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ASSESSMENT OF POSTOPERATIVE PAIN AFTER SINGLE-VISIT VERSUS MULTIPLE-VISIT ROOT CANAL TREATMENT USING DIFFERENT IRRIGANTS

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Abstract

Background:
Postoperative pain following root canal treatment remains a common patient concern and may be influenced by the number of visits and irrigant used during chemomechanical preparation.

Aim:
To evaluate and compare postoperative pain after single-visit and multiple-visit root canal treatments using two different irrigants: 5.25 % sodium hypochlorite (NaOCl) and 2 % chlorhexidine (CHX).

Materials and Methods:
A randomized controlled clinical trial was conducted on 300 patients requiring primary endodontic therapy. Participants were divided into four groups (n = 75 each): single-visit + NaOCl, single-visit + CHX, multiple-visit + NaOCl, and multiple-visit + CHX. Postoperative pain was assessed using a 100 mm visual analogue scale (VAS) at 6, 12, 24, 48, and 72 hours. Analgesic use and flare-ups were recorded. Statistical analysis included ANOVA, chi-square, and two-way ANOVA tests with $p < 0.05$ considered significant.

Results:
Single-visit groups demonstrated significantly higher pain scores at 6 h and 12 h ($p < 0.05$), which diminished by 24 h. No significant differences were observed between irrigants. Analgesic use and flare-ups were minimal and comparable among groups.

Conclusion:
Both single- and multiple-visit root canal treatments are safe and effective. Multiple-visit protocols may reduce early postoperative pain, while irrigant type exerts minimal influence on pain outcomes.

Keywords: Postoperative pain; Root canal treatment; Single-visit endodontics; Multiple-visit endodontics; Sodium hypochlorite; Chlorhexidine; Irrigants; Visual analogue scale; Randomized clinical trial; Endodontic flare-up.

Introduction

Endodontic treatment (root canal therapy) is a key intervention for preserving natural dentition in cases of pulpitis, necrosis and periapical pathology by eliminating infected pulp tissue, disinfecting the root-canal system and obturating the canals to prevent reinfection [1]. One of the major concerns for patients and clinicians alike is postoperative pain, which may manifest in the hours or days following treatment and can influence patient satisfaction, perception of treatment and clinical outcomes [2]. The incidence of post-endodontic pain has been reported to range widely (from approximately 3 % to 58 %) depending on tooth status, instrumentation technique, irrigants used, apical status and number of treatment visits [3,4].

A longstanding debate within endodontics concerns whether single-visit root canal treatment (where cleaning, shaping and obturation occur in one appointment) is comparable, superior or inferior to multiple-visit treatment (where obturation is delayed to a subsequent appointment, often following intracanal medication) in terms of pain, healing, complication rates and treatment efficiency [5,6]. Some systematic reviews and meta-analyses have found no statistically significant difference in short-term postoperative pain between single- and multiple-visit approaches [6,7], whereas others suggest a modestly higher risk of early pain or flare-ups in single-visit treatments under certain conditions (e.g., teeth with apical lesions) [8,9].

In parallel, the irrigant used during chemo-mechanical preparation of root canals plays a critical role in microbial elimination, organic tissue dissolution and removal of debris and smear layer [10]. Common irrigants include sodium hypochlorite (NaOCl) at varying concentrations, chlorhexidine (CHX), and adjunctive solutions/activation techniques. Although the primary literature suggests that different irrigant concentrations may affect microbial control, pulp-periapical tissue irritation and debris extrusion, the evidence regarding their influence on postoperative pain is scarce [11]. For instance, a randomized clinical trial showed no statistically significant difference in postoperative pain between 2.5 %, 5.25 % or 8.25 % NaOCl versus 2 % CHX during single-session endodontic treatment, but noted that over-filling and longer preparation time were associated with higher pain scores [12].

Given the interplay between number of visits, irrigant type/concentration and postoperative pain, the present study aims to assess and compare the incidence and intensity of postoperative pain in patients undergoing single-visit versus multiple-visit root canal treatment, using two different irrigants (for example, NaOCl versus CHX) in a randomized clinical design. The null hypothesis is that there is no difference in postoperative pain incidence or intensity between the treatment protocols or irrigant groups. The secondary objective is to evaluate whether irrigant type modulates pain outcomes within single- or multiple-visit protocols. This research has potential clinical relevance: if one protocol or irrigant yields lower pain, clinicians can optimise appointment scheduling and irrigation strategy to improve patient comfort and clinical efficiency.

Materials and Methods

Study Design and Ethical Approval

This study was conducted at the Department of Conservative Dentistry and Endodontics, at a tertiary care center, India. Ethical clearance was obtained from the Institutional Ethics Committee. All procedures adhered to the Declaration of Helsinki, and written informed consent was obtained from all participants prior to inclusion.

Study Population

The study population consisted of 300 patients aged between 18 and 60 years who required primary nonsurgical root canal treatment in single-rooted permanent teeth. Only teeth with mature apices and without periapical abscesses were included. Patients with systemic disorders (e.g., uncontrolled diabetes), periodontal pockets > 4 mm, pregnancy, retreatment cases, or those on analgesic or antibiotic therapy were excluded.

Randomization and Group Allocation

Participants were randomly allocated into four equal groups (n = 75 each) using a computer-generated random sequence and sealed opaque envelopes to ensure allocation concealment:

- **Group A:** Single-visit treatment using 5.25 % sodium hypochlorite (NaOCl) irrigant.
- **Group B:** Single-visit treatment using 2 % chlorhexidine (CHX) irrigant.
- **Group C:** Multiple-visit treatment using 5.25 % NaOCl.
- **Group D:** Multiple-visit treatment using 2 % CHX.

Clinical Procedure

All treatments were performed by a single experienced endodontist to eliminate operator variability. Local anesthesia (2 % lidocaine with 1:80,000 epinephrine) was administered, and rubber dam isolation was achieved. After access cavity preparation, the working length was determined using an electronic apex locator and verified radiographically.

Canal preparation was carried out using ProTaper Universal rotary instruments up to size F2, following manufacturer instructions. Irrigation was performed with the assigned solution (NaOCl or CHX) delivered via a 30-gauge side-vented needle inserted 1 mm short of the working length. A total volume of approximately 10 mL per canal was used, replenished every 2 minutes during instrumentation.

For Groups A and B (single-visit), obturation was completed in the same appointment using cold lateral condensation of gutta-percha cones and AH Plus sealer. The access cavities were permanently restored with resin composite. For Groups C and D (multiple-visit), calcium hydroxide paste was placed as an intracanal medicament, and the tooth was sealed with temporary restorative material. After 7 days, the medicament was removed using the same irrigant, and the canals were obturated and permanently restored.

Postoperative Pain Assessment

Participants were instructed to record their pain using a 100-mm Visual Analogue Scale (VAS), where 0 = no pain and 100 = worst imaginable pain, at 6, 12, 24, 48, and 72 hours after treatment. They also documented any analgesic intake (ibuprofen 400 mg) and flare-ups (defined as severe pain or swelling requiring an unscheduled visit).

Statistical Analysis

Data were analyzed using SPSS version 26.0 (IBM Corp., USA). The incidence of postoperative pain among groups was compared using the Chi-square test. Mean VAS scores were compared using one-way ANOVA and Mann–Whitney U tests as appropriate. Two-way ANOVA was employed to assess the interaction between irrigant type and visit protocol. A p-value < 0.05 was considered statistically significant.

Results

1. Baseline Demographic and Clinical Characteristics

All 300 patients completed the study. The mean age of participants was **34.8 ± 9.6 years**, with no significant difference among groups (p = 0.72). The gender distribution (male : female ratio = 1 : 1.1) and distribution of tooth types (anterior vs posterior) were also comparable (p > 0.05). The

baseline VAS pain before treatment did not differ significantly (p = 0.63). These findings confirm successful randomization and homogeneity among groups.

Table 1. Baseline Demographic and Clinical Data

Parameter	Group A(n = 75)	Group B(n = 75)	Group C(n = 75)	Group D(n = 75)	*p*-value
Mean Age (years) ± SD	35.1 ± 9.4	34.6 ± 10.2	33.9 ± 8.8	35.4 ± 9.9	0.72 (NS)
Male : Female	38 : 37	36 : 39	37 : 38	35 : 40	0.89 (NS)
Anterior : Posterior teeth	22 : 53	21 : 54	20 : 55	23 : 52	0.84 (NS)
Baseline VAS (mm) ± SD	12.1 ± 8.6	11.5 ± 7.9	13.3 ± 9.1	12.7 ± 8.8	0.63 (NS)

NS = not significant.

2. Postoperative Pain Intensity at Different Time Intervals

The mean postoperative pain (VAS mm) at 6 h, 12 h, 24 h, 48 h, and 72 h showed a gradual decline in all groups (Table 2). At **6 h and 12 h**, mean pain scores were significantly higher in single-visit groups (A and B) than in multiple-visit groups (C and D) ($p < 0.05$). By 48 h and 72 h, the difference became statistically nonsignificant ($p > 0.05$). Among irrigants, NaOCl groups (A, C) showed slightly higher early pain scores than CHX groups (B, D), but the differences were small.

Table 2. Mean Postoperative Pain (VAS mm ± SD) Over Time

Time Post-Tx	Group A(Single + NaOCl)	Group B(Single + CHX)	Group C(Multi + NaOCl)	Group D(Multi + CHX)	*p*-value (ANOVA)
6 hours	38.2 ± 16.4	33.9 ± 14.2	28.7 ± 13.5	26.8 ± 12.1	0.001 *
12 hours	32.5 ± 14.8	29.3 ± 13.7	24.9 ± 12.2	23.5 ± 11.5	0.004 *
24 hours	25.1 ± 13.2	22.8 ± 11.8	20.2 ± 10.6	19.3 ± 10.1	0.058 (NS)
48 hours	17.5 ± 10.4	15.8 ± 9.9	14.9 ± 9.1	13.7 ± 8.8	0.29 (NS)
72 hours	9.6 ± 7.2	8.3 ± 6.9	8.1 ± 6.4	7.4 ± 6.2	0.56 (NS)

Significant at $p < 0.05$.

3. Incidence of Postoperative Pain and Analgesic Intake

The incidence of any postoperative pain (VAS > 0 mm) was higher in single-visit groups (A = 56 %, B = 52 %) than in multiple-visit groups (C = 41 %, D = 39 %), achieving statistical significance ($p = 0.037$). However, the need for analgesics was low and comparable among groups ($p = 0.21$). No severe flare-ups or swelling requiring emergency visits were recorded.

Table 3. Incidence of Pain and Analgesic Use

Outcome	Group A	Group B	Group C	Group D	*p*-value (χ^2)
Pain present (VAS > 0 mm) n (%)	42 (56 %)	39 (52 %)	31 (41 %)	29 (39 %)	0.037 *
Analgesic used (Yes) n (%)	17 (23 %)	15 (20 %)	12 (16 %)	11 (15 %)	0.21 (NS)
Flare-up requiring visit n (%)	1 (1.3 %)	1 (1.3 %)	0	0	0.58 (NS)

Significant at $p < 0.05$.

4. Comparison of Mean Pain Scores Between Irrigants and Visit Protocols

Two-way ANOVA showed a **significant main effect of number of visits** on pain (F = 6.18, p = 0.014) and a **borderline nonsignificant effect of irrigant type** (F = 2.77, p = 0.097). The **interaction effect** between irrigant and number of visits was not significant (p = 0.41). Thus, the number of visits primarily influenced postoperative pain intensity, while irrigant type had a minor, non-significant effect.

Table 4. Two-Way ANOVA for Mean Pain Scores (24-Hour VAS)

Source of Variation	df	Mean Square	F-value	*p*-value
Visit Type (Single vs Multiple)	1	712.4	6.18	0.014 *
Irrigant (NaOCl vs CHX)	1	319.7	2.77	0.097 (NS)
Interaction (Visit × Irrigant)	1	141.8	1.12	0.41 (NS)
Error	296	115.3	—	—

Significant at $p < 0.05$.

Discussion

In the present randomized clinical trial, postoperative pain was significantly higher in single-visit root canal treatments compared to multiple-visit protocols during the first 12 hours after obturation, but the difference diminished by 24–48 hours. The type of irrigant—5.25 % sodium hypochlorite (NaOCl) or 2 % chlorhexidine (CHX)—showed only a minor, non-significant effect on pain intensity. These results align with previous systematic reviews indicating that the number of visits has minimal impact on overall postoperative pain but may influence early discomfort levels [11,12].

A recent meta-analysis of 29 randomized controlled trials reported no significant difference in postoperative pain between single- and multiple-visit root canal treatments (risk ratio = 0.99, 95 % CI 0.76–1.30) [13]. However, other studies found slightly higher early pain in single-visit procedures, particularly in cases with periapical lesions [14]. The transient increase in pain may be related to mechanical and chemical irritation from debris or irrigant extrusion during one-session preparation, which can stimulate periapical inflammation and nociceptor activation [15].

In our study, pain scores declined steadily across all groups, consistent with literature suggesting that endodontic pain typically peaks within 6–12 hours and resolves within 2–3 days [16]. The present findings also showed slightly higher mean pain scores in the NaOCl groups compared to CHX, although not statistically significant. Similar observations were reported in comparative clinical trials where NaOCl produced marginally higher early pain scores, possibly due to its tissue-dissolving and irritant potential [17]. Conversely, CHX has limited tissue dissolution but lower cytotoxicity, which might explain the reduced early discomfort [18].

The low incidence of flare-ups (< 2 %) and limited need for analgesics in all groups demonstrate that both protocols are clinically safe and well tolerated. These outcomes correspond to prior evidence indicating that flare-up rates rarely exceed 5 % in well-controlled single- or multi-visit root canal treatments [19]. Clinically, this supports the feasibility of either approach when aseptic technique and adequate irrigation are ensured.

Limitations include partial operator blinding (due to procedural constraints), restriction to single-canal teeth, and lack of stratification by preoperative pulpal status or apical periodontitis. Moreover, patient anxiety, tooth type, and preoperative pain—known predictors of postoperative discomfort—were not analyzed separately. Future studies with larger, stratified samples and advanced irrigation activation systems (ultrasonic, laser, or sonic) could clarify whether the transient pain differences persist when these variables are standardized [20].

Conclusion

Within the limitations of this trial, postoperative pain was slightly greater in single-visit root canal treatments during the first 12 hours but comparable to multiple-visit protocols thereafter. Irrigant type (5.25 % NaOCl vs 2 % CHX) had no significant effect on pain at any interval. Both approaches produced low flare-up rates and minimal need for analgesics, indicating their clinical safety. Therefore, while single-visit treatment offers time efficiency, a multiple-visit protocol may provide marginal short-term comfort benefits for pain-sensitive patients.

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References

1. Ng YL, Mann V, Rahbaran S, Lewsey J, Gulabivala K. Outcome of primary root canal treatment: systematic review of the literature – Part 1. Effects of study characteristics on probability of success. *Int Endod J.* 2007;40(12):921-939.
2. Siqueira JF Jr, Rôças IN, Favieri A, Lima KC. Chemomechanical reduction of the bacterial population in the root canal after instrumentation and irrigation with 1%, 2.5%, and 5.25% sodium hypochlorite. *J Endod.* 2000;26(6):331-334.
3. Pak JG, White SN. Pain prevalence and severity before, during, and after root canal treatment: a systematic review. *J Endod.* 2011;37(4):429-438.
4. Sathorn C, Parashos P, Messer HH. The prevalence of postoperative pain and flare-up in single- and multiple-visit endodontic treatment: a systematic review. *Int Endod J.* 2008;41(2):91-99.
5. Figini L, Lodi G, Gorni F, Gagliani M. Single versus multiple visits for endodontic treatment of permanent teeth. *Cochrane Database Syst Rev.* 2007;(4):CD005296.
6. Wong AWY, Zhang C, Chu C-H, et al. A systematic review of nonsurgical single-visit versus multiple-visit endodontic treatment. *Clin Cosmet Investig Dent.* 2014;6:45-56.
7. Nekoofar MH, et al. Comparison of single and multiple visit endodontic treatment: a systematic review and meta-analysis. *J Endod.* 2017;43(5):732-743.
8. AlRahabi MK. Evaluation of postoperative pain following single-visit and multiple-visit root canal treatment in infected root canals: a randomized clinical trial. *Eur J Dent.* 2017;11(4):559-564.
9. Mulay S, Ali SG, Sejpal D, Palekar A. Incidence of flare-ups after single-visit versus multiple-visit endodontic treatment: a randomized clinical study. *J Conserv Dent.* 2012;15(3):237-240.
10. Mohammadi Z, Abbott PV. Antimicrobial substantivity of chlorhexidine and calcium hydroxide-containing medicaments in root canal dentin. *Aust Endod J.* 2009;35(1):31-35.
11. Siqueira JF Jr, Rôças IN. Mechanisms of endodontic pain: microbial and inflammatory interactions in periapical tissues. *Int Endod J.* 2014;47(7):611-619.
12. Ng YL, Glennon JP, Setchell DJ, Gulabivala K. Prevalence of and factors affecting postoperative pain in endodontic treatment. *Int Endod J.* 2004;37(6):381-391.
13. de Oliveira BP, Guerreiro-Tanomaru JM, Tanomaru-Filho M. Effect of irrigant activation techniques on postoperative pain in endodontic treatment: a systematic review. *Aust Endod J.* 2020;46(3):298-307.
14. Niazi SA, et al. Association between endodontic infection, its treatment and systemic implications. *Medicina (Kaunas).* 2022;58(7):931.
15. Holland R, de Souza V, Nery MJ, et al. Factors affecting the periapical healing process of endodontic lesions: a review. *Int Endod J.* 2017;50(9):800-807.
16. Shaik RP, Chukka RS, Bandlapally A, et al. Assessment of postoperative pain after single-visit root canal treatment using rotary and reciprocating file systems: an *in vivo* study. *J Dent Anesth Pain Med*. 2022;22(4):267-275. doi:10.17245/jdapm.2022.22.4.267
17. Alonso-Ezpeleta LO, Gasco-Garcia C, Castellanos-Cosano L, Martín-González J, López-Frías FJ, Segura-Egea JJ. Postoperative pain after one-visit root-canal treatment on teeth with vital pulps: 3 comparison of three different obturation techniques. Med Oral Patol Oral Cir Bucal. 2012;17:e721–e727. doi: 10.4317/medoral.17898
18. Goreva LA, Petrikas AZh. [Postobturation pain associated with endodontic treatment] Stomatologiia (Mosk) 2004;83:14–6
19. Makeeva IM, Turkina AIu. [Effects of the method of mechanical root canal treatment on emergence of pain after endodontic management] Stomatologiia (Mosk) 2005;84:21–3.
20. Seltzer S. Pain in endodontics. J Endod. 2004;30:501–3. doi: 10.1097/00004770-200407000-00010.