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Original Article

Effect of Occlusal Reduction on Post-Operative Pain Following Endodontic Therapy in Teeth with Symptomatic Apical Periodontitis: A Randomized Controlled Trial

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https://doi.org/10.52206/jsmc.2025.15.3.1233

Abstract

Background: Post-operative pain following root canal therapy presents a common clinical concern, particularly in patients with symptomatic apical periodontitis. Although various interventions, such as occlusal reduction, have been proposed to alleviate discomfort, their effectiveness remains inconclusive.

Objective: To assess the impact of occlusal reduction on post-operative pain intensity in patients with symptomatic apical periodontitis after the initiation of root canal therapy.

Methodology: This randomized controlled trial enrolled 60 patients aged 18 years and older, randomly assigned via the lottery method into two groups: occlusal reduction (OR) and no occlusal reduction (NOR). In the OR group, a 2 mm reduction of the occlusal surface was performed following canal cleaning and shaping. The NOR group underwent the same endodontic procedures without occlusal adjustment. Pain intensity was measured 24 hours post-treatment using the Visual Analog Scale (VAS). Pearson's chi-square test was applied to examine the relationship between patient characteristics and pain relief.

Results: Among the 60 participants (36.7% males, 63.3% females), pain relief was reported in 73.3% of the OR group and 63.3% of the NOR group. The difference in pain relief between the two groups was not statistically significant ($p > 0.05$). Additionally, no significant associations were found between pain relief and variables such as gender, age, or clinical condition.

Conclusion: Occlusal reduction did not produce a statistically significant difference in post-operative pain relief compared to no occlusal reduction in patients with symptomatic apical periodontitis. These findings suggest that occlusal reduction may not be essential in managing post-operative discomfort following initial root canal therapy.

Keywords: Apical Periodontitis, Occlusal Adjustment, Pain, Postoperative, Root Canal Therapy.

ISSN (P): 1819-4583
ISSN (E): 3007-9470

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Citation:
Qureshi A, Shah SA, Jahanzeb K. Effect of Occlusal Reduction on Post-Operative Pain Following Endodontic Therapy in Teeth with Symptomatic Apical Periodontitis: A Randomized Controlled Trial. *J Saidu Med Coll.* 2025;15(3):444–453.

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Funding:
The authors received no external funding for this study.

Conflicts of Interests:
The authors have declared that no competing interests exist.

Data Sharing Statement:
The data that support the findings of this study are available on request from the corresponding author. The data is not publicly available due to privacy or ethical restrictions.

Received: February 17, 2025
1st Revision: April 29, 2025
Accepted: May 17, 2025

Introduction

Root canal treatment is widely recognized as an effective intervention for managing teeth affected by various pulpal and periapical pathoses [1,2]. Despite its success, it is often associated with a higher incidence of post-operative pain (POP) compared to other dental procedures [3,4]. Numerous factors contribute to the occurrence of POP, including patient-related variables, operator technique, and tooth-specific characteristics [5]. Operator-related influences encompass the number of appointments and the choice of intra-canal medicaments and irrigants. Tooth-related factors include the type of tooth treated, the presence of periapical lesions, and sensitivity to percussion.

To mitigate POP, several strategies have been explored in endodontics, such as the administration of long-acting anesthetics, occlusal reduction, use of intracanal medicaments, and pre-operative medications including steroids, analgesics, and antibiotics [6–9]. However, many of these approaches are invasive or involve systemic drug use, underscoring the importance of adopting pain management strategies that are supported by strong clinical evidence [10,11].

Among these strategies, occlusal reduction has been extensively studied for its potential to alleviate discomfort following non-surgical root canal therapy (NSRCT). For instance, Zaman H et al. reported significantly lower POP levels in the occlusal reduction group (mean ± SD = 2.60 ± 0.70) compared to the non-reduction group (mean ± SD = 4.40 ± 0.97) [12]. Supporting this, a systematic review by Nguyen D et al. concluded that occlusal reduction reduces post-operative pain but stressed the necessity for further well-designed clinical trials [9]. Conversely, findings from Parirokh et al. indicated no statistically significant difference in pain relief between the occlusal reduction group (52.06%) and the non-reduction group (47.94%) [13]. Similarly, Raza et al. also found no significant benefit of occlusal reduction in reducing POP [14].

These inconsistencies in the literature contribute to ongoing uncertainty regarding the clinical efficacy of occlusal reduction. Moreover, the specific scenarios in which this technique may be most beneficial remain unclear. Therefore, further investigation into interventions that can effectively reduce POP after endodontic treatment is essential to support evidence-based clinical decision-making.

The present study aims to evaluate whether occlusal reduction significantly reduces post-operative pain in teeth diagnosed with symptomatic apical periodontitis (SAP) undergoing two-stage non-surgical root canal therapy.

Methodology

Trial Design

This study was a single-blinded, parallel-group, randomized controlled clinical trial conducted at the Department of Operative Dentistry and Endodontics, Rehmat Memorial Dental Teaching Hospital, Abbottabad, Pakistan. The trial adhered to the principles of the Declaration of Helsinki and followed the Consolidated Standards of Reporting Trials (CONSORT) guidelines. Ethical approval was granted by the Institutional Review Board (Ref. no. RMDTH/EC/2083). The trial was prospectively registered with the Iranian Registry of Clinical Trials (IRCT20171123037603N1). Data collection was carried out over a six-month period from August 2023 to January 2024.

Participants

A total of 60 participants aged 18 years and above were recruited using simple random sampling. Inclusion criteria comprised patients of either gender presenting with posterior teeth diagnosed with symptomatic apical periodontitis (SAP), as confirmed by clinical signs such as tenderness to percussion and palpation, alongside radiographic evidence. Only those reporting moderate to severe preoperative pain (Visual Analog Scale [VAS] score between 4–10) were included. Patients were excluded if they had no opposing tooth, presented with facial swelling, or had a sinus tract associated with the tooth in question.

Interventions

Participants were randomly allocated into two groups:

- Occlusal Reduction (OR) group: Underwent a 2 mm reduction of the occlusal surface using a high-speed handpiece with a water-cooled diamond flame-shaped bur.
- No Occlusal Reduction (NOR) group: Received no adjustment to the occlusal surface.

All endodontic procedures were performed over two visits by a single final-year resident in Operative Dentistry and Endodontics to maintain procedural consistency. During the first appointment, local anesthesia (2% lidocaine with 1:100,000 epinephrine, Medicaine®, Huons Co. Ltd., Korea) was administered, followed by working length determination using periapical radiographs. Biomechanical preparation included instrumentation up to size 20 K-file and coronal flaring with Gates-Glidden drills (sizes 1 and 2). Irrigation was performed with 1.3% sodium hypochlorite (Parcan®, Cedex 50, France), and the canals were sealed temporarily.

In the second appointment, canals were obturated with gutta-percha, and the access cavities were permanently restored. No occlusal adjustment was carried out in the NOR group. Patients were advised not to use analgesics during the first 24 hours post-treatment unless the pain was intolerable; any use of medication was documented.

Outcomes

The primary outcome was post-operative pain relief, assessed using a Visual Analog Scale (VAS) at 24 hours post-treatment. Pain relief was defined as a reduction of ≥3 points on the VAS compared to the baseline score. Patients were contacted by phone to ensure timely completion of the VAS and were asked to return the forms at their next visit on post-operative day three. Outcome evaluation was conducted by an independent, blinded assessor who was unaware of the group allocation.

Sample Size

The sample size of 60 patients (30 in each group) was calculated using the WHO sample size calculator. The calculation was based on anticipated mean post-operative pain scores of 2.60 ± 0.70 in the OR group and 4.40 ± 0.97 in the NOR group, with a significance level of 5% and power of 80%.

Randomization

Participants were randomized into the two intervention groups using a computer-generated random number table (www.randomizer.org). Allocation was done without concealment; however, the pain outcome assessment was performed by a blinded evaluator to minimize assessment bias.

Blinding

The study employed a single-blind design. While the operator performing the intervention was necessarily aware of the group allocation, the patients were not informed of their group assignment. Importantly, the outcome assessor who recorded and analyzed pain scores was blinded to the intervention status of participants.

Ethics

Ethical clearance for this trial was obtained from the Institutional Review Board of Rehmat Memorial Dental Teaching Hospital (Ref. no. RMDTH/EC/2083). Written informed consent was obtained from all participants before their inclusion in the study. All procedures complied with the ethical standards outlined in the 1964 Declaration of Helsinki and its later amendments.

Statistical Methods

Data were analyzed using SPSS version 21.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize patient demographics and pain outcomes, expressed as frequencies, percentages, means, and standard deviations. The Pearson's chi-square test was applied to assess associations between categorical variables (e.g., age, gender, group allocation) and the primary outcome of pain relief. A p-value ≤ 0.05 was considered statistically significant.

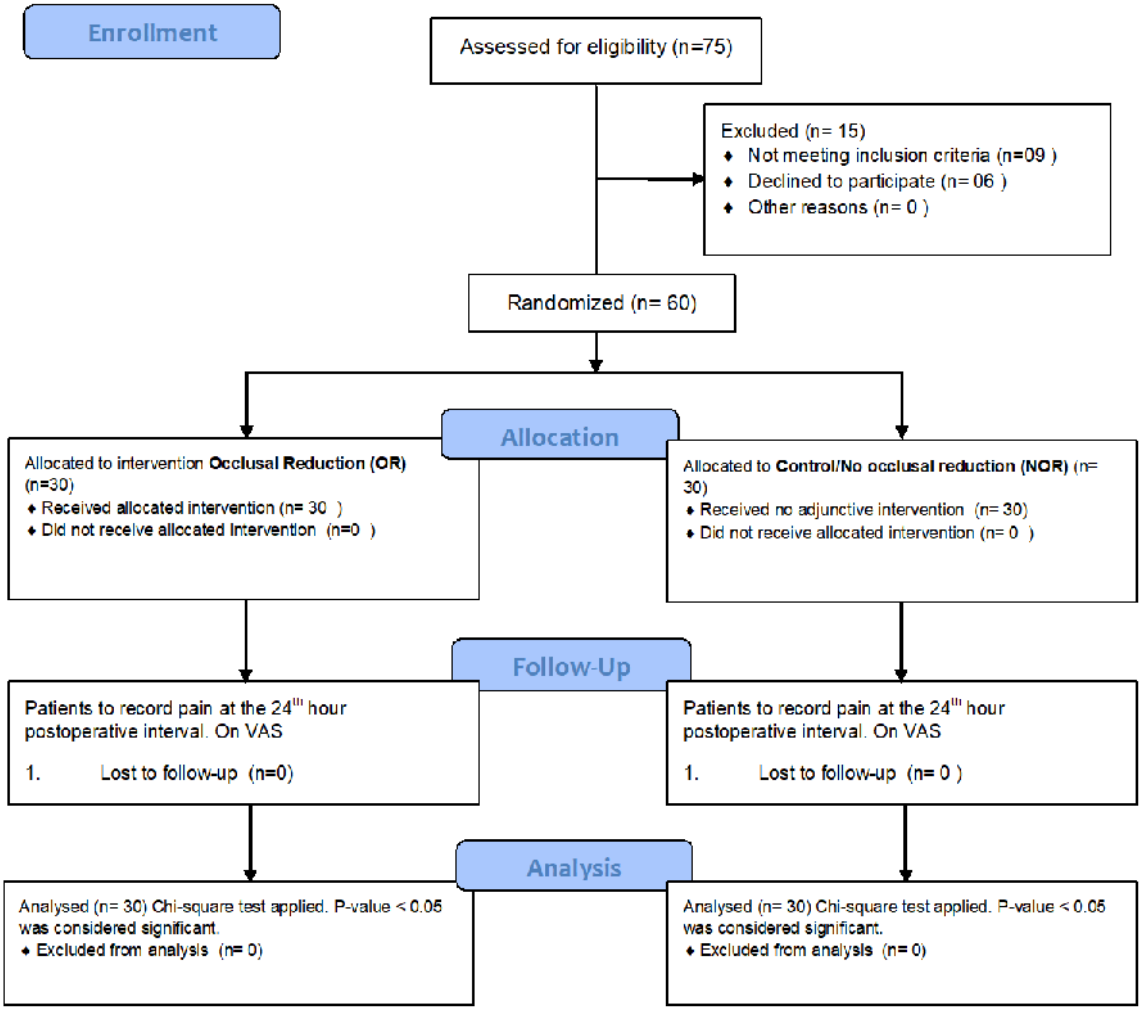


Figure 1: CONSORT Flow Diagram

Results

Recruitment

A total of 60 participants were enrolled and completed the study between August 2023 and January 2024. All participants met the eligibility criteria, and no dropouts or withdrawals occurred during the course of the trial. The final sample included 22 males (36.7%) and 38 females (63.3%). Figure 2 illustrates the distribution of pain relief outcomes between the two study groups.

Baseline Data

The mean age of the study population was concentrated in the 18–30 years age group (36.7%), followed by 31–40 years (30.0%), 41–50 years (21.7%), and 51–60 years (11.7%). Equal numbers of participants were assigned to the occlusal reduction (OR) group and the no occlusal reduction (NOR) group (n = 30 each), ensuring a balanced comparison. The baseline mean pre-operative pain score (VAS) across all patients was 4.93 ± 1.18, indicating moderate to severe pain levels at presentation. Table 1 provides a comprehensive overview of the demographic and baseline clinical characteristics of the participants.

Numbers Analyzed

All 60 randomized patients were included in the final analysis (n = 30 in each group). There were no exclusions due to protocol deviations, non-compliance, or loss to follow-up. Pain relief was defined as a reduction of ≥3 points on the VAS compared to baseline and was analyzed in relation to age, gender, and intervention group.

Outcomes and Estimation

The overall post-operative pain relief rate was 68.3% (n = 41). A significant reduction in mean pain scores was observed from pre-operative (mean ± SD = 4.93 ± 1.18) to post-operative levels (mean ± SD = 3.45 ± 1.45). Pain relief was more frequently reported in the OR group (73.3%) than in the NOR group (63.3%).

Gender-wise, 77.3% of male participants reported pain relief, compared to 63.2% of females. Among age groups, those aged 31–40 years showed the highest proportion of pain relief (72.2%), while the 18–30 years group reported the lowest (63.6%). However, none of these differences reached statistical significance, as shown in Table 2. The Chi-square analysis revealed no significant association between pain relief and gender (p = 0.257), age group (p = 0.977), or group allocation (p = 0.405).

Ancillary Analyses

No additional subgroup or per-protocol analyses were performed beyond the predefined comparisons. However, visual inspection of the data suggested a trend toward better outcomes in the occlusal reduction group, particularly among males and middle-aged adults, which may warrant further exploration in larger trials.

Harms

No adverse events or harms related to either occlusal reduction or endodontic treatment procedures were reported during the study period. All patients tolerated the interventions well, and none required emergency care or additional treatment beyond the study protocol.

Table 1: **Baseline Demographic and Clinical Characteristics of Study Participants (N = 60)**

Variables		N (%)
Gender	Male	22 (36.7)
	Female	38 (63.3)
Age Group (years)	18–30	22 (36.7)
	31–40	18 (30.0)
	41–50	13 (21.7)
	51–60	7 (11.7)
Study Group	No Occlusal Reduction	30 (50.0)
	Occlusal Reduction	30 (50.0)
Pre-operative Pain Score (VAS); Mean±SD		4.93 ± 1.18
Post-operative Pain Score (VAS); Mean±SD		3.45 ± 1.45
Pain Relief	Yes	41 (68.3)
	No	19 (31.7)

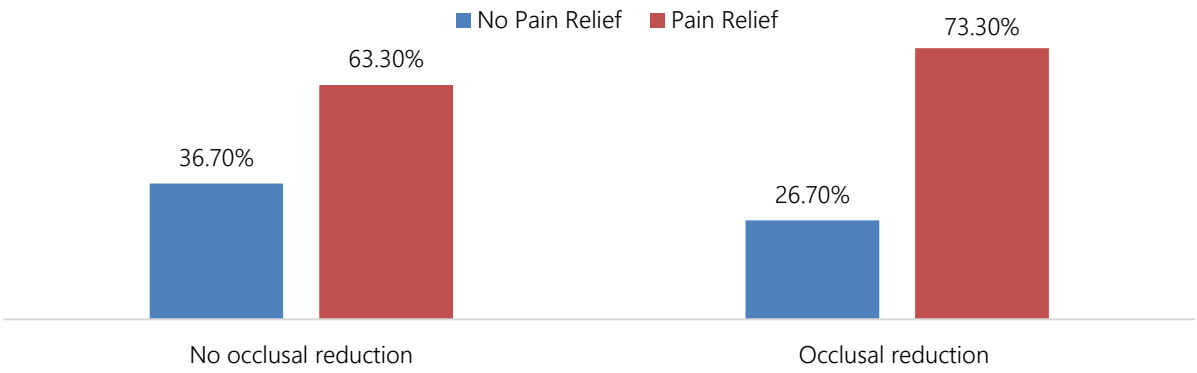


Figure 2: Distribution of Pain Relief Outcomes According to Intervention Group

Table 2: Association Between Patient Characteristics and Post-operative Pain Relief (N = 60)

Variables		Pain Relief		Chi-square (df)	p-value
		No n (%)	Yes n (%)		
Gender	Male	5 (22.7)	17 (77.3)	1.28 (1)	0.257
	Female	14 (36.8)	24 (63.2)		
Age Group (years)	18–30	8 (36.4)	14 (63.6)	0.39 (3)	0.977
	31–40	5 (27.8)	13 (72.2)		
	41–50	4 (30.8)	9 (69.2)		
	51–60	2 (28.6)	5 (71.4)		
Study Group	No Occlusal Reduction	11 (36.7)	19 (63.3)	0.69 (1)	0.405
	Occlusal Reduction	8 (26.7)	22 (73.3)		

Discussion

The primary aim of this randomized controlled trial was to evaluate the effect of occlusal reduction on post-operative pain (POP) in patients diagnosed with symptomatic apical periodontitis (SAP). Our sample included 36.3% male and 63.6% female participants, reflecting regional trends where female patients more frequently seek endodontic care in dental institutions [18,19]. The observed reduction in mean Visual Analog Scale (VAS) scores from pre-treatment (mean ± SD = 4.93 ± 1.18) to post-treatment (mean ± SD = 3.45 ± 1.45) confirms the general effectiveness of non-surgical root canal therapy (NSRCT) in alleviating pain in SAP cases [20].

Although the overall frequency of pain relief was higher in the occlusal reduction (OR) group (73.3%) compared to the non-occlusal reduction (NOR) group (63.3%), this difference was not statistically significant. This is consistent with the findings of Raza I et al. [14], who also reported no significant difference in POP outcomes between the two groups. However, their study included patients with acute pulpitis, whereas ours focused exclusively on SAP, making direct comparisons somewhat limited. In another study by Arslan H et al., no influence of occlusal reduction on post-operative pain was observed [21]. Notably, their study design included routine prescription of analgesics post-treatment, which may have masked the true effect of occlusal reduction. The potential placebo or confounding effects of analgesics in clinical trials evaluating pain are well acknowledged in the literature [22].

In contrast, studies by Ahmed YE et al. and Emara RS et al. demonstrated statistically significant reductions in pain in patients who received occlusal reduction [23,24]. Emara RS et al. highlighted that the significant difference was most pronounced within the first 12 hours post-procedure, suggesting that the timing of pain evaluation plays a critical role. Ahmed YE et al. reported a 25% reduction in pain at 24 hours despite providing

analgesics to all patients, implying that pharmacological management may have influenced the outcomes [24].

The issue of POP management remains a topic of clinical relevance and debate. Historical surveys by the American Board of Endodontists illustrate evolving trends in clinical practice regarding occlusal reduction. While 80% of practitioners reported performing occlusal reduction for apical periodontitis cases in 1977, this figure dropped to 73.2% in a follow-up survey conducted over a decade later [26]. This decline likely reflects increasing skepticism due to emerging evidence questioning its clinical value. A recent systematic review concluded that occlusal reduction does not significantly impact POP outcomes and rated the quality of evidence as moderate using the GRADE criteria [27]. The review also identified methodological flaws in earlier studies, such as lack of blinding and limited focus on SAP-specific populations. As such, the role of occlusal reduction in POP management remains unresolved, emphasizing the need for further high-quality trials.

Gender-based differences in pain relief were also noted in our study, with males reporting a higher frequency of pain relief (77.3%) than females (63.2%). Although this difference was not statistically significant, it aligns with literature suggesting that women may report greater post-endodontic discomfort, possibly due to hormonal influences and differences in pain perception [28,29]. However, other studies have similarly found no consistent correlation between gender and POP outcomes, indicating that any observed gender differences may not hold clinical relevance [30,31].

In terms of age-related trends, the greatest pain reduction was observed in the 31–40 years age group, while the lowest was in the 18–30 years cohort. This pattern, although not statistically significant, could be due to individual variability in pain thresholds, recovery capacity, or inflammatory responses. Some reviews suggest that younger patients tend to report greater pain relief due to higher healing capacity and better blood flow, but the evidence remains inconclusive [28]. Overall, the findings underscore the complex interplay of demographic and biological factors in POP, as highlighted in systematic reviews calling for further trials with more robust and standardized methodologies [7,9,32].

It is also important to consider the potential impact of analgesic use on pain reporting. While our protocol discouraged analgesic use within the first 24 hours, rescue medication was allowed in cases of unbearable pain. This may have introduced some variability in the reported VAS scores. Future trials should consider implementing standardized analgesic protocols or controlling for analgesic intake to better isolate the effect of occlusal reduction on pain outcomes.

Limitations

Despite the strengths of this randomized controlled trial, several limitations must be acknowledged. First, although outcome assessment was performed by an independent and blinded evaluator, the operator conducting the procedures could not be blinded due to the nature of the intervention, potentially introducing performance bias. Second, the sample size, although statistically justified, was modest and may have limited the power to detect small but clinically meaningful differences. Third, the follow-up period was limited to 72 hours, which may not capture delayed pain or healing patterns associated with endodontic treatment. Additionally, analgesic use, although monitored, could not be fully controlled, possibly influencing pain perception and reporting. Finally, the study was conducted at a single center, which may limit generalizability to broader populations or different clinical settings. Future studies should aim for larger, multicenter designs with longer follow-up durations, stratified analyses, and controlled analgesic protocols to validate and expand upon these findings.

Conclusion

In summary, this study found no statistically significant difference in post-operative pain reduction between patients who received occlusal

reduction and those who did not. These findings suggest that occlusal reduction may not serve as a reliable adjunctive intervention for managing post-operative pain in cases of symptomatic apical periodontitis. Further large-scale, multicenter trials with standardized protocols are warranted to confirm these results and guide evidence-based clinical practice.

Authors' Contributions

All authors meet the ICMJE criteria for authorship. They have reviewed and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

Author 1: Substantial contribution to conception and design, drafting the manuscript, final approval, agreed to be accountable for all the work.
Author 2: Substantial contribution to conception and design, data acquisition, drafting the manuscript, final approval, agreed to be accountable for all the work.
Author 3: Analysis and interpretation of data, drafting the manuscript, final approval, agreed to be accountable for all the work.

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