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# Effect of Different Concentrations of Sodium Hypochlorite in Single Visit Endodontic on Postoperative Pain: a Systematic Review.

Dr. Alpa Gupta<sup>1</sup>, Dr. Mrinalini Mrinalini<sup>2</sup>, Dr. Shweta Sharma<sup>3</sup>, Dr. Sonal Soi<sup>4</sup>, Dr. Sucheta Jala<sup>5</sup>, Dr. Seema Bukhari<sup>6</sup>

<sup>1</sup> Professor, Department of Conservative Dentistry and Endodontics, Manav Rachna Dental College, SDS, MRIIRS, Faridabad

<sup>2</sup> Senior Lecturer, Department of Conservative Dentistry and Endodontics, Manav Rachna Dental College, SDS, MRIIRS, Faridabad

<sup>3</sup> Private Practitioner, Department of Conservative Dentistry and Endodontics, Ghaziabad

<sup>4</sup> Professor, Department of Conservative Dentistry and Endodontics, Manav Rachna Dental College, SDS, MRIIRS, Faridabad

<sup>5</sup> Senior Lecturer, Department of Conservative Dentistry and Endodontics, Manav Rachna Dental College, SDS, MRIIRS, Faridabad

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#### KEYWORDS

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#### ABSTRACT:

The review aims to evaluate the effectiveness of varying concentrations of sodium hypochlorite on postoperative pain following single-sitting root canal treatment. A thorough manual search was done on electronic databases namely PubMed, Scopus, and EBSCOhost. Only randomized clinical trials (RCTS) conducted between January 2000 to March 2024 were considered. The studies that evaluated the pain levels at different time intervals following irrigation with varying concentrations of sodium hypochlorite (2.5% and 5.25%) after single-visit endodontics were included. Selected Items of Reporting for Systematic Reviews and Meta-Analysis checklists were utilized to set the review process. The checklist of critical appraisal for randomized controlled trials evolved by Joanna Briggs Institute was used in examining the risk of bias. The elementary search revealed 673 publications out of which 2 studies fulfilled the strict inclusion and exclusion criteria. One study showed that the incidence of postoperative pain using 5.25% Sodium hypochlorite is lower in contrast to 2.5%. However, no remarkable variance in pain levels was observed in the other study. This systemic review concluded that there is inconclusive data available regarding postoperative pain with 2.5% and 5.25% sodium hypochlorite following single visit root canal treatment. Further clinical trials using similar preoperative conditions and treatment protocols are needed to determine a definitive association between postoperative pain and concentration of sodium hypochlorite.

#### 1. Introduction

Postoperative pain is a very common and inevitable phenomenon characterized by multifaceted etiology and possibly associated with acute periapical inflammation. This discomfort predominantly stems from mechanical, chemical, and microbiological factors resulting from the extrusion of infected debris and fluids [1]. Post-operative pain is very prevalent, affecting from 2.5% to nearly 60% of subjects that have undergone endodontic procedures, and it tends to develop between 6 and 12 hours after treatment, reaching a prevalence of about 40% in 24 hours and dropping to 11% one week after treatment [2-4]. Several clinical trials have been conducted for the assessment of the outcome of diverse variables on the levels of pain. These studies examined the effects of instrumentation methods, types of anesthetic solutions, varieties of rotary instruments utilized, kinds of pain relief medication prescribed, occlusion reduction, and root canal filling techniques [5-9].

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Sodium hypochlorite solution (NaOCl) is widely used for the cleaning and disinfection of root canals due to its antimicrobial properties and ability to dissolve organic matter [10-12]. However, the chemical composition of sodium hypochlorite renders it highly toxic [13].

According to the literature, postoperative pain may be related to higher concentrations of NaOCl or improper handling of the solution (e.g. when leakage occurs). Some investigations suggest that a significantly lower postoperative pain was reported when the highest concentration of NaOCl solution (5.25%) was used as compared to 2.5% whereas others found no significant difference in pain with varying concentrations of sodium hypochlorite [14-16]. To reduce the possible occurrence of undesirable effects of pain, chlorhexidine (CHX) solution is thought to be an appropriate alternative, with similar antimicrobial efficacy but has a drawback that it does not cause the dissolution of pulp tissue [17]. NaOCl concentrations ranging from 0.5% to 5.25% and above are used in root canal treatment. However, there is some debate about the best NaOCl concentration to be used. There have been various investigations conducted for the evaluation of the antimicrobial efficacy of NaOCl when used in varying concentrations, its effect on the dissolution of tissue, depth of dentin penetration, capacity of smear layer removal, microhardness, viability of stem cells, viscosity, amount of extruded debris, and post-endodontic pain. The findings of these investigations have been contradictory. Various studies have encouraged a higher concentration [18-20], however, other investigations have shown that a higher concentration has a negative impact [21].

Given the increased cytotoxicity at higher concentrations of NaOCl compared to lower ones, there is a greater risk of irritation to the periapical tissues during the unavoidable, although incredibly small, extrusions [22]. Thus, the NaOCl concentration may affect the level of postoperative pain. The second goal requires a decrease in the levels of microbial load inside the root canals so that it ceases to affect the healing of periradicular tissues. The findings of investigations performed to assess the impact of concentration of NaOCl on its antimicrobial efficacy have been inconsistent. There have been various in vitro studies showing that a positive relation exists between the reduction of bacteria and concentration [23], but others have not [24]. The disparity in results, in combination with the knowledge that the exact association between healing and the amount of reduction of bacterial load is yet to be determined, suggests that the role of concentration of NaOCl in endodontic outcome is yet unknown. Also, the majority of investigations on the effect of NaOCl concentration on root canal therapy have been conducted in vitro. Most of the studies on postoperative pain have used 2.5% to 5.25% concentrations of sodium hypochlorite. Also, as per AAE, these are the most common concentrations used as intracanal irrigants.

#### 2. Objectives

The purpose of this systematic review is to compare the effect of two commonly used NaOCl concentrations (2.5%, 5.25%) on postoperative pain after single-visit endodontics.

#### 3. Methods

This systemic review was registered on the open science framework (https://doi.org/10.17605/OSF.IO/ZHEA7) and was framed using the PRISMA checklist. The review question was prepared utilizing the PICO framework of a systematic review specifying population, intervention, comparison, as well as outcome. The review question was "Would a change in concentration of NaOC1 affect the post-operative pain levels in patients undergoing single-visit root canal treatment".

#### Eligibility criteria

The search included randomised clinical trials to compare postoperative pain after using sodium hypochlorite (NaOCl) at 2 different concentrations (2.5% and 5.25%). The included patients were indicated for single-visit endodontic therapy, who had not received any analgesic or anti-inflammatory before the endodontic treatment. The post-operative pain was assessed using a Visual analog scale.

#### Inclusion criteria:

- Only randomised controlled trials.
- Studies done during the period from January 2000 to March 2024.
- Studies evaluating postoperative pain using the VAS scale.
- Studies comparing the concentration of 2.5% and 5.25% sodium hypochlorite.

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- Studies include root canal treatment in a single visit irrespective of the diagnosis.
- Studies evaluating pain for at least 72 hours

#### Exclusion criteria:

- Studies in languages other than English.
- Studies where full texts were not available.
- Studies in which premedication was given in root canal treatment.

#### Information sources and literature search strategy

A comprehensive search of literature was carried out incorporating manual search along with the following databases: Medline/PubMed, Scopus, and EBSCOhost. Search was performed utilizing the Boolean operators "AND" and "OR" and a combination of keywords. The gathered data were searched manually for recognition and debarring of duplicates

Two examiners, independently screened those articles that had been spotted through manual and electronic database searches, studies not meeting the inclusion criteria were excluded. The procedures attempted during the selection process are featured in Figure 1.



Figure 1 PRISMA flowchart depicting the workflow of the review.

#### Extraction of Data and quality assessment

The obtained data was analysed based on the author's year/country, language, journal, age group, gender, entire patient size, kind of case/study, kind of sample, amount and concentration of NaOCl used, and the outcome of the study. Table 1 lists the sum of data obtained from the

individual studies. Any difference of opinion between the two authors was solved by the third author. The checklist of critical appraisal for randomized controlled trials established by the Joanna Briggs Institute was incorporated to inspect the bias risk. For clinical trials, thirteen yardsticks were used to estimate the bias risk. For all investigations, two critics individually applied the risk of bias, followed by a discussion of each matter. The third examiner resolved any disagreements if any, to obtain a final consensus.

#### 4. Results

The search approach yielded a total of 673 relevant articles, including both manual and electronic searches. Articles were screened for abstract evaluation after duplicates were eliminated, and 10 were chosen for fulltext examination. After full-text analysis, only two publications were included within the systematic review based on strict inclusion and exclusion criteria.

#### Study characteristics

Two clinical studies, Demenech et al. 2021 and Farzaneh et al. 2017, were included in the final analysis after contemplating the strict inclusion and exclusion standards. The independent attributes of each study are mentioned in Table 2 [25,14]. According to Demenech et al., a total of 43 patients for 2.5% NaOCl and 42 patients for 5.25% NaOCl were considered for final analysis. After single-sitting root canal treatment was performed for both groups, about 14% of patients experienced postoperative pain for the 2.5% NaOCl group, and about 28.6% experienced postoperative pain for the 5.25% NaOCl group. After 24 hr. period, only 4.7 % of the patients experienced pain for the 2.5% NaOCl group whereas about 16.7 % experienced pain for the 5.25% NaOCl group. The use of postoperative medicine was indicated for only 4.7% of patients in the 2.5% NaOCl group whereas it was indicated for about 16.7% of patients in the 5.25% NaOCl group. When postoperative pain was measured at any time after 24 hours, 14% of the patients reported pain in the 2.5% sodium hypochlorite group and 28.6% of patients experienced pain in the 5.25% sodium hypochlorite group. Demenech et al. evaluated pain outcomes with the VAS scale as well as based on postoperative pain medications taken. There was no significant difference in terms of pain with a concentration of sodium hypochlorite used. However,

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the variables namely overfilling of the canal and time duration required for the procedure had a significant impact on postoperative pain [25].

Farzaneh et al <sup>[14]</sup> included 110 patients for data analysis in their study in which 35 females and 20 males took part in the 2.5% NaOCl group, whereas in the 5.25% NaOCl group, 36 females and 19 males were treated. There was no notable dissimilarity seen in the gender and age of the patients among the two groups (P = 0.50 and P = 0.51, respectively). To conduct judicious contrasts amidst the two groups, the pain experienced by the patients was categorized into no pain: 0; mild pain: 1–3; moderate pain: 4– 6; and severe pain: 7–9; the outcomes during the initial 72 h following treatment showed that the patients receiving 5.25% NaOCl as the irrigant had significantly lesser pain levels in comparison to the group treated by 2.5% NaOCl (P = 0.021); however, there was no remarkable distinction seen amid the group for the remaining span of study (P = 0.185) (i.e. 4–7 days). The mean number of painkillers ingested by the 2.5% NaOCl group patients was remarkably more than those ingested by the other group with 5.25% NaOCl (P = 0.001). Therefore, the outcome of single-visit endodontic therapy of lower molars with irreversible pulpitis with the use of either of the two concentrations of NaOCl as endodontic irrigants showed that 5.25% NaOCl solution was associated with significantly lower pain levels during the initial 72 h following treatment.

Both the studies followed the same irrigation protocol with saline being the final irrigant and kept the working length 0.5-1mm short of the apex. Also, the sealer used in the two studies was resin-based.

Author/Ye ar/Journal	Stu dy Typ e	Teeth Being Treate d	Treat ment	Irri gan t	Age	No. Of Patients	Pulp Condi tion	Instrum entation Techniq ue	Pa in Af ter 24 H	Pa in Af ter 48 H	Pa in Af ter 72 H	Use Of Postop erative Medic ation	Result s
Demenech et al. 2021, Journal of Endodonti cs <sup>[25]</sup>	Do ubl e Bli nde d Rct	Single Roote d and Multir ooted Teeth	Singl e Sittin g Root Cana 1 Treat ment	2.5 % Na OC 1	34.7 6± 12.1	43 (F=27, M=16)	Vital Pulp( 5) Necro tic Pulp ( 38)	Continu ous (31) Recipro cating (12)	Y es (2)	Y es 0	Y es (4 )	Yes (2)	No signifi cant differe nces occurr ed betwee n the irrigan ts and the pain outco mes, not even for the use of postop erative pain medic ation and
									N 0 (4 1)	N 0 (4 3)	N 0 (3 9)	No (41)	respon ses to VAS

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				5.2 5% Na OC	37.8 6 ± 12.0	42 (F=26, M=16)	Vital Pulp( 8) Necro tic	Continu ous (25) Recipro cating (17)	Y es (7 )	Y es (3 )	Y es (2 )	Yes (7)	(P. 05).
				I			Pulp (34)		o (3 5)	0 - 39	o - 40	-35	
				2.5 % Na	28.56 ±8.68	55(F=35 , M=20)			Y es - 10	Y es -6	Y es -1	Yes	The patient s that had 5.25% NaOCl reporte d
Farzaneh Et Al;		Multir ooted	Singl e Sittin	1			Irrovo	Potery	N o - 45	N o - 49	N o - 54		signifi cantly lower postop erative pain
Internation al Endodonti c Journal [14]	RC T	Teeth (Mand ibular Molar s)	g Root Cana 1 Treat ment	5.2 5% Na OC 1	28.34 ±7.61	55(F=36 ,M=19)	rsible Pulpit is	Rotary Instrum ents (Race)	Y es (6) N o	Y es (2 ) N o	Y es (1 ) N o	Yes	es the first 72 hours follow ing treatm ent (P=0.0 21)

 Table 1: Data extracted from the selected articles

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Critical Appraisal tools for use in JBI Systematic Reviews	Farzaneh	Luciana		
Was true randomization used for the assignment of participants to treatment groups?	Yes	Yes		
Was allocation to treatment groups concealed?	Yes	Yes		
Were treatment groups similar at the baseline?	Yes	Yes		
Were participants blind to treatment assignment?	Yes	Yes		
Were those delivering treatment blind to treatment assignment?	Yes	Yes		
Were outcomes assessors blind to treatment assignment?	Yes	No		
Were treatment groups treated identically other than the intervention of interest?	Yes	Yes		
Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately described and analysed?	Yes	Yes		
Were participants analysed in the groups to which they were randomized?	Yes	Yes		
Were outcomes measured in the same way for treatment groups?	Yes	Yes		
Were outcomes measured in a reliable way?	Yes	Yes		
Was appropriate statistical analysis used?	Yes	Yes		
Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?	Yes	Yes		

Table 2: Risk of bias	of selected studies
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#### **Risk of bias**

Both studies showed a low risk of bias according to the critical appraisal checklist for randomized controlled trials developed by Joanna Briggs Institute (Table 2).

#### 5. Discussion

The choice of irrigating solution used in root canal treatment plays an important part in its outcome. NaOCl is the most popular chemical used for the irrigation of root canals and is considered the "gold standard" solution [10].

There is no universal agreement on the best NaOCl concentration for root canal preparation. Higher NaOCl concentrations are more cytotoxic while also having more tissue-dissolving properties [27]. The majority of studies on postoperative pain have used NaOCl concentrations of 2.5-5.25% or higher [14,32]. Some

authors have confirmed the relation between the intensity of pain and NaOCl solution when used in its highest concentration [14] but have been rebutted by others [15,16], which makes the theme debatable.

In this systematic review, two clinical trials were included [14, 25] to evaluate the efficacy of irrigation 2.5% 5.25% sodium hypochlorite with and concentrations on postoperative pain following root canal treatment. Various parameters included in these studies, such as gender, age, and periapical tissue conditions, are seen in different studies with varying outcomes. Arias et al [33] had done an investigation on the possibility of the occurrence, severity, extent, and triggers of root canal pain postoperatively. For instance, a higher possibility of medium or extreme pain exists with the increase in age and teeth in the lower jaw; also, the likelihood of pain to last for greater than 2 days was

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higher with age and when a lesion was detected on an xray. The conclusion drawn by these authors was that considering the presence of an interrelation between multiple related clinical factors was crucial for the prognostic prototypes of pain. Pamboo et al [34], however, did not find any statistically significant difference in terms of age about postoperative pain, but a higher incidence was found in women and it showed a significant difference.

In both the studies single visit root canal was done. It requires shorter treatment durations for the patient but the risk of increasing postoperative pain is an issue. The study done by Sevekar and Gowda [35] confirmed that a significant difference was not seen in this result among patients who underwent treatment in one or several sittings. However, Sathorn et al [36], in their systematic review were not able to determine this difference.

Various techniques of instrumentation were carried out in the included studies where one study used both rotary and reciprocating systems [25] the other used only a rotary system [14]. According to Demirci et al (2021), a remarkable dissimilarity was not present in the pain postoperatively at any time when instrumentation techniques were compared in patients with asymptomatic mandibular molar teeth with large periapical lesions in single-visit root canal treatment [37]. The results in a systematic review by Nobar et al (2021)[38] were also similar and stated that there was no difference in postoperative pain at 12, 24, and 48 hours after nonsurgical root canal treatment and retreatment, using reciprocating or rotary instrumentation motions.

According to the study by Farzenah et al.[14] the patients who received 5.25% NaOCl reported significantly lower pain during the first 72 hours following the treatment. In the patients who had 5.25% NaOCl, the number of analgesics taken was notably lesser than in the other group with 2.5% NaOCl (P = 0.001). This confirms that those patients who were in the 5.25% NaOCl group had lower severity of pain. The improved antibacterial efficacy of 5.25% sodium hypochlorite (NaOCl) over a 2.5% solution might not significantly reduce pain postendodontic therapy, mainly because the study only involved patients suffering from irreversible pulpitis without periapical lesions. The reason for reduced pain with the higher NaOCl concentration remains uncertain, though it may be linked to the specific selection of participants who had inflamed pulp but no periapical

disease. The absence of periapical radiolucency and the presence of normal structures around the apex might hinder the leakage of the irrigant and debris, despite the greater ability of 5.25% NaOCl to dissolve tissue. Additionally, the superior tissue dissolution property of the higher concentration of NaOCl might more effectively disintegrate the remaining apical pulp tissue, potentially preventing the release of molecules that could trigger inflammation in the surrounding periapical areas. Demenech et al. [25] conducted a study that included 169 patients, in which there were 107 females, and 38.1 +/-14.4 years was the mean age. Postoperative pain was present in 18.3% of cases which occurred with more frequency in the first 24 hours (11.8%) and decreased afterward. The differences between the irrigants and the pain outcomes were not significant, even for the use of postoperative pain medication and responses to VAS (P >0.05). The authors highlighted that prior pain and the initial diagnosis of the endodontic condition might influence the level of postoperative pain experienced. It was found that 80.5% of the cases involved necrotic teeth, and the same percentage of patients reported no pain before treatment. This observation could partly account for the low occurrence of pain after the procedure.

Concerning the studies in which vital pulp tissue or necrotic pulp tissue was treated, a significant association does not exist between the level of postoperative pain experienced and treatment performed (Demenech), the results of which are different from that conducted by Pamboo et al [34], which concluded that the existence of radiolucent lesions had an influence on the occurrence of flare-up or postoperative pain. Gotler et al [39], performed a survey in which patients were divided into a group with either vital pulp and a group with necrotic pulp. Postoperative pain was evaluated during a 24-hour span and it validated that there was a greater occurrence and acuteness of pain in the group containing vital pulps.

#### Limitations

Inclusion of patients with similar preoperative conditions and following a standardized treatment protocol is an important aspect of clinical trials. Other factors, such as prolonged preparation time and overfilling, are also linked to pain outcomes which were not considered. Therefore, more clinical trials are needed in order to

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confirm or refute an association between the concentration of irrigant on postoperative pain. **References** 

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