

EVALUATION OF POST-OPERATIVE PAIN ASSOCIATED WITH FOUR DIFFERENT ENDODONTIC SEALERS

Dentistry

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ABSTRACT

Aim: To compare the effect of four different endodontic sealers (AH Plus, Sealapex, MTA Fillapex and Ceraseal) on endodontic post-operative pain. **Methodology:** Patients (n=70) reporting with pain and diagnosed with symptomatic irreversible pulpitis in single rooted teeth with single canal configuration were randomly divided into five groups according to the sealer used (n=14). All patients received a single-visit root canal treatment. After the treatment, postoperative pain scores and analgesic intake were recorded at 6, 12, 24 and 48 hours using Visual Analog Scale (VAS) and the data were statistically analyzed. **Results:** Intensity of pain decreased as follow-up time increased i.e. from 6 to 48 hours. The maximum post-operative pain was seen in AH Plus sealer (Group-I) and least in Ceraseal (Group-IV) with maximum decline in pain levels after 24 hours (p-value=0.043). **Conclusion:** Bioceramic sealer (Ceraseal) showed least post-operative pain among the four endodontic sealers used in the study.

KEYWORDS

Post-operative pain; Endodontic sealers; Resin based sealers; Bioceramic sealers

INTRODUCTION

The main objective of endodontic treatment is to debride, disinfect and shape the root canal system and seal it three dimensionally in order to prevent reinfection of the tooth. To eliminate all portals of exit and to create a "fluid tight seal", the most important requirement is the complete chemomechanical preparation and obturation of the root canal till the working length and the most common material used for this purpose is polyisoprene material termed gutta percha, which is available in cone-shaped forms of various diameters that can be easily inserted along the prepared root canal space.^[1]

Difficulty in achieving adequate adaptation of gutta percha to the canal walls may occur due to the complex internal anatomy of root canal system, even after biomechanical preparation, therefore an endodontic sealer provides an interface to bond the gutta percha with the root canal walls.^[2] Hence, the major function of a root canal sealer is to fill imperfections and increase adaptation of the obturating material to the canal walls, failing which the chances of leakage and failure increases.^[3]

The most undesirable outcome of an endodontic treatment is the occurrence of postoperative pain that manifest in hours and may persist for days following treatment (Wang et al. 2010).^[4] The incidence of post-endodontic pain has been reported to be between 3-58% as stated by Gondim et al. 2010^[5] and was considered to be related with periapical inflammatory response which could be due to the presence of various physical, chemical and microbial factors. It has been reported that extrusion of the sealer during root canal filling has cytotoxic effects on periapical tissues, causing periapical inflammation, necrosis, and pain.

Jamali S et al (2021)^[6] evaluated the effect of resin-based and bioceramic root canal sealers on postoperative pain intensity using Visual analog scale (VAS) at 24, 48, 72 hours and 7 days after the treatment. The authors found that pain was felt more in the first 24 hours than after 48 hours however there was no statistically significant difference between resin-based and bioceramic root canal sealers at any of the time intervals.

Due to the relative biological and technical importance of sealers, their chemical and physical properties have been the subject of considerable attention. Hence, the purpose of the present study was to assess the post-operative pain in patients requiring endodontic treatment using

four different endodontic sealers (AH Plus, Sealapex, MTA Fillapex and Ceraseal). The null hypothesis tested in this study stated that the type of sealer used would not change the incidence and the intensity of the post-treatment endodontic pain.

MATERIALS AND METHOD

In this in-vivo study, the patients reporting with pain and diagnosed with symptomatic irreversible pulpitis were selected from the Department of Conservative Dentistry and Endodontics, Sri Guru Ram Das Institute of Dental Sciences and Research, Sri Amritsar.

Inclusion Criteria

1. Single rooted teeth with 1-1 canal configuration.
2. Permanent teeth with complete root development.
3. Teeth free of cracks and restorations.

Exclusion Criteria

1. Teeth with periapical lesion.
2. Teeth with periodontal defects.
3. Patients with any systemic illness

Sample Size Calculation

The sample size was calculated by using the following formula as suggested by Charan and Biswas (2013)^[7]

$$n = 2 * Z_{1-\alpha/2} * SD / d$$

$Z_{1-\alpha/2}$ = Power of the study

SD: Assumed standard deviation of the study variable

d: Mean value

$$n = 2 * 1.96 * 1.96 * (0.15 * 0.15) / (0.157 * 0.157) = 7 \text{ in each group}$$

Taking into account the various patient factors, the sample size for the study was increased to 14 in each group.

Procedure

Prior to commencement, the procedure was explained to the patient and written consent was taken. After ruling out any drug allergy, local anaesthesia with 2% xylocaine and 1:200,000 adrenaline (German Remedies, Ahmedabad) was administered to the patients using No.2 gauge needle in a 5ml syringe (Dispo Van, Hindustan Syringes and Medical Devices). Isolation of the tooth was done using rubber dam (GDC Marketing, India), access cavity was prepared using No.2 round carbide bur (Mani, Japan) under a high-speed handpiece with air-water spray cooling. Apical patency of the canal was achieved with smaller number K-files e.g. 6, 8 or 10 (Dentsply Maillefer, Switzerland). The

working length was determined using 15 No. K file with both Ingle's radiographic technique and electronic apex locator (Woodpecker DTE Dpex V, China).

Biomechanical Preparation

The root canal was prepared using rotary file system (neo endo system) by crown down preparation technique in the sequential order of 17/4%, 20/4% and 25/4% rotary file. During preparation the root canals were irrigated using 30- gauge side vented needle (Orikam Healthcare Pvt. Ltd., India) with total of 10ml of 5.25% sodium hypochlorite solution (Parcan, Septodont Healthcare India Pvt. Ltd., India) and then 17% ethylenediamine tetra acetic acid (Endo-L, Maarc Dental, Maharashtra, India). Normal saline was used as the last irrigant.

Obturation Technique

The canals were dried with sterile paper points and the master gutta percha cone was taken (25/4%) and tug-back was achieved. The apical half of primary gutta percha cone and the root canal walls were coated with sealer using lentulospiral and obturated by using Cold Lateral Condensation technique. Based upon the sealers used, patients were randomly divided into following groups (TABLE-1):

GROUP-1 (n=14):- AH Plus sealer (Dentsply, Konstanz, Germany) which was delivered in two tubes, Paste A (epoxy resins) and Paste B (amines) and mixed onto a paper pad in equal volumes (1:1), according to the manufacturer's instructions to a homogenous consistency and placed into the canal using a lentulospiral.

GROUP- 2(n=14):- Sealapex (Sybron Endo, USA) a calcium hydroxide based polymeric root canal sealer that is available in two paste system- base and catalyst paste which were mixed onto a paper pad in equal volumes according to manufacturer's instructions and delivered into the canal with the help of lentulospiral and then coating it around the master cone.

GROUP- 3(n=14):- MTA Fillapex (Angelus, Londrina-Parana, Brazil) a calcium silicate based sealer comes in two forms - in dual syringes with automix tips or in tubes. In our study, we have used the tube form. It was manually mixed with a spatula after dispensing both the tubes in equal volumes onto a paper pad and delivered in the canal with master cone.

GROUP-4(n=14):- Ceraseal (Meta Biomed Co., Cheongju, Korea) is a premixed ready-to-use injectable bioceramic cement paste. The master gutta percha cone was coated with a thin layer of sealer and very slowly inserted into the canal.

GROUP-5(Control; n=14):- Access opening and BMP was done in single visit and obturation was done after 72 hours.

As the sealers were mixed by the dental assistant who was unaware of the experimental protocol on random basis, the operating dental surgeon doesn't know the type of sealer used. After the completion of obturation, the post obturation restoration was done with composite resins (Figure I-II). Assessment of pain perception was done using visual analog scale at 6, 12, 24 and 48 hours post-operative.

The results were presented in frequencies, percentage and mean±SD. The Chi-square test was used to compare categorical variables. The Unpaired t-test/One way analysis of variance (ANOVA) test was used to compare continuous variables. The Pearson/Spearman correlation coefficient was calculated.

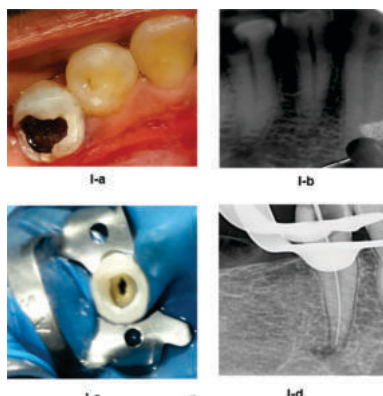


Figure-I (a) and (b): Pre-operative photograph and radiograph (c): Pre-endo build up and access opening under rubber dam isolation (d): Working length determination

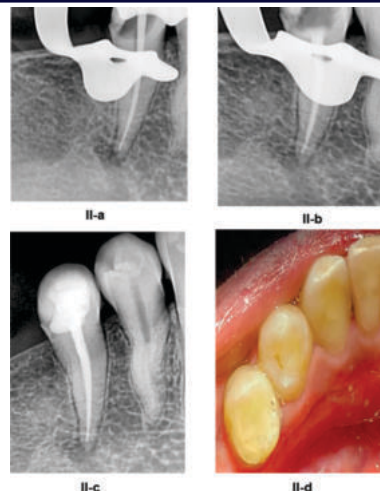


Figure-II (a): Master cone (b) Obturation radiograph (c): Post obturation radiograph, (d): Photograph after composite restoration

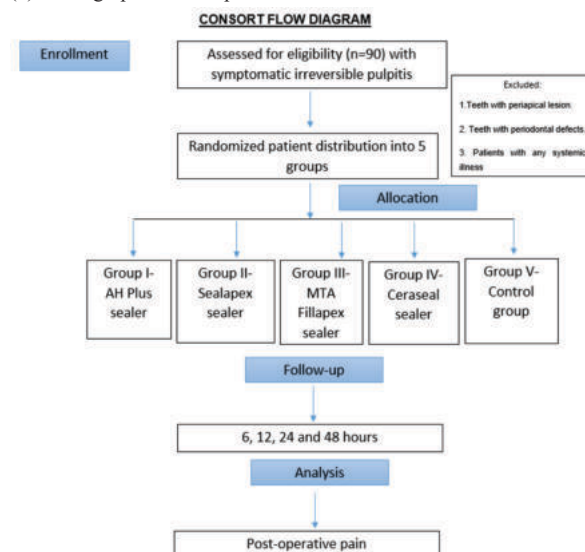


Table-1: Name And Composition Of Sealers Used In The Study

NAME OF THE SEALER	COMPONENTS
AH PLUS (Dentsply, Konstanz, Germany)	Paste A: Bisphenol-A epoxy resin, Bisphenol-F, epoxy resin, Calcium tungstate, Zirconium oxide, Silica, Iron oxide pigments. Paste B: Dibenzylldiamine, Aminoadamantane, Tricyclodecane-diamine, Calcium tungstate, Zirconium oxide, Silica, Silicone oil.
SEALAPEX (Sybron Endo, USA)	Base: Calcium oxide, bismuth trioxide, zinc oxide, sub-micron silica, zinc stearate, titanium dioxide, tricalcium phosphate Catalyst: Blend, ethyl toluene sulfonamide, poly (methylene methyl salicylate) resin, isobutyl salicylate
MTA FILLAPEX (Angelus, Londrina-Parana, Brazil)	Paste A: salicylate resin, bismuth trioxide, fumed silica Paste B: fumed silica, titanium dioxide, mineral trioxide aggregate (40%), base resin
CERASEAL (Meta Biomed Co., Cheongju, Korea)	Calcium silicates, zirconium oxide, thickening agent

RESULTS & OBSERVATIONS

70 patients with symptomatic irreversible pulpitis were evaluated over the period of 48hours post-obturation and the mean pain scores were

recorded for all the groups which shows that after 24 hours there was sudden decline in pain and gradual decrease in VAS scores in all groups at all of the time intervals (TABLE-2).

Statistical comparative analysis of pain using VAS at different time intervals among various groups of endodontic sealers showed that the significant difference was seen among Group-I and Group-II at 6 and 12 hours whereas Group-I and Group-III showed significant difference at 12 and 24 hours post-operative. Similarly, significant difference was seen between Group-I and Group-V at 6, 12 and 24 hours. However, no significant difference was seen among other groups (TABLE-3).

Table-2: Mean Of VAS At Different Time Intervals For All The Groups

Time	Group I	Group II	Group III	Group IV	Group V
Pre-op	4.00	4.21	4.29	3.50	4.36
At 6 hours	0.93	0.50	0.79	0.78	0.43
At 12 hours	0.71	0.21	0.21	0.42	0.21
At 24 hours	0.36	0.07	0.00	0.07	0.00
At 48 hours	0.00	0.00	0.00	0.00	0.00

Table-3: Statistical Comparative Analysis Of Pain Using VAS At Different Time Intervals Among Various Groups Of Endodontic Sealers

Comparison	Pre-op	At 6 hours	At 12 hours	At 24 hours	At 48 hours
	p-value	p-value	p-value	p-value	p-value
Group I vs II	0.069	0.035*	0.021*	0.138	1.000
Group I vs III	0.053	0.450	0.021*	0.034*	1.000
Group I vs IV	0.460	0.411	0.032*	0.023*	1.000
Group I vs V	0.050	0.016*	0.021*	0.034*	1.000
Group II vs III	0.886	0.195	1.000	0.317	1.000
Group II vs IV	0.066	0.190	0.319	1.000	1.000
Group II vs V	0.756	0.710	1.000	0.317	1.000
Group III vs IV	0.053	0.963	0.319	0.336	1.000
Group III vs V	0.886	0.104	1.000	1.000	1.000
Group IV vs V	0.051	0.102	0.319	0.336	1.000

DISCUSSION

The local inflammatory response in periapical tissues causes postoperative pain during endodontics treatment. In vivo studies^[8,9] have reported that reactive oxygen species can be directly associated with inflammatory pain. If human pulp cells were treated in vitro with the root canal sealers, reactive oxygen species would increase from 4 to 7 times.

Induction of formation of reactive oxygen species (ROS) and cytotoxic unpolymerized by-products of root canal sealers that remain activated and present at the site in the first 6-12 hours of obturation justified the reason of post-operative pain till 24 hours after which pain rapidly declined. Also, this decrease in pain by increasing time is both logical and expected because this is a natural course of disease process after debridement.

Resin based AH Plus endodontic sealer showed high post-operative pain levels which depicted higher cytotoxicity of the sealer that was not present in the case of calcium hydroxide based Sealapex endodontic sealer. This could be due to the presence of unpolymerized resinous residues such as diglycidyl ether bisphenol A and release of formaldehyde by the AH Plus.^[9,10] The delayed setting time of AH Plus sealer triggers the potential for cytotoxic by-products to be released before the final setting which affects its biocompatibility and causes more post-operative pain than that of MTA Fillapex sealer that has increased flowability into the root canals.

The bioceramic sealer i.e. Ceraseal endodontic sealer exhibited cytotoxic effects as well although it was significantly lower than that of AH Plus which could be due to the hydrophilic nature, an alkaline pH, insolubility in tissue fluids, anti-bacterial properties and property of bio mineralization that outways its cytotoxicity and prove them to be highly biocompatible.^[11,12]

In the present study, control group was taken in which obturation was done three days after the access opening and biomechanical preparation to maintain the standard operating protocol in order to compare the postoperative pain levels to that of single visit treatment. As the obturation was done after 3 days, this could be the reason for statistically significant difference in post-operative pain levels

between the AH Plus and control group.

The selection of single rooted teeth for study was done in order to minimize the risk of complicated root canal anatomy with multirooted teeth which could affect the subjective symptoms and results. In addition to this, in the present study, root canal treatment was completed in a single visit^[13,14] in order to minimize the possible triggers of postoperative pain that originate from periapical tissue reactions generated upon the procedural steps or intracanal medication.

There are various parameters that can be used to measure post-operative pain, Visual Analog scale is the most commonly used for its validity and reliability.^[15] Hence in this study, a 10 cm VAS scale ranging from 0-10 was used to measure the postoperative pain intensity, which was explained, and familiarised to all patients.

Limitations Of The Study

1. It was difficult to objectively measure a patient's level of discomfort. Data for this variable therefore depends on the subjective information varying with each person's threshold for pain, provided by the patients themselves and thus were subject to error.
2. Also, only single rooted teeth were included in the study, for an easier accomplishment of conditions required to assess the pain and chances of taking a good representative sample were much increased.

CONCLUSION

The following conclusions were drawn from the present study:-

1. There was decline in pain from immediate post-op till 48 hours follow-up time period that could probably be due to healing that would occur as a natural course of a disease process.
2. In terms of post-operative pain, AH Plus sealer group showed the maximum pain on VAS with statistically significant difference at 6, 12 and 24 hours of follow-up time period when compared with all the other sealers used in the study (Sealapex, MTA Fillapex and Ceraseal). However, no significant difference was seen among other three groups of sealers used in the study in comparison to one another at any of the time intervals.

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