Comparative Evaluation of Effect of Resinbased, Calcium Hydroxide - Based and Bioceramic - Based Root Canal Sealers on Postoperative Pain

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Abstract

Aims: The aim of this in-vivo study is to compare and evaluate the effect of AH Plus, Sealapex and MTA Fillapex on postoperative Pain.

Material and Method: 60 patients requiring root canal treatment on 60 single rooted teeth with irreversible pulpitis were randomly divided into 5 Groups: **Group-I:** (n=20) AH Plus (Dentsply) Root Canal Sealer Group **Group-II:** (n=20) MTA Fillapex (Angelus) Root Canal Sealer Group **Group-III:** (n=20) Sealapex (Kerr Sybron Endo) Root Canal Sealer Group Patients were recalled at 6 hours, 12 hours, 24 hours, 48 hours and 72 hours to evaluate the postoperative pain in treated tooth.

Result: There was a statistically non significant difference seen for the values of Visual Analogue Scale between the groups ($p>0.05$) at all time intervals.

Conclusion: Within the limitation of present in vivo study, in all three groups, post endodontic pain represented with highest values after 6 hours of treatment, moderate pain after 12 hours, mild after 24 hours, trivial after 48 hours and reduced to almost nil after 72 hours.

INTRODUCTION

Modern endodontics offers advancements in technologies, procedures and materials, giving you many treatment options to save your natural teeth.1 Post-operative pain is defined as pain of any degree that occurs after initiation of root canal treatment.[2] The causes of postoperative pain can be classified as mechanical, chemical and/or microbiological injuries to the peri-radicular tissues. Factors identified that contribute to post-operative pain after single- visit root canal treatment consist of the following: age, sex, tooth type or location,

preoperative pain, periapical radiolucency, pulpal status, prophylactic drug, anesthetic agent, working length method, instrumentation, irrigation, use of lasers, obturation technique, occlusal reduction, postoperative drug, and operator.[3]

Number of treatment related parameters associated with the presence of postoperative pain, including working length (WL) estimation with an apex locator connected to every file, the number of visits, the choice of instrumentation, and the choice of root canal sealer. [4,5,6,7]

Sealers placed in the root canals interfere with periodontal tissues through the apical foramina, lateral canals, or leaching and can potentially affect the healing process in the periodontium.8 Therefore, it can be expected that root canal sealers may stimulate an inflammatory response and activate sensory neurons.[9,10,11] Thus, the local inflammation caused by root canal obturation materials may result in postoperative pain. The intensity of inflammatory reactions depends on a number of different factors, including the composition of the sealer.8

The un-polymerized residues remain due to formation of oxygen inhibition layer in the mixture of AH Plus sealer, which is responsible for maintaining its toxic effect.[12]

Sealapex is one of calcium hydroxide based root canal sealer. Sealapex show pain due to cytotoxic potential. After setting Sealapex becomes unstable and disintegrates.[13]

MTA Fillapexcomes in contact with water, CaO present in it can be converted into and calcium hydroxide dissociated into Ca+2 and OH-. The diffusion of hydroxyl ions from the root canal increases the pH at the surface of the root, possibly interfering with osteoclastic activity and promoting alkalization in the adjacent tissues, which favors healing.[14]

Aim

The aim of this in-vivo study is to compare and evaluate the effect of AH Plus, MTA Fillapex and Sealapex sealers on postoperative Pain.

Objectives of the Study

The objective of this study is to record post-operative pain on a Visual Analogue Scale after single visit root canal treatment in single rooted mandibular premolars.

Materials and Methods

The present study titled “Comparative Evaluation of Effect of Resin-based, Calcium Hydroxide-based and Bioceramic-based Root Canal Sealers on Postoperative Pain" was carried out in the Department of Conservative Dentistry and Endodontics, RUHS College of Dental Sciences, Jaipur.

The institutional ethical clearance was obtained. A comparative study was carried out in 60 patients requiring root canal treatment on 60 single rooted teeth with irreversible pulpitis.

INCLUSION CRITERIA:

Selection of Teeth for the Study are:

- Carious, exposed and symptomatic single rooted teeth.
- Sign and symptoms consistent with irreversible pulpitis.
- A sharp and lingering pain on thermal stimulus.
- Vital pulp.

EXCLUSION CRITERIA:

- Patients who are taking non-steroidal anti-inflammatory drug or corticosteroid prior to time of treatment
- Teeth with calcified canal
- Grossly decayed teeth where rubber dam isolation is difficult
- Periodontally compromised teeth
- Medically compromised patient (with immunosuppressive/ systemic diseases, patient on medication)

Selected patients were randomly divided into three groups of 20 patients each:

Group-I: (n=20) AH Plus (Dentsply) sealer group

Group-II: (n=20) MTA Fillapex (Angelus) sealer group

Group-III: (n=20) Sealapex (Kerr Sybron Endo) sealer group

Patients were recalled at 6 hours, 12 hours, 24 hours, 48 hours and 72 hours to evaluate the postoperative pain.

Armamentarium and material used in study are as follows:

- Explorer (GDC)
- Tweezers (GDC)
- RVG machine (KODAK 5200)
- Rubber dam (GDC Dental Dam)
- Barbed Broaches (Mani, Inc, Japan)
- ISO 0.02 taper files (Mani, Inc, Japan)
- Lantulo Spiral (Mani, Inc, Japan)
- Neo endo Flex files (Orikam Health Care)
- lidocaine 2% with 1:200000 epinephrine (Alves Healthcare Pvt Ltd., India)

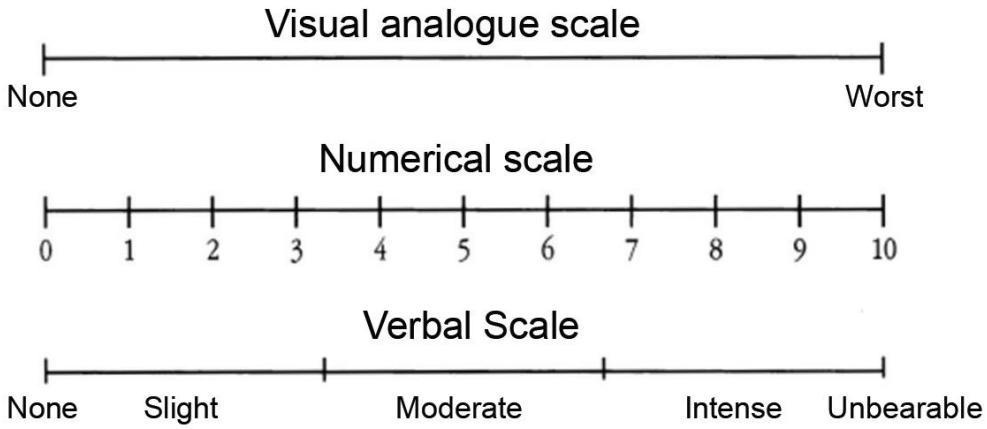
- 3% Sodium hypochlorite (Neelkanth, Orthodent Pvt. Ltd.)
- 30-G side vented needle (Orikam Health Care)
- Endomotor (X-MART, DentsplyMaillefer, Ballaigues, Switzerland)
- Electronic apex locater (I ROOT, META SYSTEM)
- Paper point (Millimeter Marked, DiaDent, Korea)
- GP Points 15-40 (Meta Biomed Co. Ltd., Korea)
- GP Point 0.04 and 0.06 (Dentsply, Mallifer, India)
- AH Plus sealer (Dentsply, Maillefer, Switzerland)
- MTA Fillapex sealer (Angelus, Londrina, Brazil)
- Sealapex sealer (Kerr Sybron Endo, USA)
- 17% EDTA (Prime Dental Pvt. Ltd., India)

METHODOLOGY

Oral and written informed consent was obtained from the patients for study and understood the need to attend follow up sessions.

Visual Analogue Scale (VAS)

The Visual Analogue Scale (VAS) included a 10 cm straight horizontal line numbered at each centimetre with following criteria;0, no pain; 1-3, mild pain; 4-6, moderate pain; 7-9, severe pain and 10, the worst pain experienced.



Clinical Procedure:

- All 60 patients were treated in single visit to minimize the number of procedure and potential effect of intracanal medication.
- Preoperative Visual Analogue Scale (VAS) score was taken from patients.
- The standard procedure for all groups was infiltration of local anaesthetics (2% lidocaine with 1:200000 epinephrine), rubber dam application was done and access preparation made in conservative manner.
- After the access cavity preparation, pulp chamber was flooded with 3% NaOCL solution.
- A fine barbed broach was used for extirpation of pulpal tissue. Coronal shaping and enlargement was performed 30/0.08 % Neoendo Flex Files to obtain straight line access to the apical third of each root. The canals were irrigated with 2 ml 3% NaOCL using 30- G side vented needle after each file.
- The working length was determined with K-file from a coronal reference point to a distance 0.5-1 mm short of the radiographic apex i.e apical constriction with the aid of radiovisiogarphy and i-ROOT Electronic Apex Locator. The instrumentation was carried out using hand K-files and Neoendo Flex Files. The files were driven by an endodontic motor (DENTSPLY MAILLEFER'sX-SMART) and used with a continuous brushing motion according to the manufacturer's instructions. Canal patency was maintained by passing a #10 no. stainless steel file approximately 0.5-1.0mm beyond the working length. Final irrigation was performed with each solution (ie, 2.0 mL NaOCl,2.0 mL 17% EDTA, and 2.0 mL NaOCl per canal).

Root Canal Obturation

Following the completion of biomechanical preparation obturation was done.

In Group-I obturation was done using AH Plus sealer and gutta-percha.

In Group-II obturation was done using MTA Fillapex sealer and guttapercha.

In Group-III obturation was done using Sealapex sealer and guttapercha.

After drying with paper point, a small amount of sealer was introduced into canal with paper point. A gutta-percha point was adapted and canal was obturated by cold lateral condensation technique. The coronal cavity was sealed by direct composite restoration and post obturation RVG image was taken.

Fig1: AH Plus Root Canal Sealer

Fig2: MTA Fillapex Root Canal Sealer

Fig3: Sealapex Root Canal Sealer

Assessment of Postoperative Pain

The primary study outcome was postoperative pain. Each patient received a Visual Analogue Scale (VAS) to record pain intensity at 6 hours, 12 hours, 24 hours, 48 hours and 72 hours. The patient was asked to mark his or her perceived postoperative pain level on the line. The patients was contacted at 5 consecutive time period to record pain scores.

Follow up and Evaluation Criteria:

- The patients were instructed to report immediately in case of unbearable pain or swelling.
- Patient were also asked to report prior of intaking any analgesic in case of severe pain.
- For follow up patients were recalled after 6 hours, 12 hours, 24 hours, 48 hours, 72 hours and there post-operative pain was revaluated on the basis of VAS score.

RESULT

In all three groups, post endodontic pain represented with highest values after 6 hours of treatment, moderate pain after 12 hours, mild after 24 hours, trivial after 48 hours and reduced to almost nil after 72 hours. In an intergroup comparison, at all-time intervals, the mean value of pain scores among three groups were not statistically significant ($p>0.05$). (Table: 2)

Statistical Procedures

- Data obtained was compiled on a MS Office Excel Sheet (v 2019, Microsoft Redmond Campus, Redmond, Washington, United States).
- Data was subjected to statistical analysis using Statistical package for social sciences (SPSS v 26.0, IBM).
- Descriptive Mean & SD for numerical data was depicted.

Inter group comparison (>2 groups) was done using Kruskall Wallis ANOVA followed by pair wise comparison using Mann Whitney U test.

For all the statistical tests, $p<0.05$ was considered to be statistically significant, keeping α error at 5% and β error at 20%, thus giving a power to the study as 80%.

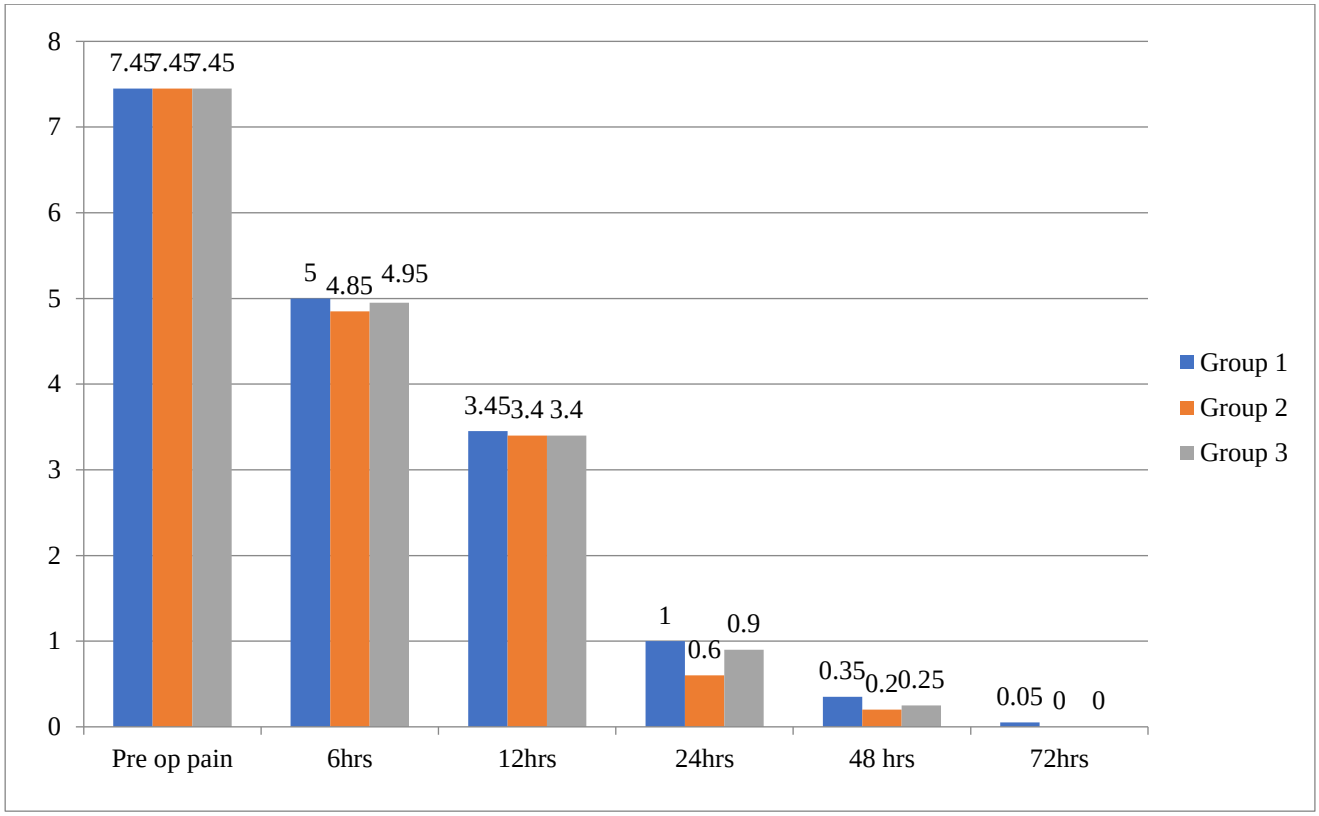
Table 1: Comparison of Mean Pain Scores between Patients in both the Groups

Time (Hours)	Mean±SD		
	Group 1 (n=20)	Group 2 (n=20)	Group 3 (n=20)
Pre-Operative Pain	7.45±1.191	7.45±1.191	7.45±1.191
6	5±1.124	4.85±0.875	4.95±0.999
12	3.45±0.999	3.40±0.821	3.40±0.833
24	1.00±1.076	0.60±0.883	0.90±1.071
48	0.35±0.587	0.20±0.410	0.25±0.444
72	0.05±0.224	0.00±0.000	0.00±0.000

SD - Standard Deviation

Table 2: Intragroup and Intergroup Comparison of VAS Pain Scores among the Groups with the Mean, Median and Standard Deviation

Groups	VAS preop	VAS 6 Hours	VAS 12 Hours	VAS 24 Hours	VAS 48 Hours	VAS 72 Hours	P of Intra Group Comparison	Wilcoxon Signed Rank Test for Pairwise Comparison
Group 1 (n=20)								
Mean	7.45	5.00	3.45	1.00	0.35	0.05	.000**	6hr, 12 hr, 24hr, 48 hr, 72hr
Standard Deviation	1.191	1.124	0.999	1.076	0.587	0.587		
Median	7.5	5	3.5	1	0	0		
Group-2 (n=20)								
Mean	7.45	4.85	3.40	0.60	0.20	0	.000**	6 hr, 12hr, 24h, 48hr, 72hr
Standard Deviation	1.191	0.875	0.821	0.883	0.410	0		
Median	7.5	5	3	0	0	0		
Group-3 (n=20)								
Mean	7.45	4.95	3.40	0.90	0.25	0	.000**	6hr,12hr,24h, 48hr,72hr
Standard Deviation	1.191	0.999	0.833	1.071	0.444	0		
Median	7.5	5	3	0	0	0		
P of Inter Group Comparison	1.000#	0.888#	0.970#	0.442#	0.725#	0.368#		



Graph1: Comparison of VAS scale between the groups

DISCUSSION

The basic biological rationale for achieving ultimate success with root canal treatment consists primarily of eliminating microorganisms from the entire root canal system and creating an environment that is most favorable for healing.15

Post endodontic pain most often occurs during the first 24 to 48 hours after obturation. The incidence of post endodontic pain was reported to range from 3-58%.16 The pain could be initiated by biological (microorganisms) or non-biological (chemical or mechanical) factors.17 Mechanical factors, including over instrumentation or extrusion of root filling material, have been associated to the presence of postoperative pain suggesting that root canal instrumentation and obturation techniques may influence postoperative pain.18,19

Microbial factors like, preexisting infection, apical extrusion of infected debris, incomplete bio-mechanical debridement of the root canal and secondary intra-radicular infection can lead to postoperative pain with endodontic therapy.

Chemical factors like irrigation solutions, intracanal medicaments and sealers are used within root canal. They invariably contact the periapical tissues can cause postoperative pain or flare ups.

Endodontic sealers may release chemical irritants during the setting process and may induce local inflammation in the periapical region.20,21 Biochemical mediators such as reactive oxygen species (ROS) and oxidative stress are strongly correlated with inflammatory pain.22 In an in Discussion 46 vitro study, reactive oxygen species (ROS) production increased 4–7-fold when human pulp cells were exposed to root canal sealers.23

In the present study, a 10-cm Visual Analogue Scale was used to assess pain. Two equally sized intervals on a Visual Analogue Scale are always interpreted as two equally sized differences by respondents. This makes it possible to calculate the arithmetic mean. 24

A complete sealing of the root canal system after cleaning and shaping is critical for a successful endodontic treatment.25 Root canals are traditionally filled with gutta-percha cones and a root canal sealer.26,27The present study aimed to evaluate postoperative pain following their use (MTA Fillapex) compared with a resin-based (AH Plus) and calcium hydroxide root canal sealer (Sealapex). In a recent clinical study, no significant difference was observed between the resin-based sealer (AH plus) and a bioceramic sealer (Total Fill)

in terms of postoperative pain after single-visit root canal treatment.28

Among all the sealers, AH Plus was associated with the highest pain intensity post 12 hr evaluation. This signifies the increased toxic effect of AH Plus sealer then Sealapex. AH Plus contains both epoxy resins and amines which have toxic effect.29Increase in cytotoxicity as time progressed might be due to the volatilization of formaldehyde during the hot incubation or setting process of the AH Plus sealer.30

In Sealapex group, severe pain was experienced by three patients at 6 hr and five patients at 12 hr interval. This can be correlated to its cytotoxic potential. Sealapex after setting becomes unstable and disintegrated.31Its cytotoxicity is due to components Calcium Hydroxide itself because of its high pH.32

In an initial period MTA Fillapex was more irritating to bone tissue than AH Plus and did not improve bone tissue repair.33The severe toxicity of MTA Fillapex may be attributed to the presence of resinous components, mainly salicylate resin.34

The results of the present study reported that the Postoperative pain with the use of AH Plus sealer, MTA Fillapex and Sealapex is statistically nonsignificant.

CONCLUSION

Within the limitation of present in vivo study, it can be concluded:

1. Post-operative pain was present in almost in all the patient after single visit root canal treatment; in the range of trivial to severe.
2. AH plus, MTA Fillapex and Sealapex sealers were not significantly different in terms of the severity of postoperative pain after single visit root canal treatment.

Future studies are needed because there are few studies investigating the effect of bioceramic sealer type on postoperative pain.

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