

Comparison of Endodontic Pain Observed with Sodium Hypochlorite, Hydrogen Peroxide and Normal Saline Based Root Canal Irrigants

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^{1,2}Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work, Final approval of the version to be published.^{3,4}Drafting the work or revising it critically for important intellectual content,^{5,6}data collection, manuscript writing

Funding Source: None

Conflict of Interest: None

Received: Oct 10, 2021

Accepted: Feb 04, 2022

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ABSTRACT

Objective: To compare the frequency and intensity of endodontic pain with sodium hypochlorite, hydrogen peroxide, and normal saline groups.

Methodology: This comparative study was conducted in School of Dentistry, Islamabad, from March 2021 to December 2021. One hundred and five patients were randomly allocated to 3 study arms. Group A (Sodium Hypochlorite), Group B (Hydrogen Peroxide) & Group C (Normal saline). Data regarding endodontic pain was recorded by asking the patient to mark on the Visual Analogue Scale (VAS) according to the severity of pain on the Performa provided.

Results: The minimum intensity of pain was 0 and the maximum was 10 with a mean and standard deviation was 3.43 ± 3.576 VAS. Endodontic pain was present in 12/35 (34.3%), 24/35 (68.6%), 30/35 (85%) patients of Group's A, B, C respectively. Significant difference between groups with respect to the intensity of pain (VAS) was shown by one-way ANOVA. For Group A the intensity of pain (VAS) was 82.38 ± 4.34 and for Group B, C the Intensity of pain (VAS) were 4.37 ± 3.456 and 6.11 ± 3.197 respectively.

Conclusions: Sodium Hypochlorite was much better than Hydrogen peroxide and normal saline in the management of endodontic pain in terms of incidence and intensity.

Keywords: Endodontic Pain, Sodium Hypochlorite, Hydrogen Peroxide, Normal Saline, Root Canal Irrigants

Cite this article as: Noor N, Mujtaba H, Humayoun S, Umer MF, Javaid MM, Rehman A. Comparison of Endodontic Pain Observed with Sodium Hypochlorite, Hydrogen Peroxide and Normal Saline Based Root Canal Irrigants. Ann Pak Inst Med Sci. 2022; 18(1):3-8. doi. 10.48036/apims.v18i1.634

Introduction

The reason most of the individual undergo endodontic treatment is the relief from pain. Root canal treatment (RCT) is the treatment of choice that renders the tooth completely free from pain. It is a lengthy procedure in which the tooth is mechanically and chemically cleaned

of bacteria and pulpal remnants, shaped into canals and then sealed into the canal system along with restoration of the coronal portion to prevent future reinfection.^{1,2} This is usually done in multiple appointments. At the end of each visit, intracanal medicament with a temporary filling is placed. Usually, the patient complains of pain in the interappointment period. Even in patients whose teeth

were asymptomatic because of necrosis before the treatment can undergo painful experience in the interappointment period. Hence the management of endodontic pain is very important as it results in the patient burden requiring unscheduled appointment and the unsatisfactory prediction of prognosis of RCT by the patient.^{3,4} Since pain was the complaint that prompted the patient to seek treatment, the re-emergence of pain during the waiting period discourages them from continuing with the treatment.

To precisely prevent endodontic pain, knowledge of its causes is essential. The factors include (a) leakage of irrigants beyond the apical barrier into surrounding periapical tissues. (b) Improper instrumentation causing injury to the tissues. (c) Remnant virulent clones of bacteria. (d) Endodontic flare up (e) environmental influence over expression of certain virulent clones (f) host resistance.^{5,6}

Mechanical preparation of the canals is not enough for the complete removal of bacterial and pulpal insults from the canal system. They harbor the agents which then cause pain before the next appointment. So, to reduce the incidence of pain, proper chemical irrigation is employed to aid with mechanical instrumentation. To date, there is no perfect irrigant available for use in endodontic treatment that would have the maximum antibacterial and tissue dissolving properties with minimal or no side effects. Strong antimicrobial properties and ability to dissolve pulpal remnants, collagen, necrotic and vital organic tissue coin sodium hypochlorite the gold standard in RCT.^{7,8}

However, sodium hypochlorite is cytotoxic if extruded beyond the apical foramen and causes inflammation, swelling, pain, and ulceration presenting as hypochlorite injury. The taste and smell are unacceptable, and it is caustic to the metallic instruments.

Chlorhexidine Di-gluconate (CHX) is relatively more biocompatible and has antimicrobial activity but lacks tissue dissolution. Hydrogen peroxide is another agent that has been in use since a long time. it physically removes debris as well as through effervescence. Although it is active against bacteria, viruses and yeasts nevertheless its anti-bacterial properties are not well established. It also exhibits toxicity to the surrounding tissues.⁹⁻¹¹ Currently, a lot of research has been done to suggest using H_2O_2 in combination with CHX. The combination is found to be more effective than either agent used alone.^{12,13} This synergism is proposed to work

by CHX increasing the efficacy of H_2O_2 by making the bacterial wall more susceptible to the action of H_2O_2 ⁵ and causes further damage to intracellular organelles.¹⁴ The effect of H_2O_2 on CHX antibacterial properties is however not known. Mirhadi et al, compared the cytotoxicity and antibacterial properties of sodium hypochlorite and H_2O_2 in combination with CHX. It found that both exhibit similar level of bacterial elimination but H_2O_2 and CHX is less cytotoxic to the tissues so it could be safe to use in routine RCT in any combination except mixing 3% H_2O_2 with 0.1% CHX which is not recommended for clinical application.¹⁵ However, there is a lack of research on the pain-relieving properties of these agents in the literature.

Several studies have done comparison of different root canal irrigants according to their efficacy, antibacterial potency^{12,14}, their safety against surrounding tissues¹³ but no study have been done so far to determine their pain-relieving potential. Therefore, this study is anticipated to compare these irrigation agents with respect to their ability to prevent endodontic pain.

Methodology

This comparative study was conducted in the School of Dentistry, Islamabad from March 2021 to December 2021. Patients who were undergoing treatment after fulfilling the inclusion criteria were recruited. After the shaping of canals in the first appointment, the patient was given the next appointment after 7 days. The frequency of endodontic pain was evaluated by the Visual Analogue Scale (VAS) as: "Yes (VAS ranging from 1 to 10) and No (VAS=0), and the intensity of pain considered was the highest score recorded (1-3=mild, 4-6=moderate, 7-10=severe). To ensure standardization, only one operator performed and evaluated all the cases. Participants were randomly allocated to 3 study arms.

For Group A, sodium hypochlorite (NaOCl) Irrigant was used at a concentration of 2.5%. In Group B, Hydrogen Peroxide (H_2O_2) Irrigant was used in a concentration of 3%, and in Group C (normal saline), normal saline was used.

The sample size was calculated using the WHO sample size calculator, was used to calculate the sample size. There were 105 patients in each group. A formula for estimating a proportion with specified absolute precision was used with assumptions as under: The confidence level is 95%, the proportional error is 5%, the expected population proportion with pain in the hydrogen peroxide

group is 70%¹, and the expected population proportion with pain in the sodium hypochlorite group is 36.7%.¹⁰

Typical inclusion criteria was include, both genders age between 10-60 years, both Single and multi-rooted teeth, teeth with normal healthy pulp and teeth diagnosed with irreversible pulpitis by Electric Pulp Tester. Teeth having resorbed roots, Mobile teeth, Teeth having open apices, Periapical radiolucencies. Non-vital teeth was the exclusion criteria in research study.

This study was approved by the Ethics Committee of School of Dentistry, Islamabad. The purpose of the study, hazards along with benefits of the materials to be used was described to the patients before a signed consent from every patient. The study outcome was measured in terms of frequency and intensity of endodontic pain compared between the three study arms. Statistical Package for Social Science (version 20.0) was used to analyse the data set. Categorical variables like gender and presence/absence of pain were defined as frequencies and percentages. Age and intensity of pain (Quantitative variables) were described as mean \pm standard deviation. Outcome variable i.e. pain was stratified by age and gender, and analysed. Data was presented in the form of tables and diagrams.

One-way ANOVA test was used to compare the intensity of pain as mean between the three study arms. The frequency of endodontic pain was compared between the study arms with chi-square test. Probability value of less than 0.05 was considered statistically significant. The frequency of endodontic pain was stratified according to age and gender. Post stratification, chi-square test was used.

Results

The minimum Intensity of pain was 0 and maximum was 10 with mean and standard deviation 3.43 ± 3.576 VAS. The mean and standard deviation for age was 32.72 ± 15.279 . Total 105 participants were placed into 3 groups, 35 cases in each group. 57/105 (54.30%) were males while 48/105 (45.70%) were females. In Group A (Sodium Hypochlorite), endodontic pain was present in 12/35 (34.3%) patients, in Group B (Hydrogen Peroxide) endodontic pain was present in 24/35 (68.6%) patients while in Group C (normal saline) endodontic pain was present in 30/35 (85%) patients. After using One-way ANOVA for all three groups i.e. Group A (Sodium Hypochlorite), Group B (Hydrogen Peroxide), Group C (normal saline) with respect to Intensity of pain (VAS), it

was found that there was a significant difference (p-values 0.001) between them. It was also found that Group B (Hydrogen Peroxide) and Group C (normal saline) have higher Intensity of pain as compared to Group A (Sodium Hypochlorite) i.e. for Group A (Sodium Hypochlorite) the Intensity of pain (VAS) was 1.77 ± 2.84 and for Group B (Hydrogen Peroxide) and Group C (normal saline) the Intensity of pain (VAS) were 4.37 ± 3.456 and 6.11 ± 3.197 respectively (Table I). By using chi-square test it was observed that there was a significant association between groups and presence of endodontic pain (VAS) having p-value = 0.001 (Table II). Endodontic pain (VAS) was significantly associated in three groups with regards to gender having p-value = 0.014 and 0.002 for male and female, respectively (table III). Significant association between participants of < 35 years and presence of endodontic pain (VAS) was found where the p-value was 0.002. Stratification of endodontic pain (VAS) in groups with regards to age is shown in table IV.

Table I: Results of One-way ANOVA of Intensity of pain (VAS) among three groups (N = 105)

Groups	Intensity of pain (VAS)	p-value
	Mean \pm SD	
Group A	1.77 ± 2.84	0.001
Group B	4.37 ± 3.456	
Group C	6.11 ± 3.197	

Group A: Sodium Hypochlorite, Group B: Hydrogen Peroxid, Group C: Normal saline

Table II: Cross tabulation between Endodontic Pain (VAS) and groups (Chi-square test) (n = 105)

Groups	Endodontic Pain (VAS)		Total	P-value
	Present	Absent		
Group A	12	23	35	0.001
Group B	24	11	35	
Group C	30	5	35	
Total	66	39	105	

Table III: Stratification of Endodontic Pain (VAS) in groups with regards to gender (n = 105)

Gender	Groups	Endodontic Pain (VAS)		P-value
		Present	Absent	
Male	Group A (Sodium Hypochlorite)	7	12	0.014
	Group B	13	7	
	Group C	15	3	
Female	Group A	5	11	0.002
	Group B	11	4	
	Group C	15	2	
Total		66	39	105

Table IV: Stratification of Endodontic Pain (VAS) in groups regarding age (n = 105)

Age	Groups	Endodontic Pain (VAS)		p-value
		Present	Absent	
< 35 years	Group A	7	12	0.002
	Group B	13	7	
	Group C	19	2	
≥ 35 years	Group A	5	11	0.013
	Group B	11	4	
	Group C	11	3	
Total		66	39	105

Group A: Sodium Hypochlorite, Group B: Hydrogen Peroxid, Group C: Normal saline

Discussion

A tooth with damaged pulp is usually treated by root canal procedure, with primarily aim to save and preserve the natural tooth. It is designed to eradicate bacteria from an infected root canal. Millions of procedures are performed each year with a high success rate, and patients are often pleased with the results because they are minimally invasive.¹⁶ For RCT to be satisfactory, irrigation must be supplemented with preparation of canals. NaOCl has before now found a decent place among various irrigation materials.

Results of our study showed that endodontic pain was present in 12/35 (34.3%) patients who were treated with Sodium Hypochlorite, while 24/35 (68.6%) participants of Hydrogen Peroxide group presented with the complaint of endodontic pain. These results are in accordance with that documented by Sangi et al, where the frequency of endodontic pain was significantly higher in patients given hydrogen peroxide (70%) as compared to sodium hypochlorite (36.7%).¹⁶

Naenni et al. observed that the performance of NaOCl as an ideal irrigating solution is better than other agents. These agents are citric acid (10%), peracetic acid (10%), dichloroisocyanurate (NaDCC) (5%), chlorhexidene (3%), and H₂O₂ (3%). Effectiveness of NaOCl is reliant on its capacity to dissolve organic matter within the pulp cavity. Furthermore, its strong antibacterial property due to the formation of hypochlorous acid is coined for inactivating vital metabolic enzymes thereby eliminating bacterial cells. Hypochlorous acid (HOCl) has a detrimental effect on DNA formation.¹⁷

Association between dentistry and pain is often depicted in the general culture as identical with conditions to be evaded. In reality, badly controlled dental pain with its

associated anxiety are factors contributing to cancelled or postponed appointments. Dental fear/phobia is a prime cause of side-stepping dental visits.¹⁸ Successful pain management decreases anxiety, enables delivery of dental/oral care, improves patient comfort, and may improve one's oral health.¹⁹ Several treatment options for pain management throughout endodontic treatment, includes, establishment of drainage, pre-medication de-occlusion, systemic and intra-canal medicaments. Root canal preparation systems comprises of enlargement as well as shaping of endodontic space in addition to its disinfection. Certain factors for instance use of intra-canal medications, preoperative pain, and tooth localization might influence the post and inter appointment pain. Endodontic pain still is one of the most frequent tissue in endodontic treatment, even though, in most situation it may not last long, however it may well be a cause of awkwardness for dentist as well as irritating for the patients. Researches exploring inter- appointment pain have stated 15% to 25% incidence of moderate to severe pain. Studies have also reported frequencies of inter-appointment emergencies in the range of 1.4%-16%. While one study noted inter-appointment pain from 35% to 46.7%. These results are comparable to those reported in our study.¹⁸

Fouad et al²⁰ concluded that pain frequency or flare-ups in necrotic pulp patients were significantly high when compared to patients with vital teeth. Naidorf has also conversed about how necrotic pulp influences the development of antigens-antibodies reaction which induce complement system and inflammatory reaction ensuing in the flare-up or inter-appointment pain.²¹

Findings of our study revealed that endodontic Pain Visual Analogue Scale (VAS) was significantly associated with males having p-value = 0.014, However highly significant association was reported among inter-appointment pain and females (p-value=0.002). These results are contrary to that reported by few other studies, where they did not find any relation between gender and inter-appointment pain.^{18, 22, 23}

Outcomes of our comparative study demonstrates a significant association between participants of < 35 years and presence of endodontic Pain (VAS), where the p-value was 0.002. These results support the conclusion of Toosy²⁴, where difference in the flare-ups rate of above 50-year age groups was noticed. These findings are opposite to several other studies, which were failed to establish any relation between inter-appointment pain and

ages.^{20,25} Saba et al stated significant association between pain and 31 years or above age group.²⁶ The incidence of pain was less in teeth instrumented with NaOCl.²⁶ Other study didn't report any significant difference in intensity of pain or incidence following either treatment group was notified.²⁷

Our study found that group B (Hydrogen Peroxide) and group C (normal saline) have higher intensity of pain as compared to group A (Sodium Hypochlorite). These results are not consistent with the findings documented in another research, where endodontic pain experienced with NaOCl was greater than other agents used. Hydrogen peroxide was the least effective irrigant when used alone.

Our investigation identified gender difference and females' predominance as factors in the increased frequency of endodontic pain. The emotional status of a woman has also been considered by doctors to direct pain in women. Similarly, the biological differences among genders likewise clarify the greater incidence of pain in women in comparison to men. The explanations possibly be difference in the pelvic and reproductive structures offering an additional entrance of infection in them, causes probable distant and local hyperalgesia. Likewise, variation in the hormonal levels of female may be linked with changing in levels of nor-adrenaline and serotonin, triggering the pain during their menstrual period.¹⁸

Conclusion

It was concluded that Sodium Hypochlorite was much better than Hydrogen Peroxide and Normal Saline in the management of endodontic pain in terms of incidence and intensity.

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