

# Comparison of Effects of Different Endodontic Irrigating Solutions on Post-Operative Pain During Single Visit Root Canal Treatment

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## ABSTRACT

**Aims:** Comparing the effects of normal saline, 5.25% sodium hypochlorite and 2% chlorhexidine on the post-operative pain intensity after a single visit root canal treatment.

**Methods:** A total of 120 male and female patients requiring an endodontic treatment for necrotic teeth with chronic apical periodontitis were randomly divided into three equal groups (40 each) according to the type of root canal irrigating solution, i.e. group A (normal saline {NaCl}), group B (sodium hypochlorite {5.25% NaOCl}) and group C (chlorhexidine {2.0% CLX}). The post-operative pain intensity was determined using a self-explanatory questionnaire with four-point pain intensity scale at 6 hrs and 24 hrs and on 4<sup>th</sup>, 7<sup>th</sup> and 10<sup>th</sup> day after a single visit endodontic procedure. Tukey's test was used to compare significant pain intensity among three root canal irrigating solution.

**Results:** Among group A (NaCl) participants, most of them experienced mild pain at 6<sup>th</sup> hr. The mean pain score was further compared among the three irrigant groups at different time intervals by Post hoc comparison using Tukey's HSD test, which showed that group A (NaCl) had a significant difference ( $p \leq 0.05$ ) with a mean pain value of  $0.66 \pm 1$  at 6<sup>th</sup> hr post-endodontic pain determination as compared to group B (5.25% NaOCl) and group C (2.0% CLX) where the mean pain value was  $1.05 \pm 0.91$  and  $2.48 \pm 0.55$  respectively.

**Conclusion:** The present study concludes that normal saline should not be used as the sole root canal irrigant during the endodontic treatment especially when the involved teeth are having necrotic pulp and chronic peri-radicular periodontitis to avoid the incidence of post-endodontic pain.

**Keywords:** Endodontics, Irrigant, Pain, Chlorhexidine.

## INTRODUCTION

The non-surgical endodontic treatment is aimed to eliminate bacteria by using various antimicrobial irrigants in conjunction with mechanical root canal cleaning and shaping, especially the inaccessible areas to the different hand and rotary instruments due to complex root canal anatomy<sup>1,2</sup>. During the mechanical instrumentation of the canal, the smear layer is created, blocking the dentinal tubules and preventing the decontamination<sup>3</sup>. Therefore root canal irrigants used for the chemo-mechanical preparation should possess four important and desirable properties: should be antimicrobial, be able to debride the root canal system, should be able to dissolve organic and inorganic tissue, and be non-toxic especially if extruded into the peri-radicular tissue<sup>3</sup>. In addition to these, they should have lubricating potential so as to reduce friction of the instruments during the root canal preparation<sup>4</sup>.

Sodium hypochlorite (NaOCl) solution is considered as gold standard irrigant for the root canal cleansing and disinfection<sup>5</sup>. It is a commonly used root canal irrigating solution in a concentration of 0.5%-5.25%<sup>6</sup>. It has high alkaline pH and tissue-dissolving and anti-microbial properties<sup>6</sup>. Despite all these facts, NaOCl has many disadvantages, e.g. it is toxic, has an unpleasant taste, not able to remove the smear layer, at low concentration has a less antibacterial effect, and also highly irritating to the peri-radicular tissues especially when used at high concentrations<sup>1,6</sup>. Two percent chlorhexidine (CLX) is used as an alternative root canal irrigant. Although it is a potent antiseptic but is unable to dissolve the necrotic tissues, therefore it should not be used as a sole root canal irrigant during the routine endodontic procedure<sup>6,7</sup>. Normal saline (NaCl) is also used as an alternating root canal irrigating solutions between the two main irrigating solutions such as NaOCl and CLX but it is rarely used as a sole root canal irrigant, because it does not possess anti-bacterial and tissue dissolving property<sup>8</sup>. However, it is not toxic if extruded accidentally in the peri-radicular tissue and does not have any unpleasant taste<sup>9</sup>.

Even after taking extreme precaution during an endodontic treatment, patient may sometimes suffer from pain, discomfort, swelling and tissue damage after the root canal treatment (RCT)<sup>2</sup>. Such an outcome of RCT is an unacceptable and undesirable situation for the patients and treating clinicians in addition to being a poor indicator of long term success of the procedure<sup>10,11</sup>. Therefore, post-endodontic pain prevention should be considered as an essential aspect of endodontic treatment<sup>12</sup>. Although a large number of in vitro comparison were done to evaluate the activity and effectiveness of NaOCl and CLX,<sup>13-15</sup> however the literature review reveals no in-vivo clinical trial done to evaluate and compare the effectiveness of 5.25% NaOCl and 2.0% CLX with NaCl in reducing the post-operative pain after single-visit endodontic treatment. So the present study is first of its kind in which NaCl was compared as a sole root canal irrigant during the single visit endodontic treatment in mandibular teeth with necrotic pulp and chronic peri-radicular periodontitis with 5.25% NaOCl and 2.0% CLX to evaluate the effects on post-operative pain.

## MATERIALS AND METHODS

The current prospective in-vivo study was carried out from 1<sup>st</sup> September 2020 till 31<sup>st</sup> December 2020, after receiving an institutional ethical approval.

A total of 120 patients, aged between 20-50 years and either sex who had necrotic pulp and chronic peri-radicular periodontitis related to the anterior and posterior mandibular teeth were selected by systematic random sampling method from patients attending the outpatient section of the Department of Operative Dentistry, Rehman College of Dentistry, Pakistan. Patients having uncontrolled medical conditions, teeth with discharging sinus, pre-operative dental pain, and pregnant women were excluded from the study. The patients signed individual informed consent forms containing information about the aim of the study and the study procedures. The selected patients were divided randomly into three groups. Group A comprised 40 patients in which NaCl was used as an endodontic irrigant, group B comprising 40 patients in

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which 5.25% NaOCl was used, and group C comprising 40 patients in which 2.0% CLX was used.

**Baseline examination:** Once patients were enrolled, they underwent a complete oral clinical and radiographic examination to confirm the diagnosis. During the clinical examination, the pulp vitality was checked using electrical and thermal pulp tests to confirm the diagnosis of necrotic pulp. Pre-operative digital periapical radiographs were taken to check the peri-radicular status of the teeth.

**Procedure:** The tooth was anesthetized using 2% lignocaine plus adrenaline conc. of 1:80,000. After the tooth has been isolated by using the rubber dam, the root canal was accessed by following ideal cavity preparation principles. The canal was negotiated by ISO size 8 and 10 no K files. The barbed broaches were used to extirpate the pulp and canal length was measured by digital radiographic technique. The canal was prepared chemo-mechanically by crown down technique using Wave One Gold reciprocation root canal preparation system with the help of root canal irrigating solution for each of the three groups simultaneously by following the manufacturer instructions. About 2 ml of irrigant was used after each file use with 27 gauge Max-i-probe syringe having side vented needle. However, extreme care was taken, thus not letting the needle to bind with the canal walls and extruding the irrigant slowly using the finger pressure rather than thumb pressure. To keep irrigation effective, the side vented needle was kept moving up and down during the irrigation, and a stopper was used on the irrigating needle, to keep a distance of 1-2 mm from the apex. The extrusion rate of the irrigant should be kept not more than 2-4 ml / min. To make the canal dry, the paper points were used. Following this, the root canals were obturated using warm vertical condensation technique (System B), with gutta-percha and pulp canal sealer and back filled by using the Obtura II system. Finally, the access cavity was filled with glass ionomer restorative material in paste form, and on the top, it was layered with bulk-fill resin composite.

**Follow-up evaluations:** At the end of endodontic treatment, a structured questionnaire was given to each participant for recording the pain intensity level on a self-explanatory pain intensity scale. Each participant was instructed to fill the questionnaire at 6<sup>th</sup> hr and 24<sup>th</sup> hr and on 4<sup>th</sup>, 7<sup>th</sup> and 10<sup>th</sup> day after the completion of endodontic treatment and was asked to return for review. The post-endodontic pain was measured on a 4-point scale, where 0 = no pain, 1 = mild pain, 2 = moderate pain (need analgesic and relieved), 3 = severe pain (not relieved by analgesic). The entire data were then entered into the proforma.

**Statistical analysis:** Data were analysed using SPSS software version 2021. Initially, normality of questionnaire was checked

using the Kolmogorov–Smirnov test (K-S test). The results are presented as means ± standard deviation and as frequencies and percentages. Two-way repeated measures ANOVA (irrigant x time) was used to compare dependent variables. In cases where Mauchly’s test of sphericity indicated that data were not normally-distributed over time, Huynh-Feldt correction factors were applied to the data. Post hoc comparisons were made with Tukey’s HSD. Statistical significance was set at p≤0.05.

**RESULTS**

A total of 120 participants were divided into three groups of 40 (33.3%) each. All of the patients complied with follow-up, and the results were evaluable. There were 71 (59.1%) males and 49 (40.9%) female participants. With respect to pulpal diagnosis, 84 (70.0%) participants had pulpal necrosis, and 36 (30.0%) were having irreversible pulpitis and necrotic teeth showed significant difference (Table-I).

Most of the participants responded with mild pain (28, 70%), followed by moderate pain (7, 17.5%) and severe pain (3, 7.5%) at 6<sup>th</sup> hr in group A (NaCl). The mean pain score was further compared among the three irrigant groups at different time intervals by Post hoc comparison using Tukey’s HSD which showed that group A (NaCl) had a significant difference (p≤0.05) with a mean pain value of 0.66±1 at 6<sup>th</sup> hr post-endodontic pain determination among the other groups, where the mean pain value for found to be 1.05±0.91 for group B (5.25% NaOCl) participants and 2.48±0.55 for group C (2.0% CLX) participants (Table-II).

The mean value of pain score determined post-operatively at different time intervals among three different age ranges using two way ANOVA test, was not significant (p=0.43) with the mean values 1.52±1.2, 1.3±1, 1.2±1.1 for age group 20-30 years, 31-40 years, 41-50 years respectively (Table-III).

Similarly no significant difference (p=0.72) was found between the male and female participants when the pain score was determined using independent variable or sample ‘t’ test, at different time intervals post-operatively with the mean values of male 1.35±1.1 for male participants and 1.4±1 for female participants (Table-IV).

Table-I: Participant characteristics

Gender	Age group (in years)			Total (N{%)
	20-30 (N{%)	31-40 (N{%)	41-50 (N{%)	
Male	30 (42.3%)	25 (35.2%)	16 (22.5%)	71 (59.1%)
Female	23 (46.9%)	17 (34.7%)	9 (18.4%)	49 (40.9%)
Total	53 (44.2%)	42 (35.0%)	25 (20.8%)	120 (100%)

Table-II: Frequency of pain experienced at different time intervals with the use of different endodontic irrigating solutions

Pain intensity by group	6 <sup>th</sup> hr			24 <sup>th</sup> hr			4 <sup>th</sup> day			7 <sup>th</sup> day			10 <sup>th</sup> day		
	Freq	%age	Cumul %age	Freq	%age	Cumul %age	Freq	%age	Cumul %age	Freq	%age	Cumul %age	Freq	%age	Cumul %age
<b>Group A (NaCl)</b>															
None (0)	2	5.0	5.0	10	25.0	25.0	32	80.0	80.0	36	90.0	90.0	37	92.5	92.5
Mild (1)	28	70.0	75.0	22	55.0	80.0	8	20.0	100	4	10.0	100	3	7.5	100
Moderate (2)	7	17.5	92.5	6	15.0	95.0	0	0	0	0	0	0	0	0	0
Severe (3)	3	7.5	100	2	5.0	100	0	0	0	0	0	0	0	0	0
Total	40	100	--	40	100	--	40	100	--	40	100	--	40	100	--
<b>Group B (5.25% NaOCl)</b>															
None (0)	18	45.0	45.0	23	57.5	57.5	31	77.5	77.5	35	87.5	87.5	39	97.5	97.5
Mild (1)	21	52.5	97.5	17	42.5	100	9	22.5	100	5	12.5	100	1	2.5	100
Moderate (2)	1	2.5	100	0	0	0	0	0	0	0	0	0	0	0	0
Severe (3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	40	100	--	40	100	--	40	100	--	40	100	--	40	100	--
<b>Group C (2.0% CLX)</b>															
None (0)	19	47.5	47.5	24	60.0	60.0	26	65.0	65.0	30	75.0	75.0	38	95.0	95.0
Mild (1)	21	52.5	100	16	40.0	100	14	35.0	100	10	25.0	100	2	5.0	100
Moderate (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Severe (3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	40	100	--	40	100	--	40	100	--	40	100	--	40	100	--

Table-III: Comparison between means pain score among the three irrigant groups at different time intervals

Groups	6 hrs	24 hrs	4 <sup>th</sup> day	7 <sup>th</sup> day	10 <sup>th</sup> day	ANOVA
Group A	0.66±1**	0.25±0.49	0.05±0.22	0.05±0.22	0	Time=0.002 Group=0.000 Time x Group=0.000
Group B	1.05±0.91	0.41±0.78	0.10±0.38	0	0	
Group C	2.48±0.55	1.15±0.70	0.12±0.33	0	0	

\*\* Statistically significant for Tukey's HSD, Group-A vs Group B and Group C at 6 hrs

Table-IV: Comparison of mean pain (VAS) scores with age and gender

Variable	Mean±SD	Statistical test
Age groups		ANOVA p=0.43
20-30	1.52±1.2	
30-40	1.3±1	
40-50	1.2±1.1	
Gender		Independent samples 't' test p=0.72
Male	1.35±1.1	
Female	1.4±1	

## DISCUSSION

In the modern endodontics, completion of endodontic therapy is done in a single visit, and this approach has been proven for its reliability by prospective randomized clinical trials<sup>16-18</sup>. One aspect that aids in the success of endodontic therapy is the subsequent reduction in the post-operative pain level because if there is any post-operative pain, it will weaken the trust of the patient in treating dentist<sup>18</sup>. The post-endodontic treatment discomfort is an issue faced by the dentist and is commonly associated with a tissue response to multiple factors, namely, the presence of infected debris, damage to pulp and failure at cleaning stages<sup>19</sup>. Apart from the tissue-related factors there are certain other factors which could be related to post-endodontic discomfort and pain. The mechanical factors include over instrumentation, whereas chemical factors like a purging of irrigant, restorative materials or intra-canal medicaments also play the role<sup>20</sup>.

Sodium hypochlorite is most widely used irrigant in the present-day endodontic practice as it is anti-microbial and can dissolve the organic tissues<sup>21</sup>. But unfortunately, it proves to be caustic if accidentally extruded into the peri-radicular area<sup>1</sup>. Chlorhexidine is another irrigating solution used during endodontic treatment, but it is not capable of dissolving the necrotic tissue debris although it has some good antimicrobial activity<sup>22</sup>. The normal saline can be used between the two main irrigating solutions, to prevent any untoward chemical reaction between the two solutions. However, in the present study it was used as sole intracanal irrigating solution to evaluate its efficacy in reducing the post-endodontic pain keeping in view of its less toxic effect if it is extruded accidentally in the peri-radicular tissues and also not having any unpleasant taste. But on the other hand it does not possess any anti-bacterial activity and only results in the cleaning of the root canal during the irrigation<sup>23</sup>.

During the sample selection, recruitment was restricted to the participants having chronic peri-radicular periodontitis and pulpal necrosis as these patients are having an increased risk of post-operative pain<sup>24</sup> but in order to reduce the risk of acute exacerbation of pain due to microbial factors, a strict aseptic technique followed. In addition to this, any participant having pre-operative pain was not included in the present study as it is a strongest post-operative pain predictor<sup>25</sup>.

The data regarding the post-endodontic discomfort and pain is dependent on the subjective pieces of information provided by the patient that are subject to errors therefore it is very difficult to measure the post-endodontic pain and discomfort objectively. In the present study, a self-explanatory questionnaire and four-point pain intensity scale were used to measure the post-endodontic pain and discomfort and similar methods were used in the majority of the earlier studies<sup>26,27</sup>. However, some of the researchers had determined the post-endodontic pain and discomfort, using two levels only: no pain and discomfort.

Although a large number of in vitro comparison were done to evaluate the activity and effectiveness of NaOCl and CLX,<sup>13-15</sup> however it has been revealed by the literature review that there is no in vivo clinical trials comparing 5.25% NaOCl and 2.0% CLX

with normal saline to determine post-operative pain after single-visit endodontic treatment. So the present study is first of its kind in which the normal saline was compared as a sole root canal irrigant during the single visit endodontic treatment in mandibular teeth with necrotic pulp and chronic peri-radicular periodontitis with 5.25% NaOCl and 2.0% CLX to evaluate their effects on post-operative pain. The frequencies of pain experienced by using different irrigating solution at different time intervals have shown that most of the participant responded with mild pain at 6<sup>th</sup> hr in group A (NaCl). The mean pain score was further compared among the three irrigant groups at different time intervals, which has demonstrated that participants of group A (NaCl) had a significant difference (p≤0.05) with a mean pain value of 0.66±1 at 6<sup>th</sup> hr post-endodontic pain determination, as compared to group B (5.25% NaOCl) and group C (2.0% CLX) where the mean pain value was 1.05±0.91 and 2.48±0.55 respectively. The reason could be that majority of the participants were having necrotic pulp with chronic peri-radicular periodontitis and the normal saline was used as the sole root canal irrigant which did not possess the anti-bacterial and tissue dissolving properties. Other possible reason could be the extrusion of the necrotic debris, inflammation in the peri-radicular tissue and no chance for using the intracanal medicaments. However, no significant difference was found in post-operative pain at any other time point evaluated between group B (5.25% NaOCl) and group C (2.0% CLX). With time the pain decreased and by 10<sup>th</sup> day 7.5% participants in Group A, 2.5% participants in group B and 5% participants in group C were having only mild discomfort in each group (not requiring any analgesics). Bashetty and Hedge (2010)<sup>1</sup> during a randomized comparison between 5.25% NaOCl and 2.0% CLX during multi-visit endodontic treatment found a significant difference in post-operative pain at 6 hrs after the endodontic procedure, but no significant difference was found at any other point time interval.

In another similar study both 5.25% NaOCl and 2.0% CLX were compared as irrigant and at different time intervals of 6 hr, 24 hr and 4<sup>th</sup>, 7<sup>th</sup> and 10<sup>th</sup> day the participants were followed for post-endodontic pain and discomfort assessment. The frequency of pain in NaOCl group was found to be 55% and in CLX group 75.0% (p=0.006) in terms of post-operative pain at 6<sup>th</sup> hr. At other time intervals, there was no significant difference<sup>28</sup>.

## CONCLUSION

It is concluded from the present study that normal saline should not be used as the sole root canal irrigant during the endodontic treatment, especially when the involved teeth were having necrotic pulp and chronic peri-radicular periodontitis. Similarly, in the necrotic teeth, RCT should be completed in multiple visits instead of a single visit, in order to utilize the intracanal medicaments during inter-appointment visit. Strict rubber dam isolation protocol should be followed and the irrigating needle should not bind within the canal wall and should constantly be moving up and down during the irrigation to allow the backflow of irrigant and should be kept 1-2 mm from the apex. Low pressure irrigating technique with index finger pressure instead of thumb pressure should be used, and rate of extrusion of irrigant should not be more than 4 ml per min in order to avoid the post-operative pain and flare-up.

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