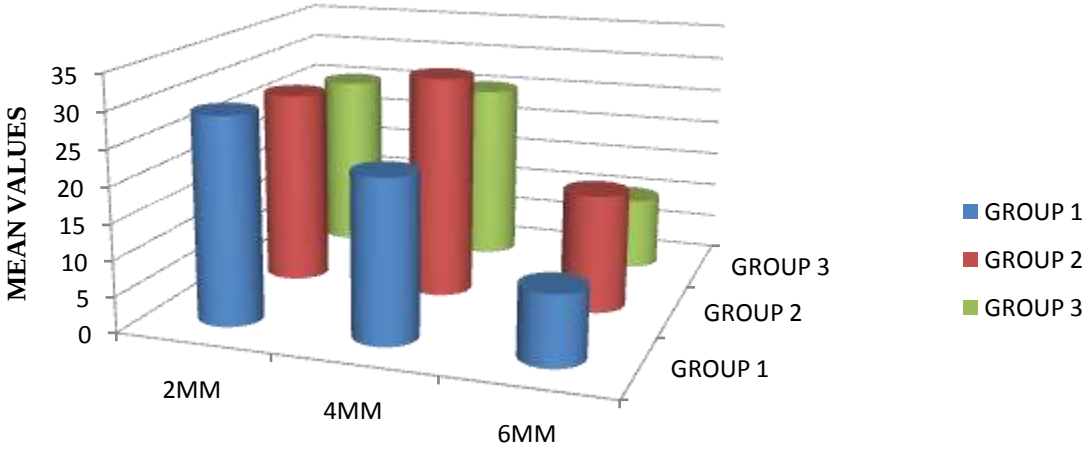
Table 1:- Representing The Comparison Of Three Groups With Respect To Dye Penetration Using One Way Anova Analysis.

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SUM OF SQUARES	F-VALUE	P-VALUE
BETWEEN GROUPS	2	89.49	44.7415	9.4792	0.0002*
WITHIN GROUPS	27	339.83	4.7198		
TOTAL	29	429.32			

Table 2:- Representing The Comparison Of Three Groups With Dye Penetration At 2mm, 4mm And 6mm Respectively.

GROUP	MEAN (µM)	STANDARD DEVIATION	P-VALUE
2 MM			
GROUP 1 (ZOE)	28.92	6.78	0.0945
GROUP 2 (AH)	27.35	6.10	
GROUP 3 (TRI-Ca)	25.22	4.72	
4 MM			
GROUP 1	31.25	8.78	0.0001*
GROUP 2	22.62	5.23	
GROUP 3	25.39	4.23	
6 MM			
GROUP 1	9.81	7.25	0.0001*
GROUP 2	16.55	4.01	
GROUP 3	10.21	5.23	

GRAPH 2: COMPARISON OF THREE GROUPS WITH DYE PENETRATION AT 2MM, 4MM AND 6MM RESPECTIVELY.



Discussion:-

Creating an impervious apical seal and obturating the entire root canal system are the primary goals of a root filling material. The core and the sealer are the two main materials used in the obturation of a root canal. The warm condensation multi phase (gutta-percha-sealer) technique, which results in a friction fit and a cold or thermoplasticized type of sealing, is regarded as the "golden" standard for endodontic treatment resulting in “cork in the bottle” type of sealing.[5] There are a variety of sealers available, ranging from non-eugenol and eugenol-based sealers to the most recent calcium silicate sealers. Despite the fact that each one has its own set of disadvantages, the search for the ideal sealer continues.[6]

Tracers like dyes, radioisotopes, bacteria and their products like endotoxins, as well as other methods like fluid filtration and the dye extraction method, have been used to evaluate the sealing ability of sealers.[7] The linear measurement of dye penetration is one approach that is frequently used to assess the sealing capacity of various root filling materials and methods. Black India Ink, Procion Brilliant Blue, and other dyes are utilized. In this study methyl blue dye was used because of its molecular size being similar to that of bacterial byproducts like butyric acid, which can leak out of infected root canals and irritate periapical tissues. Additionally, it is easy to use, pH can be adjusted, and it is easily available.[8] The outcome for the sealers that were evaluated was determined by the flow of methylene blue dye through the apex of the tooth in our study. Through the intricate anatomy of the apical third of the root canal or the space between dentin-sealer-core material interfaces, methyl blue dye has the potential to enter the obturated canals.[9] The vertical and horizontal penetration of color was estimated in units by a stereomicroscope utilizing micrometer eye-piece to achieve more precise outcomes. Antibacterial efficacy, fluid filtration, and the use of SEM, light microscope, or digitally captured images to evaluate the sealer-dentin interface have all been used in previous studies to evaluate the apical sealing ability of various sealers.[10] Using the dye penetration method, the present study compared and evaluated the amount of apical leakage in root canal walls following obturation with three distinct root canal sealers.

This study's findings are consistent with those of other experimental studies, which looked at how well various bioceramic sealers worked when used with both cold and warm gutta-percha techniques.[11] Contrary to what was thought, these results show that chemical changes during heating have an effect on a variety of gutta-percha and endodontic sealers and are correlated with the ability of various heat carriers to heat. Epoxy resin-based sealers can degrade and calcium silicate-based sealers can evaporate water in vitro at temperatures up to 100 °C, according to reports. Sealers' stability was also shown to be affected by how long they were heated.[12]

According to statistical analysis, Group 3 (CALCIUM BASED) followed by Group 2 (AH PLUS) and Group 1 (ZOE sealer) had the lowest dye penetration. Insufficient bonding between the sealer and the gutta-percha point can cause AH Plus to leak, allowing fluid to pass through the interface when compared to calcium containing sealers. One in vitro study compared the microleakage of three sealers suggesting that newly introduced ceraseal a calcium better sealer than AH Plus sealer.[6]

The sealing power of a Tricalcium silicate based sealer (Ceraseal) combined with conventional or bioceramic gutta-percha is superior to that of zinc oxide eugenol sealer and is comparable to that of AH Plus. Using the fluid filtration method and an analysis with a scanning electron microscope, Zhang et al. looked at the microleakage in canals that had been obturated with Total Fill BC, a bioceramic sealer and AH Plus sealer. For the most leaky specimens, gaps were observed at the sealer dentin and cone-sealer interface, indicating that Total Fill BC performed better than AH Plus sealer.[13]

Conclusion:-

The outcome of teeth that has undergone root canal treatment cannot completely eliminate leakage; This is influenced by lateral canals, accessory canals, and other anatomical variation, with periapical pressure being the most important factor. Considering that a more viscous material like sealer can't reach the areas that are typically unaffected by irrigation and instrumentation during root canal preparation, which can open up leaky spaces and reduce success rates. Newer sealers like calcium based sealers can thus be considered equally and more efficient than AH plus sealers.

References:-

1. Ballullaya SV, Vinay V, Thumu J, Devalla S, Bollu IP, Balla S. Stereomicroscopic dye leakage measurement of six different root canal sealers. Journal of clinical and diagnostic research: JCDR. 2017 Jun;11(6):ZC65.
2. Ashwini KS, Devadiga D, Hegde MN. Evaluation of Microleakage of Four Root Canal Sealers--A Fluorescent Microscope Study. Journal of Evolution of Medical and Dental Sciences. 2020 Dec 14;9(50):3800-6.
3. Komabayashi T, Colmenar D, Cvach N, Bhat A, Primus C, Imai Y. Comprehensive review of current endodontic sealers. Dental materials journal. 2020 Sep 28;39(5):703-20.
4. Berg JH, Croll TP. Glass ionomer restorative cement systems: an update. Pediatr Dent 2015; 37: 116-124.
5. Nunes VH, Silva RG, Alfredo E, Sousa-Neto MD, Silva-Sousa YT. Adhesion of Epiphany and AH Plus sealers to human root dentin treated with different solutions. Braz Dent J. 2008;19:46–50.
6. Pawar SS, Pujar MA, Makandar SD. Evaluation of the apical sealing ability of bioceramic sealer, AH plus & epiphany: An in vitro study. Journal of conservative dentistry: JCD. 2014 Nov;17(6):579.
7. Veríssimo DM, do Vale MS. Methodologies for assessment of apical and coronal leakage of endodontic filling materials: A critical review. J Oral Sci. 48(3):93–8.
8. Tanomaru-Filho M, Pinto RV, Bosso R, Nascimento CA, Berbert FL, Guerreiro-Tanomaru JM. Evaluation of the thermoplasticity of gutta-percha and Resilon using the Obtura II system at different temperature settings. Int Endod J.2011;44:764–8.
9. Figdor D. Apical periodontitis: A very prevalent problem. Oral Surg Oral Med Oral Pathol Oral Radiol Endod.2002;94:651–2.
10. Tay FR, Loushine RJ, Weller RN, Kimbrough WF, Pashley DH, Mak YF, et al. Ultrastructural evaluation of the apical sealin roots filled with a polycaprolactone-based root canal filling material. J Endod. 2005;31:514–9.
11. Pontoriero DIK, G Madaro, V Vanagolli, S Benedicenti, G Verniani, Ferrari Cagidiaco E, Grandini S, Ferrari M (2021). Sealing ability of a bioceramic sealer used in combination with cold and warm obturation techniques. J Osseointegr 2021;13,248-255, ISSN: 2036-4121.
12. Pontoriero DIK, Ferrari Cagidiaco E, Cardinali F, Fornara R, Amato M, Grandini S, Ferrari M. Sealing ability of two bioceramic sealers used in combination with three obturation techniques. J Osseointegr 2022;14(3):143-148.
13. Zhang W, Li Z, Peng B. Ex vivo cytotoxicity of a new calcium silicate–based canal filling material. Int Endod J. 2010;43:769–74.