



Original Research Article

A Comparative Evaluation of Postoperative Pain Following Endodontic Treatment With and Without Apical Patency in Asymptomatic Necrotic Teeth

Article History:

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Received: 12-10-2025

Revised: 05-11-2025

Accepted: 20-11-2025

Published: 24-12-2025

Abstract: Background: The maintenance of apical patency during endodontic treatment has been advocated to improve canal debridement and prevent blockage of the apical foramen. However, its influence on postoperative pain remains a subject of clinical interest, particularly in asymptomatic necrotic teeth undergoing root canal treatment. **Objectives:** To compare postoperative pain following endodontic treatment performed with and without apical patency in asymptomatic necrotic teeth. Study Design & Setting: This study was conducted in the Department of Operative Dentistry and Endodontics Shahida Islam Dental College Lodhran from Jan 2025 to June 2025.

Methodology: A total of 120 patients aged 18–60 years with asymptomatic necrotic permanent teeth requiring primary root canal treatment were enrolled and randomly allocated into two equal groups. Group A (n=60) underwent endodontic treatment with maintenance of apical patency, while Group B (n=60) underwent treatment without apical patency. Standardized instrumentation, irrigation, and obturation protocols were followed in both groups. Postoperative pain was assessed using the Visual Analog Scale (VAS) at 24 hours, 48 hours, and 7 days after treatment. Data were analyzed using SPSS version 26.0, and a p-value ≤ 0.05 was considered statistically significant. **Results:** The mean age of participants was 36.5 ± 10.9 years, and 55.0% were male. The apical patency group demonstrated significantly lower mean postoperative pain scores compared with the no apical patency group at 24 hours (2.83 ± 1.54 vs. 4.12 ± 1.87 ; $p < 0.001$), 48 hours (1.57 ± 1.18 vs. 2.68 ± 1.41 ; $p < 0.001$), and 7 days (0.27 ± 0.55 vs. 0.73 ± 0.88 ; $p = 0.001$). At day 7, 81.7% of patients in the apical patency group reported no pain compared with 63.3% in the no apical patency group ($p = 0.021$). **Conclusion:** Maintenance of apical patency during endodontic treatment of asymptomatic necrotic teeth was associated with significantly lower postoperative pain scores and a greater proportion of pain-free patients during follow-up.

Keywords: Apical patency, Asymptomatic necrotic teeth, Endodontic treatment, Postoperative pain, Root canal therapy, Visual analog scale.

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INTRODUCTION

Endodontic treatment is a well-established procedure aimed at eliminating infection from the root canal system and preserving natural teeth affected by pulpal and periapical diseases.¹ One of the procedural considerations during root canal therapy is the maintenance of apical patency, which involves the passive passage of a small flexible file slightly beyond the apical foramen to prevent the accumulation of dentinal debris and maintain canal cleanliness.² Although apical patency has been advocated to improve working length determination and facilitate canal debridement, its influence on postoperative pain remains a subject of clinical interest, particularly in teeth with pulpal necrosis.^{3,4}

Pulpal necrosis is a common consequence of untreated dental caries, trauma, and restorative procedures, contributing substantially to the global burden of oral disease. According to international epidemiological reports, apical periodontitis associated with necrotic pulps affects a considerable proportion of the adult population worldwide.⁵ The prevalence is particularly high in developing countries where delayed access to dental care and untreated carious lesions remain common. Root canal therapy therefore represents a significant component of contemporary dental practice aimed at managing these conditions and preventing tooth loss.⁶ The development of pulpal necrosis is primarily associated with microbial invasion of the pulp tissue. Factors such as deep dental caries, repeated restorative interventions, cracked teeth, traumatic injuries, and periodontal infections may contribute to pulpal degeneration and eventual necrosis. Patient-related factors including age, oral hygiene status, systemic health conditions, and the extent of microbial contamination may further influence treatment outcomes and postoperative symptoms.⁷

The pathophysiology of pulpal necrosis involves progressive inflammation, vascular compromise, and tissue breakdown within the pulp chamber. Subsequent bacterial colonization of the root canal system results in the release of microbial toxins and inflammatory mediators that may extend into the periapical tissues.⁸ During endodontic instrumentation, extrusion of debris, microorganisms, and irrigants beyond the apical foramen may

stimulate an inflammatory response, potentially contributing to postoperative pain. The practice of maintaining apical patency has been proposed to reduce debris accumulation within the canal; however, concerns remain regarding possible irritation of periapical tissues.⁹ Clinically, necrotic teeth may present as asymptomatic or symptomatic, with manifestations ranging from mild discomfort to severe pain and swelling. Asymptomatic necrotic teeth frequently exhibit no clinical symptoms despite the presence of underlying periapical pathology. If left untreated, complications such as chronic apical periodontitis, acute exacerbations, abscess formation, and eventual tooth loss may occur.^{10,11}

The effect of apical patency on postoperative pain following endodontic treatment remains controversial, with previous studies reporting inconsistent findings. Postoperative pain is an important outcome that directly influences patient comfort, satisfaction, and quality of life after root canal therapy. Limited local data are available regarding the impact of apical patency in asymptomatic necrotic teeth. Evaluating postoperative pain associated with this technique may help clinicians adopt evidence-based treatment protocols. The findings of this study may contribute to optimizing endodontic procedures and improving patient outcomes.

MATERIALS AND METHODS

This study was conducted at Department of Operative Dentistry and Endodontics Shahida Islam Dental College Lodhran from Jan 2025 to June 2025. The study design was a randomized controlled trial (RCT). A total of 120 patients requiring endodontic treatment for asymptomatic necrotic permanent teeth were enrolled in the study. The sample size of 120 patients was calculated using a 95% confidence level, 80% study power, and an anticipated difference in postoperative pain frequency between the two groups reported in previous literature.¹² To compensate for possible dropouts and ensure adequate statistical power, 120 patients were included in the final analysis. Randomization was performed using a computer-generated sequence. Due to the nature of the intervention, blinding of the operator was not feasible. This was an open-label trial; however, participants were not informed about the specific

significance of apical patency and were unaware of the study hypothesis. Postoperative pain assessment was based on self-reported Visual Analog Scale (VAS) scores, thereby minimizing the possibility of outcome assessor bias. Ethical approval for the study was obtained from the Institutional Ethical Review Committee prior to the commencement of the study, and all procedures were conducted in accordance with the principles of the Declaration of Helsinki.

Patients aged 18–60 years of either gender presenting with asymptomatic necrotic single-rooted permanent teeth requiring primary root canal treatment were included. Teeth exhibiting negative responses to pulp vitality tests and radiographic evidence consistent with pulpal necrosis were considered eligible. Patients with symptomatic teeth, acute apical abscess, swelling, systemic diseases affecting pain perception or healing, pregnancy, previous endodontic treatment, recent use of analgesics or antibiotics, and patients unwilling to participate were excluded from the study.

After obtaining written informed consent, demographic and clinical information was recorded. The patients were randomly allocated into two equal groups using a computer-generated randomization sequence. Group A consisted of 60 patients who underwent endodontic treatment with maintenance of apical patency, whereas Group B consisted of 60 patients who underwent endodontic treatment without maintenance of apical patency. All procedures were performed by the same experienced endodontist under local anesthesia and rubber dam isolation. Working length was determined using an electronic apex locator and confirmed

radiographically. In Group A, apical patency was maintained throughout instrumentation by gently passing a size #10 K-file approximately 0.5–1.0 mm beyond the apical foramen between successive instruments. In Group B, instrumentation was confined to the established working length without extending beyond the apical constriction. Root canal preparation was completed using a standardized rotary instrumentation system and irrigation protocol with sodium hypochlorite and normal saline. Following cleaning and shaping, canals were dried and obturated using gutta-percha and an endodontic sealer with the lateral condensation technique. A permanent coronal restoration was subsequently placed.

Postoperative pain was assessed using a 10-cm Visual Analog Scale (VAS), where 0 represented no pain and 10 represented the worst imaginable pain. Patients were instructed to record their pain intensity at 24 hours, 48 hours, and 7 days after treatment. The primary outcome measure was postoperative pain intensity following endodontic treatment. Data analysis was performed after completion of follow-up using coded records to reduce analytical bias.

Data were entered and analyzed using SPSS version 26.0. Quantitative variables such as age and pain scores were expressed as mean $\pm$ standard deviation, whereas qualitative variables such as gender and pain categories were presented as frequencies and percentages. Independent sample t-test was applied to compare mean pain scores between the groups, while chi-square test was used for categorical variables. A p-value of ≤ 0.05 was considered statistically significant.

RESULTS

The study included 120 participants equally distributed between the apical patency group (n=60) and the no apical patency group (n=60). The overall mean age of the participants was 36.5 ± 10.9 years, with mean ages of 35.8 ± 10.7 years and 37.1 ± 11.2 years in the apical patency and no apical patency groups, respectively. Most participants belonged to the 18–39 years age category (60.8%), while 39.2% were aged 40–60 years. Males constituted 55.0% of the study population and females 45.0%. The distribution of maxillary and mandibular teeth was equal (50.0% each), while anterior teeth accounted for 60.0% of cases and premolars for 40.0%. No statistically significant differences were observed between the two groups regarding age, gender, arch, or tooth type ($p > 0.05$), as given in Table 1.

The mean postoperative pain scores were significantly lower in the apical patency group compared with the no apical patency group at all follow-up intervals. At 24 hours, the mean pain score was 2.83 ± 1.54 in the apical patency group compared to 4.12 ± 1.87 in the no apical patency group ($p < 0.001$). At 48 hours, the mean pain scores decreased to 1.57 ± 1.18 and 2.68 ± 1.41 , respectively ($p < 0.001$). By the seventh day, the mean pain scores further declined to 0.27 ± 0.55 in the apical patency group and 0.73 ± 0.88 in the no apical patency group, with the difference remaining statistically significant ($p = 0.001$), as given in Table 2.

At seven days following treatment, the majority of participants reported no postoperative pain. Overall, 87 (72.5%) patients had a VAS score of 0, including 81.7% of patients in the apical patency group and 63.3% in the no apical patency group. Mild pain (VAS 1–3) was reported by 25.0% of participants, while moderate pain (VAS 4–6) was observed in only 2.5% of cases, all of whom belonged to the no apical patency group. No participant reported severe pain (VAS 7–10). The distribution of pain severity differed significantly between the study groups ($p = 0.021$), as given in Table 3.

Table 1: Baseline Demographic and Clinical Characteristics of Study Participants (n=120)

Variable	Type	Apical Patency (n=60)	No Apical Patency (n=60)	Total (n=120)	p-value
Age (years)	Mean $\pm$ SD	35.8 $\pm$ 10.7	37.1 $\pm$ 11.2	36.5 $\pm$ 10.9	0.512
	18–39 years, n (%)	38 (63.3)	35 (58.3)	73 (60.8)	0.575
	40–60 years, n (%)	22 (36.7)	25 (41.7)	47 (39.2)	
Gender	Male, n (%)	34 (56.7)	32 (53.3)	66 (55.0)	0.712
	Female, n (%)	26 (43.3)	28 (46.7)	54 (45.0)	
Arch	Maxillary Teeth, n (%)	31 (51.7)	29 (48.3)	60 (50.0)	0.714
	Mandibular Teeth, n (%)	29 (48.3)	31 (51.7)	60 (50.0)	
Tooth Type	Anterior Teeth, n (%)	37 (61.7)	35 (58.3)	72 (60.0)	0.705
	Premolars, n (%)	23 (38.3)	25 (41.7)	48 (40.0)	

Table 2: Comparison of Mean Postoperative Pain Scores (VAS) Between Study Groups

Follow-up Interval	Apical Patency (n=60) Mean $\pm$ SD	No Apical Patency (n=60) Mean $\pm$ SD	p-value
24 Hours	2.83 $\pm$ 1.54	4.12 $\pm$ 1.87	<0.001
48 Hours	1.57 $\pm$ 1.18	2.68 $\pm$ 1.41	<0.001
7 Days	0.27 $\pm$ 0.55	0.73 $\pm$ 0.88	0.001

Table 3: Severity of Postoperative Pain at 7 Days According to VAS Categories (n=120)

Pain Category	Apical Patency (n=60)	No Apical Patency (n=60)	Total (n=120)	p-value
No Pain (VAS=0)	49 (81.7%)	38 (63.3%)	87 (72.5%)	0.021
Mild Pain (VAS 1–3)	11 (18.3%)	19 (31.7%)	30 (25.0%)	
Moderate Pain (VAS 4–6)	0 (0.0%)	3 (5.0%)	3 (2.5%)	
Severe Pain (VAS 7–10)	0 (0.0%)	0 (0.0%)	0 (0.0%)	

DISCUSSION

Endodontic treatment is a widely performed procedure aimed at eliminating infection and preserving teeth affected by pulpal necrosis. Apical patency refers to the maintenance of canal openness by passing a small file slightly beyond the apical foramen during instrumentation. This technique has been proposed to improve debris removal and maintain working length accuracy. However, concerns remain regarding its potential effect on postoperative pain due to possible irritation of periapical tissues. Postoperative pain is a common outcome following root canal treatment and may influence patient satisfaction and treatment acceptance. Therefore, evaluation of postoperative pain associated with apical patency remains clinically relevant in the management of asymptomatic necrotic teeth.

Postoperative pain remains one of the most important clinical outcomes following endodontic treatment, and the effect of maintaining apical patency on postoperative discomfort continues to be debated. In the present study, patients treated with apical patency demonstrated significantly lower mean postoperative pain scores compared with those treated without apical patency at all follow-up intervals. At 24 hours, the mean pain score was 2.83 ± 1.54 in the apical patency group versus 4.12 ± 1.87 in the no apical

patency group ($p < 0.001$). Similarly, at 48 hours, pain scores were 1.57 ± 1.18 and 2.68 ± 1.41 , respectively ($p < 0.001$), while at 7 days the scores further decreased to 0.27 ± 0.55 and 0.73 ± 0.88 ($p = 0.001$). Furthermore, 81.7% of patients in the apical patency group reported complete absence of pain at day 7 compared with 63.3% in the no apical patency group ($p = 0.021$). These findings suggest that maintenance of apical patency was associated with improved postoperative comfort and faster pain resolution.

Our findings are generally consistent with those reported by Ajmal et al. (2021), who conducted a randomized controlled trial on 240 patients with necrotic teeth and asymptomatic apical periodontitis. They observed lower postoperative pain in the apical patency group, with 65.0% versus 55.83% of patients reporting no pain at 24 hours and 84.17% versus 81.67% reporting no pain at 48 hours. Although their differences were not statistically significant ($p = 0.345$ and $p = 0.649$, respectively), the trend favored apical patency, which is in agreement with our findings showing consistently lower pain scores in the apical patency group.¹⁵

The present results also support the observations of Arora et al. (2016), who reported an overall postoperative pain incidence of 43%. They found that pain occurred in 34% of patients treated with apical patency compared with 52% in the non-patency

group, although the difference did not reach statistical significance ($P=0.163$).¹⁶ Similar to their findings, our study demonstrated a lower burden of postoperative pain among patients receiving apical patency. The consistency between both studies suggests that maintenance of patency may contribute to reduced postoperative discomfort even when statistical significance is not always demonstrated.

A particularly close agreement was observed with the study by Yaylali et al. (2018), who reported significantly lower VAS pain scores in the apical patency group during the first five postoperative days ($P<0.05$). Their mean VAS scores at 12 and 24 hours were 42.90 mm and 37.78 mm in the apical patency group compared with 64.46 mm and 65.74 mm in the non-patency group. They further noted that postoperative pain increased between 12 and 24 hours in the non-patency group while decreasing in the apical patency group. Similarly, our study demonstrated significantly lower pain scores in the apical patency group at 24 hours, 48 hours, and 7 days.¹⁷

Our findings are also supported by the observations of Arias et al., who reported significantly less post-endodontic pain when apical patency was maintained in non-vital teeth. They concluded that maintenance of apical patency did not increase the incidence, degree, or duration of postoperative pain. The significant reduction in pain scores observed in our study further reinforces their conclusion and suggests that maintaining patency may facilitate more effective canal debridement without increasing periapical irritation.^{18,19}

In contrast, our findings differ from those reported by Waseem et al. (2022), who evaluated 280 patients divided equally into two groups. They found no statistically significant difference in postoperative pain between the groups at any follow-up interval. At 6 hours, pain was reported by 123 patients in group A and 119 patients in group B, while at 24 hours pain was reported by 113 and 105 patients, respectively. By the seventh day, only 8 and 7 patients in the respective groups continued to experience pain.²⁰ A notable contradiction was observed when comparing our findings with those of Akbar et al. (2025). In their randomized controlled trial involving 60 patients, overall postoperative pain occurred in 35% of cases, with similar incidence in the apical patency and non-patency groups (36.6% versus 33.3%; $p=0.787$). Furthermore, they reported significantly higher mean pain scores during the first five postoperative days in the apical patency group and a greater proportion of patients requiring analgesics (16.7% versus 10%).²¹ These findings contrast with the present study, where postoperative pain was consistently lower among patients treated with apical patency.

Study Limitations

This study was conducted at a single center, which may limit the generalizability of the findings. Postoperative pain assessment was based on patient-reported Visual Analog Scale scores, which may be influenced by subjective perception. In addition, the follow-up period was limited to seven days and did not evaluate long-term treatment outcomes. In addition, the follow-up period was limited to seven days and therefore only assessed short-term postoperative pain outcomes without evaluating long-term periapical healing. Future studies with extended follow-up periods, including 30-day clinical assessment for symptom resolution and 6-month radiographic evaluation for apical healing, are recommended to provide a more comprehensive assessment of treatment outcomes.

CONCLUSION

Maintenance of apical patency during endodontic treatment was associated with significantly lower postoperative pain scores compared with treatment without apical patency. Patients in the apical patency group experienced a greater reduction in pain throughout the follow-up period. These findings suggest that maintaining apical patency may contribute to improved postoperative comfort in asymptomatic necrotic teeth undergoing root canal treatment.

Acknowledgement: We sincerely acknowledge the support and guidance of our mentors, colleagues, and the staff of the participating hospital for their valuable assistance throughout this study.

Conflict of Interest: No

Funding Disclosure: None

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