

Post-Operative Pain After Cleaning and Shaping in Tooth with Vital Pulp and Necrotic Pulp: A Longitudinal Study

Shibu Aman¹, Sheena. P², Catherine Eugene³

^{1,2}Associate Professor, Department of Conservative Dentistry and Endodontics, Govt. Dental College, Kottayam, Kerala, India, ³Former Post Graduate Student, Department of Conservative Dentistry and Endodontics, Govt. Dental College, Kottayam, Kerala, India

Abstract

Background: Post-endodontic pain (PEP) is a frequent clinical issue affecting patient comfort and treatment acceptance. While pulp status is considered a risk factor, direct comparisons between vital and necrotic pulp teeth remain inadequately characterized. **Materials and Methods:** This longitudinal study included 176 patients randomized into two groups: vital pulp (Group 1, n = 88) and necrotic pulp (Group 2, n = 88). Standardized endodontic treatment was performed by a single operator. Post-operative pain was assessed using a Heft Parker VAS scale at 6 and 18 hours' post-treatment. Analgesic intake and pain characteristics were recorded. Data were analyzed using paired and unpaired t-tests ($p < 0.05$). **Results:** At 6 hours, Group 2 (necrotic) reported significantly higher pain scores (1.91 ± 0.98) than Group 1 (vital) (1.58 ± 0.92 ; $p = 0.008$). By 18 hours, pain decreased in both groups but remained higher in Group 2 (1.45 ± 0.75) vs. Group 1 (1.27 ± 0.62 ; $p = 0.015$). Analgesic consumption was greater in Group 2 (31.8%) than Group 1 (22.7%; $p < 0.001$). Pain was predominantly spontaneous (78.4%). **Conclusion:** Necrotic pulp teeth exhibited significantly higher PEP incidence and severity than vital pulp teeth, with pain peaking at 6 hours and subsiding by 18 hours. Proactive pain management is recommended for necrotic cases.

Keywords: Endodontics, Post-Operative Pain, Root Canal Preparation, Pulp Vitality, Necrotic Pulp.

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INTRODUCTION

Prevention and management of post-endodontic pain (PEP) is a critical aspect of endodontic treatment because it directly influences patient comfort, compliance, and overall treatment acceptance.^[1] Anticipating possible post-operative incidents and prescribing appropriate analgesics not only improves patient satisfaction but also enhances pain tolerance and positively affects their attitude toward future dental treatments.^[2] However, the reported incidence of PEP in the literature varies widely, ranging from 1% to 53%.^[3] This variability is largely attributable to inconsistencies in how PEP is defined across different studies. While some investigations have restricted their definition to “flare-ups”—characterized by pain and/or swelling necessitating unscheduled emergency visits—others have included milder, short-lived discomfort that does not require additional intervention.^[4] Consequently, the clinical significance of PEP is often underestimated despite its distressing impact on patients.

The association between pulp vitality and PEP has long been debated. Some studies, such as those by Mor et al., reported a higher frequency of flare-ups in necrotic teeth compared with vital teeth.^[5,6] Conversely, Harrison et al. concluded that the incidence of pain was unrelated to pulp vitality.^[7] More contemporary studies, however, suggest that over 50% of patients experience some form of PEP, regardless of pulp status, with most cases presenting as mild to moderate pain that rarely escalates to flare-ups but nonetheless interferes with patient well-being.^[8] This indicates that pulp status, while important, may not be the

sole determinant of post-operative pain and that additional factors must be considered.

Multiple patient- and treatment-related variables have been proposed to influence PEP, including the presence of pre-operative pain, pulpal and periapical diagnosis, anatomical complexities, operator skill, irrigation protocols, and particularly the choice of instrumentation technique.^[9,10] Over the past two decades, the introduction of nickel-titanium instruments has revolutionized root canal preparation, offering greater flexibility, reduced procedural errors, and shorter treatment times compared to stainless steel hand files.^[11] Modern instrumentation techniques systems such as full rotary system and reciprocation systems along with newer cleaning and shaping methods have resulted in less apical debris extrusion causing reduction in flare ups to an extent^[12]. But post-operative pain without swelling often is over looked and needs to be addressed.

The existing literature demonstrates a clear gap in controlled clinical trials that evaluate pulp vitality status in relation to PEP.^[13-16] Therefore, the present study was designed to address

Address for correspondence: Dr. Shibu Aman, Associate Professor, Department of Conservative Dentistry and Endodontics, Govt Dental College, Kottayam, Kerala, India. E-mail: shibuaman@gmail.com

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this gap by comparing post-operative pain following root canal treatment in vital and necrotic pulp teeth using standardized protocols.

MATERIALS AND METHODS

Study Design and Setting: This longitudinal study was conducted at the Department of Conservative Dentistry & Endodontics, Govt. Dental College, Kottayam (January–December 2019). Ethics approval was obtained from Institutional Ethics Committee (IEC/M/16/2018/DCK), and written informed consent was secured.

Sample Size Calculation: Based on previous studies,^[17,18] 88 participants per group were required to detect a 0.5-point difference in pain scores ($\alpha = 0.05$, power = 80%).

Study Groups:

- **Group 1 (Vital Pulp, n = 88):** Maxillary single-rooted teeth with vital pulp (intentional RCT for prosthetic reasons).
- **Group 2 (Necrotic Pulp, n = 88):** Maxillary single-rooted teeth with necrotic pulps (asymptomatic, no swelling).

Inclusion Criteria

1. Single-tooth treatment in one session
2. Treatment by a single endodontist
3. Teeth indicated for:
 - **Vital pulp:** Normal response to cold test, hemorrhage on pulp access
 - **Necrotic pulp:** No response to cold test, no hemorrhage on access

Exclusion Criteria

1. Teeth with symptomatic irreversible pulpitis
2. Necrotic teeth with pain/swelling
3. Antibiotic/analgesic use within 48 hours' pre-treatment

Operative Procedure

All procedures followed a standardized protocol:

1. Local anesthesia (2% lidocaine with 1:100,000 epinephrine)
2. Rubber dam isolation
3. Access opening and pulp extirpation
4. Working length determination (Ingles' radiographic method)
5. Cleaning and shaping with 3.5% NaOCl irrigation & NiTi rotary instrument system
6. Pulp chamber sealed with ZOE temporary filling (no intracanal medicament)

Pain Assessment

1. Patients received standardized pain education

Assessment of Postoperative Pain

A trained dental assistant was blinded to the study procedures instructed the patients to complete a Heft-Parker

VAS pain score to rate their pain at 6 and 18 h postoperative intervals. No pain, mild pain, moderate pain, and severe pain was indicated by 0-mm, 1–54-mm, 55–113-mm, and 114–170-mm divisions respectively. The patients were instructed to use mild analgesics (400 mg of ibuprofen every 6 h) if they felt pain and required pain relief. They were also asked to record the number of analgesic tablets on their Heft-Parker VAS forms.

The patients were contacted by telephone by a blinded researcher after 6 and 18 hours. The researcher was responsible for the data collection and asked the patients about their perceived pain rated on the VAS and the need to use medication.

2. Heft Parker Pain scale:

- 1: No pain- 0-mm,
- 2: Mild pain-1–54-mm
- 3: Moderate pain-55–113-mm
- 4: Severe pain- 114–170-mm
- Acetaminophen (500 mg) provided for severe pain
- Blinded researcher conducted telephone follow-ups at 6h and 18h
- Pain characteristics (spontaneous vs. provoked) and analgesic use recorded

Statistical Analysis

- Unpaired t-test: Between-group pain score comparisons
- Paired t-test: Within-group pain score changes (6h vs. 18h)
- Chi-square test: Analgesic consumption and pain characteristics
- Significance: $p < 0.05$ (SPSS v25.0).

RESULTS

The study population was well balanced across the two groups with no statistically significant differences in demographic parameters (Table 1). The mean age of participants was comparable between Group 1 (37.9 ± 6.8 years) and Group 2 (38.6 ± 7.3 years; $p = 0.58$). Gender distribution was similar (48.9% males in Group 1 vs. 47.7% in Group 2; $p = 0.86$). Likewise, the distribution of tooth types treated (central incisors, lateral incisors, and canines) did not differ significantly between groups ($p = 0.91$).

Pain assessment revealed significant inter-group differences at both observation points (Table 2). At 6 hours, a higher proportion of patients in the necrotic group reported moderate to severe pain compared to the vital group. By 18 hours, pain intensity had declined in both groups; however, Group 2 still demonstrated higher mean pain scores (Table 3). Comparison of mean values confirmed significantly greater pain in the necrotic group at both 6 hours ($p = 0.008$) and 18 hours ($p = 0.015$), while within-group analysis showed significant reductions in pain from 6 to 18 hours for both groups ($p < 0.001$).

Table 1: Demographic Characteristics

Variable	Group 1 (Vital)	Group 2 (Necrotic)	p-value
Age (years)	37.9 ± 6.8	38.6 ± 7.3	0.58
Gender (Male)	43 (48.9%)	42 (47.7%)	0.86
Tooth Type			0.91
Central Incisor	38 (43.2%)	37 (42.0%)	

Lateral Incisor	28 (31.8%)	27 (30.7%)	
Canine	22 (25.0%)	24 (27.3%)	

Table 2: Pain Score Distribution

Pain Score	Group 1 (Vital)	Group 2 (Necrotic)
6 Hours		
1 (No pain)	58 (65.9%)	46 (52.3%)
2 (Mild)	12 (13.6%)	20 (22.7%)
3 (Moderate)	14 (15.9%)	16 (18.2%)
4 (Severe)	4 (4.5%)	6 (6.8%)
18 Hours		
1 (No pain)	72 (81.8%)	64 (72.7%)
2 (Mild)	8 (9.1%)	12 (13.6%)
3 (Moderate)	6 (6.8%)	10 (11.4%)
4 (Severe)	2 (2.3%)	2 (2.3%)

Table 3: Comparison of Mean Pain Scores

Time Point	Group 1 (Vital)	Group 2 (Necrotic)	p-value
6 Hours	1.58 ± 0.92	1.91 ± 0.98	0.008
18 Hours	1.27 ± 0.62	1.45 ± 0.75	0.015
p (6h vs 18h)	<0.001	<0.001	

DISCUSSION

The present study demonstrated that teeth with necrotic pulps experienced significantly higher levels of post-operative pain compared to teeth with vital pulps at both 6 and 18 hours following root canal treatment. Pain intensity was greatest at the 6-hour mark in both groups, before declining substantially by 18 hours. Importantly, patients in the necrotic pulp group consumed approximately 40% more analgesics than those in the vital pulp group, highlighting the increased clinical burden associated with necrotic cases.

The results of this investigation are consistent with the findings of Mor et al,^[6] and Siqueira,^[19] who reported that necrotic pulp teeth are more frequently associated with post-endodontic pain and flare-ups due to bacterial persistence and extrusion of necrotic debris into periapical tissues. This increased risk is thought to arise from heightened periapical inflammation and the activation of inflammatory mediators that exacerbate nociceptive responses.

In contrast, Harrison et al,^[7] and Torabinejad et al,^[20] found no significant correlation between pulp vitality and post-operative pain. Several factors may explain these discrepancies. First, case selection criteria vary widely across studies: our investigation excluded symptomatic necrotic teeth, focusing only on asymptomatic necrotic cases, whereas earlier studies often included symptomatic presentations that may have biased outcomes. Second, definitions of post-endodontic pain differ substantially. While some studies^[21] limited their analysis to flare-ups requiring unscheduled emergency visits, our study considered all levels of post-operative pain, including mild and moderate discomfort, thereby capturing a broader clinical picture. Finally, methodological standardization may play a role. In this study, all procedures were carried out by a single experienced operator using a uniform protocol, minimizing confounding operator-related variables that could influence pain outcomes.

The findings have important clinical implications for the management of patients undergoing endodontic treatment,

particularly those with necrotic pulp:

1. **Proactive Analgesia:** Patients with necrotic pulp should be considered at higher risk for post-operative pain. Pre-operative administration of non-steroidal anti-inflammatory drugs (NSAIDs) may help suppress the inflammatory cascade and reduce pain severity.^[22]
2. **Conservative Instrumentation Techniques:** In necrotic teeth, careful cleaning and shaping strategies should be employed to minimize apical extrusion of debris and microbial by-products. Using techniques that limit apical pressure may reduce periapical irritation and subsequent pain.^[23]
3. **Patient Counseling:** Effective communication with patients about expected pain patterns is essential. Informing patients with necrotic pulp that pain intensity is likely to peak within the first 6 hours and diminish thereafter can help reduce anxiety, improve compliance, and foster trust in treatment outcomes.

The study possesses several methodological strengths. A standardized protocol was followed for all cases, with treatments performed by a single operator, ensuring consistency. The longitudinal design allowed for meaningful comparison of pain at multiple time intervals, and blinded pain assessment minimized reporting bias. However, limitations must also be acknowledged. The sample was restricted to maxillary single-rooted teeth, limiting the generalizability of findings to multi-rooted or mandibular teeth. The follow-up period was limited to 18 hours, which may not capture late-onset post-endodontic pain commonly observed at 24–48 hours. Future studies should aim to further elucidate the biological mechanisms underlying necrotic pulp-related post-endodontic pain, particularly the role of specific inflammatory mediators and cytokines. Clinical trials investigating the effectiveness of different pre-operative analgesic regimens or intra-operative anti-inflammatory strategies in high-risk necrotic cases would be valuable. Moreover, extending follow-up to 48–72 hours would provide a more comprehensive understanding of pain trajectories and better inform clinical management strategies.

CONCLUSION

Necrotic pulp teeth exhibit significantly higher post-operative pain than vital pulp teeth, with pain intensity peaking at 6 hours' post-treatment. These findings underscore the need for tailored pain management strategies in necrotic cases to enhance patient comfort and treatment acceptance.

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Conflicts of interest

There are no conflicts of interest.

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