Original article

Comparison Of Inter-Appointment Pain Between Calcium Hydroxide Mixed With Normal Saline And Calcium Hydroxide Mixed With 2% Chlorhexidine During Root Canal Treatment

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Abstract

Introduction: Pain is one of the major and common symptoms a patient goes through during root canal treatment (RCT). Calcium hydroxide [$Ca(OH)_2$] combined with normal saline (NS) is commonly used as an intracanal medicament against root canal pathogens, but combination of $Ca(OH)_2$ with chlorhexidine (2% CHX) is not routinely used. Aim of this study is to compare the combination of $Ca(OH)_2$ +NS and $Ca(OH)_2$ +2% CHX to reduce the interappointment pain in RCT.

Methods: A comparative, prospective, qualitative study was conducted in the Department of Conservative Dentistry and Endodontics, KIST Medical College and Teaching Hospital from September 2022 to March 2023. Total of 60 patients aged 16-70 years were included in the study. Group I received $Ca(OH)_2$+NS and group II received $Ca(OH)_2$ +2% CHX. Pain score was recorded using visual analogue scale (VAS) from baseline to 6,12,24 and 48 hours.

Results: The mean pain score after 6 hours for Group I was 0.93(±0.83) and Group II was 1.43 (±0.63); P=0.011. The mean pain score after 12 hours for Group I was 0.40(±0.56) and Group II was 0.90(±0.66); P=0.003. 24 hours, mean pain score for Group I was 0.27(±0.45) and Group II was 0.60(±0.56); P=0.014. Patients reported reduction of pain after 24 hours, with $Ca(OH)_2$ +NS (Group I) than $Ca(OH)_2$ +2% CHX (Group II).

Conclusion: The combination of $Ca(OH)_2$ +NS was more effective in reducing interappointment pain than $Ca(OH_2$ +2%CHX.

Keywords: Calcium hydroxide; Chlorhexidine; Intracanal medicaments; Interappointment pain; Normal saline

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Introduction

Pain of endodontic origin has been a major concern to the patients and clinicians for a long time.[1] Odontogenic pain usually occurs due to decayed tooth, trauma, infections and after post endodontic treatment.[2] In spite of recent advances in management of pain, previous study reported the prevalence of postoperative pain ranging from 3-58%.[3] Microbes play a critical role in the pathogenesis of periapical and periodontal disease; thus, their complete removal is the key to success for root canal treatment.[4]

Endodontic treatment is done to remove the infected pulp and eliminate the pain. The root canal system is chemo-mechanically debrided and cleaned followed by filling the canals known as obturation. Some patients might feel mild pain or discomfort during or even after the procedure. If root canal treatment is done according to recommended protocols, then mild pain is considered to be a usual phenomenon.[5]

The chances of inter-appointment pain are higher in case of necrotic pulp due to a greater number of microbes present in the root canal system.[6] Furthermore, the causal factors of postoperative pain might include chemical, mechanical or microbial insult to the pulp or periapical tissues. The infection when progressed to the peri-radicular region can render it more complex to cure or remove it by the conventional procedure. The patient feels discomfort and severe pain if there is development of acute inflammation beyond the root apex, which might lead to the inter-appointment pain.[7]

Thus, it is important to remove bacteria from root canal and proper obturation of the system should be done to prevent re-infection. Moreover, proper coronal seal and post endodontic restoration of the tooth are essential to prevent re-infection of the root canal system.[8] Also, if the canals are left empty without intracanal medicament, microbes will grow and multiply. Thus, bio-mechanical preparation of root canal can reduce bacteria, an intracanal medicament with anti-bacterial properties is required to enhance the disinfection of the root canal system, especially for infected cases. Therefore, we require intracanal medicament to achieve maximum disinfection of the root canal system.[9]

Calcium hydroxide [$Ca(OH)_2$] is commonly used in modern dental practice as an intra-canal medicament. It contains most of the ideal properties of a root canal dressing. $Ca(OH)_2$ contains high pH that makes it anti-bacterial. $Ca(OH)_2$ resulted in 97% of the canals culture negative, whereas other intra canal medicaments achieved this effect in only two-thirds of the treated canals.[10]

Chlorhexidine (CHX) is widely used irrigant and intracanal medicament in endodontics due to its superior anti-microbial activity.[11] It has a positively charged molecule that bonds with the negatively charged microbial cell wall which increases the permeability of cell wall, resulting in cell death.[12]

Different mediums like normal saline, distilled water, CMCP (camphorated mono chlorophenol), glycerin, cresatin, propylene glycol or CHX have been widely used to mix with $Ca(OH)_2$, thus affecting its dissociation into Ca^{2+} and OH^-. According to a study carried out by Sjogren, $Ca(OH)_2$ when mixed with normal saline reduces the residual bacteria when placed in the root canal for one week.[13]

Due to wider spectrum of CHX as an antimicrobial agent, it is widely used as an intra canal medicament. $Ca(OH)_2$ when mixed with CHX have shown better results.[14]

Thus, the purpose of this study is to determine the effectiveness of two different formulations of intracanal medicaments to reduce the inter-appointment pain during root canal treatment.

Methods

A comparative, prospective, qualitative study was conducted among 60 patients of 16-70 years of age visiting at the Department of Conservative Dentistry and Endodontics, KIST Medical College and Teaching Hospital from September 2022 to March 2023.

Inclusion and exclusion criteria

Pretesting for feasibility was done in 10% of the total sample size meeting inclusion and exclusion criteria, which was not included in the data collection.

Patients of both the gender with written consent, patients with either anterior or posterior teeth including periapical periodontitis, with history of pain, closed apices with or without periapical radiolucency and presence of pulp necrosis were included in the study.

Teeth with incomplete root formation, severe periodontal problem and those requiring re-treatment were excluded from the study. Teeth with vertical or horizontal root fractures were also excluded from the study.

Sample size determination

The sample size was calculated using software G-Power version 3.1; the test error was 5% and the test power was 80%.

- The mean and standard deviation from previous study[26]
- Mean Group I: 27.90
- Mean Group II: 11.86
- Standard deviation Group I: 25.90
- Standard deviation Group II: 10.24

According to the software G-Power, the sample size was calculated to be 25.

By considering the withdrawal cases 15% more was included

and total sample size calculated to be approximately 30 in each group.

Data Collection

Total 60 patients, according to the study inclusion criteria were selected and equally divided into two groups by odd-even method.

Teeth with pain and periapical periodontitis were treated with root canal treatment. In the first visit, baseline data was taken using visual analogue scale (VAS). Tooth was anesthetized with local anesthesia (LA) solution (Lignocaine 2% and Adrenaline 1:200000) and isolation was maintained. Access preparation was done using high speed handpiece with a No. 02 round bur/ endo access bur. EDTA was used as a lubricant and No. 10 K file of 0.02 taper was used to check the patency of root canal. Working length was determined with periapical radiograph using ISO No. 15 K file. Canals were enlarged using ProTaper hand files by crown down technique and were irrigated with 2.5% sodium hypochlorite (NaOCL) and normal saline. Absorbent paper points were used to dry canals and intracanal medicaments were inserted using lentulo spiral and tooth restored with cotton pellet and temporary restorative material (Caviton). Pain intensity was recorded using visual analogue scale (VAS).

Group I received calcium hydroxide [$Ca(OH)_2$] mixed with normal saline (NS) and Group II received calcium hydroxide [$Ca(OH)_2$] mixed with 2% chlorhexidine (CHX).

Pain was then recorded through a phone call after 6,12, 24 and 48 hours after cleaning and shaping of canals. Pain rating from 0-1 was categorized as no pain, 2-3 as mild pain, 4-6 as moderate pain and 7-10 as severe pain.

In the second visit, tooth was obturated with gutta percha and resin sealer followed by permanent restoration with composite resin.

Statistical evaluation

We used descriptive statistics, means and standard deviations to evaluate gender, tooth type and age score. The Chi-square test and independent sample t-test were used to evaluate differences between two medicaments which are used to reduce the inter-appointment pain during root canal treatment. A p-value<0.05 was considered statistically significant. We used the Statistical Package for Social Sciences (SPSS), version 22.0 to perform the statistical analyses.

Ethical approval

This study was approved by Ethics Committee of the Institutional Review Committee of KIST Medical College and Teaching Hospital, Imadol (Ref. No. 2079/80/47). Written informed consent was obtained from all the study participants prior to inclusion in the study.

Results

A total of 60 patients, both male and female participated in the study. Among them 30 participants were representative of Group I and 30 of Group II. Group I was allocated as calcium hydroxide mixed with normal saline and Group II as calcium hydroxide mixed with chlorhexidine.

The demographic variables represent that among 60 participants 38.3% were males and 61.7% were females. The age range of the patients was 16-70 years. The Chi-Square test revealed that no significant difference was found between gender and tooth types among both Group I and Group II with (p= 0.184) and (p=0.718) respectively. (**Table 1**)

Table 1. Demographic information including the patient's gender, teeth type and age [N(%)]

	Group I $Ca(OH)_2$ +NS	Group II $Ca(OH)_2$ +2% CHX	Total	P-value
Gender				
Male	9 (30%)	14 (46.6%)	23 (38.3%)	0.184
Female	21 (70%)	16 (53.3%)	37 (61.7%)	
Teeth Type				
Anterior	4 (13.3%)	5 (16.7%)	9 (15.0%)	0.718
Posterior	26 (86.7%)	25 (83.3%)	51 (85.0%)	

*Chi-square test

Table 2. Distribution of pain in two groups at different time intervals [N%]

	Groups	No pain	Mild pain	Mod. pain	Severe pain
Baseline	Group I	0 (0%)	5 (16.6%)	11 (36.7%)	14 (46.7%)
	Group II	0 (0%)	8 (26.7%)	16 (53.3%)	6 (20%)
6 hours	Group I	10 (33.3%)	13 (43.3%)	6 (20%)	1 (3.3%)
	Group II	2 (6.7%)	13 (43.3%)	15 (50%)	0 (0%)
12 hours	Group I	19 (63.3%)	10 (33.3%)	1 (3.3%)	0 (0%)
	Group II	8 (26.7%)	17 (56.7%)	5 (16.7%)	0 (0%)
24 hours	Group I	22 (73.3%)	8 (26.7%)	0 (0%)	0 (0%)
	Group II	13 (43.3%)	16 (53.3%)	1 (3.3%)	0 (0%)
48 hours	Group I	26 (86.7%)	4 (13.3%)	0 (0%)	0 (0%)
	Group II	25 (83.3%)	5 (16.6%)	0 (0%)	0 (0%)

The numbers and percentages of the participants who reported different pain rates at different time intervals have been tabulated. The data demonstrates that the rate of pain has been decreased among the people in both group from baseline to 48 hours analysis.

Also, comparing among both the medicaments in 48 hours duration the number of participants with no pain is more in Group I than that of Group II with 86.7% and 83.3% respectively. (**Table 2**)

Table 3. The number of individuals with comparing the significance of the mean pain between the groups of different intervals

	Group I $Ca(OH)_2$ +NS	Group II $Ca(OH)_2$ +2% CHX	Total	P-value*
Mean pain score at baseline	2.30 (±0.75)	1.93 (±0.69)	2.12 (±0.74)	0.054
Mean pain experienced after 6 hours	0.93 (±0.83)	1.43 (±0.63)	1.18 (±0.77)	0.011*
Mean pain experienced after 12 hours	0.40 (±0.56)	0.90 (±0.66)	0.65 (±0.66)	0.003*
Mean pain experienced after 24 hours	0.27 (±0.45)	0.60 (±0.56)	0.43 (±0.53)	0.014*
Mean pain experienced after 48 hours	0.13 (±0.35)	0.17 (±0.38)	0.17 (±0.36)	0.723

* Independent t- test ($p<0.05$)

Independent sample t-test was used to analyze the difference in pain scores between Group I and Group II. Pain score was calculated as a mean of 0 to 3 scale, where 0 was 'No pain' (VAS=0-1), 1 was mild pain (VAS=2-3), 2 was moderate (VAS=4-6), and 3 was 'Severe pain' (VAS=7-10). Mean pain experienced for both the Group I and II were calculated at baseline, and after each 6, 12, 24 and 48 hours.

The mean pain was found to be 2.30 (±0.75) for Group I at baseline, slightly higher than for Group II at 1.93 (±0.69). The difference in the mean pain score among the two groups were found to be statistically not significant (P=0.054).

The mean pain score after 6 hours for Group I was reduced to 0.93 (±0.83) and for Group II was 1.43 (±0.63). The difference was statistically significant with the P-value=0.011.

Similarly, the mean pain score after 12 hours for Group I was 0.40 (±0.56) and that for Group II was 0.90 (±0.66). There was a statistically significant difference found (P=0.003).

After 24 hours, the mean pain score for Group I was 0.27 (±0.45) and that for Group II was 0.60 (±0.56) which had a significant correlation (P=0.014).

After 48 hours, the mean pain score was found to be 0.13 (±0.35) for Group I and 0.17 (±0.38) for Group II. It was found to be statistically not significant (P=0.723) (**Table 3**). In conclusion, both medication types were seen to be effective in reducing the pain amongst the patient groups. Patients in Group I reported their pain reduced at a rapid rate until 24 hours after the medication, compared to patients in Group II. However, after 48 hours, the mean pain score reported by both the patient groups were comparable, with Group I reporting slightly lower pain score than Group II.

Discussion

Pain itself is one of the most unwanted feelings in our life. Dental treatment is considered a fearful and painful experience by most of the people. Post endodontic therapy pain has a higher prevalence despite of having recent advances in dentistry.[15] In the present study, we had recorded both the intensity and incidence of pain.

There could be different factors responsible which includes pre-treatment inflammation, development of periapical degeneration of the root apex. Pain can also be linked to the immunological status of a patient, genetic factors, tissue degeneration and infection if present. Pain after endodontic therapy might be due to necrotic pulp in an asymptomatic tooth with periodontal lesion.[16,17]

Among the various techniques of instrumentation used to clean and shape the root canals and to remove the micro-organisms, we implemented crown down technique which is believed to extrude little debris in the periapical region as compared to the other techniques. But, regardless of a particular technique being followed for the biomechanical preparation, still there could be some space in the root canal that is totally untouched by the instrument because of anatomical complexity where the microbes can survive.[18] In addition to the cleaning and shaping, intracanal medicaments are given in the prepared root canals provided that they are not extruded beyond the root apex and are not cytotoxic so the microbial load gradually decreases over the time period resulting in pain reduction.

The combination of $Ca(OH)_2$ with 2% CHX releases the active oxides and combats endotoxins released by root canal microbes.[19] In contrast, there was no difference between $Ca(OH)_2$ combined with CHX for the removal of root canal endotoxins in some of the studies that supports our study. The difference in results of various studies might be due to the different methodologies implemented.[20]

In this study, there was marked reduction in interappointment pain when $Ca(OH)_2$ was mixed with normal saline as compared to $Ca(OH)_2$ and CHX combination.

Pain reduction was found to be significant after 6 hours, 12 hours and 24 hours post treatment. These findings are in accordance with other studies where CHX showed

little efficacy in deactivating the biologically active part of endotoxin lipid, lipopolysaccharides (LPS) after biomechanical preparation in root canals that has a major role in endodontic infections and pain sensation.[21,22]

Whereas, our findings are in contrast with other similar kind of studies.[23,24] This might have happened due to the synergistic action of $Ca(OH)_2$ when combined with the CHX. Chlorhexidine enhances the action of $Ca(OH)_2$ to lower the amount of endotoxin that is found in the root canal.[23,24]

There was no significant difference among two groups in the mean pain value after 48 hours of the treatment. This finding is also same as the study conducted by Al Zaka.[25] Regarding teeth type and pain value, there was no significance in our study which was also consistent with the previous study conducted by Ghanbarzadegan et al.[26] Our study also revealed the consistency with other studies conducted by Ghanbarzadegan et al and Rizwan Ullah et al regarding insignificant correlation between gender and pain value among two groups of medications.[26,27]

Whereas, the study conducted by Al-Negrish AR and Habahbeh R showed increased incidence of pain in females. They correlated the female hormones and its association with fluctuation in nor-adrenaline and serotonin leading to increased pain during menstrual cycle, those taking oral contraceptives or hormone replacement.[28]

There are a few limitations of our study, the main one is expression of pain itself. There can be individual variations in the interpretation of pain as it is a subjective factor. Individual differences in the pain threshold for the same level of pain can always occur. A standard method to quantify pain, if developed would be better for standardized interpretation all over the world. Otherwise, the one we followed in our study, i.e. visual analogue scale (VAS) can be effectively used for such kind of studies.

Conclusion

According to our findings, we can conclude that the post-operative pain during the root canal treatment could gradually decrease by the two different combinations of medications used in the present study. But when compared, the combination of calcium hydroxide with normal saline was more efficient than calcium hydroxide combined with 2% chlorhexidine to reduce the inter-appointment pain. Still, further studies are required to find out the long-term effects of these two formulations in the elimination of post-operative pain and discomfort in a patient.

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