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Original Article

Post-Operative Pain Following Single Visit Endodontics in Vital and Non-Vital Teeth by Using M3 Larger Taper Gold File System.

Mahnoor Baloch[1], Dil Rasheed [2], Farzana Abdul Hayee[3], Iqra Saleem[4], Mehmooda Quttab Shah[5]

1. Post Graduate Resident / Registrar FCPS Operative Dentistry & Endodontics Combined Military Hospital, Quetta.
2. Classified Specialist FCPS Operative Dentistry & Endodontics Combined Military Hospital, Quetta.
3. Post Graduate Resident / Registrar FCPS Operative Dentistry & Endodontics Combined Military Hospital, Quetta.
4. Post Graduate Resident / Registrar FCPS Operative Dentistry & Endodontics Combined Military Hospital, Quetta.
5. Post Graduate Resident FCPS Operative Dentistry & Endodontics Sandeman Provincial Hospital, Quetta.

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Corresponding Author: Mahnoor Baloch

Postgraduate Resident / Registrar, FCPS Operative Dentistry & Endodontics, Combined Military Hospital, Quetta.

Email: mahnorb9@gmail.com

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ABSTRACT

Background: Root canal treatment can cause postoperative pain, which varies depending on pulpal status. This study evaluated the postoperative pain after single-visit endodontic treatment with the M3 Larger Taper Gold file system in vital and non-vital teeth.

Objective: To evaluate the intensity of postoperative pain and the need for analgesics in vital and non-vital teeth following single-visit endodontic treatment with the M3 Larger Taper Gold system.

Methodology: A Cross-Sectional Study was carried out on 173 patients who were treated with single-visit endodontics. Patients were classified into the vital tooth group (n=87) and the non-vital tooth group (n=86). Root canals were prepared using the M3 Larger Taper Gold rotary system, followed by irrigation, obturation, and coronal restoration during the same appointment. We used a numeric rating scale to assess pain at 6, 12, 24, 48, and 72 hours after surgery. Consumption of analgesics was also documented. The data were analyzed in SPSS using independent-samples t-tests and chi-square tests. A p-value <0.05 was considered statistically significant.

Results: The overall mean age was 36.8 ± 10.7 years. Mean age was 35.9 ± 10.2 years in vital and 37.7 ± 11.1 years in non-vital groups (p=0.276). Mean pain scores were significantly higher in non-vital teeth at 6 hours (3.8 ± 1.6 vs. 3.2 ± 1.4; p=0.012), 12 hours (3.2 ± 1.5 vs. 2.7 ± 1.3; p=0.018), 24 hours (2.4 ± 1.3 vs. 1.9 ± 1.1; p=0.009), 48 hours (1.4 ± 1.0 vs. 1.0 ± 0.9; p=0.006), and 72 hours (0.6 ± 0.7 vs. 0.4 ± 0.6; p=0.041). Analgesic use was also greater in non-vital teeth (p=0.021).

Conclusion: With SVE staggered at 3 months between visits, the M3 Larger Taper Gold system produced progressively less postoperative pain. Non-vital teeth showed significantly more pain and analgesic needs, especially during the early postoperative period.

INTRODUCTION

One of the most common complications following the completion of the root canal treatment is postoperative pain, which is one of the important factors to consider for patient comfort and satisfaction. While the primary purpose of endodontic therapy is to remove infection, inflammation, and pulpal disease, instrumentation of the root canal system may also transiently cause inflammation around the tooth apex and lead to pain or discomfort after the procedure. Several factors determine the degree of postoperative pain, such as the nature of the preoperative symptoms, the pulpal and periapical condition, the mechanical instrumentation, the irrigation, the obturation method, and extrusion of infected debris into the periapical tissues [1]. Periapical tissues may react very differently in vital and non-vital teeth. Vital teeth have inflamed, but still living, pulps; non-vital teeth have pulps that are generally dead, and they tend to be more likely to have some microbial contamination in the root canal system. A higher inflammatory response may occur after mechanical preparation because non-vital teeth contain microorganisms, inflammatory mediators, and necrotic tissue. Thus, comparing vital and non-vital teeth is clinically relevant for assessing endodontic treatment outcomes with respect to post-treatment pain [2,3]. Single-visit endodontics has gained in popularity because it enables the cleaning, shaping, obturation, and restoration to occur in one appointment. This method can help decrease the number of appointments, treatment costs, and the potential for interappointment contamination. But the pain after treatment is a concern after single-visit treatment, especially if the length of instrumentation is extensive in infected or necrotic canals. Therefore, it is crucial to prepare the canal walls properly to reduce the amount of microorganisms remaining in the root canal system while preserving its anatomical structure [4]. With the evolution of nickel-titanium rotary instruments, the efficiency and predictability of root canal preparation have significantly improved. Conventional hand instrumentation is less efficient than modern rotary instrumentation, which offers greater flexibility, better canal shaping, and reduced instrumentation time. The M3 Larger Taper Gold file system: a nickel-titanium rotary instrumentation heat-treated system that enables canal enlargement with large taper and canal centering with minimum procedures. Better flexibility and taper qualities could lead to preparation with fewer instruments and less chairside time [5]. Although rotary instrumentation is becoming more popular, postoperative pain cannot be attributed entirely to the instrumentation system. The amount of debris extruded apically, the condition of the pulp before treatment, canal morphology, working length, irrigation protocol, and operator technique can all affect postoperative symptoms. Thus, assessing postoperative pain based on pulpal status and the same instrumentation system provides clinically relevant information about patient outcomes [6]. Most often, numerical or visual analog scales are used to assess postoperative pain after endodontic treatment. Multiple postoperative assessments will enable assessment of an initial inflammatory response and the later resolution of symptoms. A clinically relevant measure of postoperative pain is analgesic use. In most cases, postoperative symptoms diminish gradually over the first day or two, but differences between vital and non-vital teeth may be apparent early in the postoperative period [7]. The purpose of the present study was to assess postoperative pain after 1-visit endodontic treatment with the M3 Larger Taper Gold file system and to compare postoperative pain intensity in vital and non-vital teeth. We also evaluated analgesic needs in the postoperative period. Awareness of these differences can help clinicians counsel patients about the symptoms they can expect after surgery and make treatment decisions. The results can also contribute to the body of knowledge on the clinical performance of modern rotary instrumentation systems for single-visit endodontics [8,9].

METHODOLOGY

Study Design & Setting

This cross-sectional study was conducted in the Department of Operative Dentistry and Endodontics, Combined Military Hospital, Quetta, from June to December 2025. Consecutive patients receiving a one-visit root canal were selected.

Participants

We included 173 patients who needed primary endodontic treatment of permanent teeth. Based on pulpal status, the participants were divided into two groups: 87 vital and 86 non-vital. Informed consent was obtained and written before treatment and post-treatment evaluation.

Sample Size

The sample size was determined using a standard formula for comparing two independent groups with a 95% confidence level, 80% statistical power, and an anticipated clinically meaningful difference in postoperative pain. We calculated a sample size of 173 participants to account for potential losses to follow-up, resulting in the final sample.

Inclusion Criteria

The study included patients with a permanent tooth needing primary root canal treatment aged 18–60 years. Eligible patients had teeth with adequate coronal structure for restoration and were willing to undergo a single-treatment visit and postoperative pain assessment.

Exclusion Criteria

Patients were excluded if they had a systemic disease that impacted their pain perception, healing, or any other reason, and if they were pregnant, had had previous endodontic treatment, a root fracture, severe periodontal disease, or a tooth requiring surgery. Those unable to complete the postoperative pain assessment were also excluded.

Diagnostic and Management Strategy.

Pulpal status was evaluated using clinical examination, thermal testing, percussion, palpation, and radiographic evaluation. The M3 Larger Taper Gold system was used for root canal preparation with standard irrigation and working-length protocols, and the teeth were obturated and crowned in the same sitting.

Postoperative Pain Assessment

At 6, 12, 24, 48, and 72 hours after treatment, pain intensity

was assessed on a standard numerical pain scale from 0 to 10, with 0 being no pain and 10 being the worst pain. Data were also collected to document any analgesics patients used during follow-up.

Statistical Analysis

SPSS was used to enter and analyze data. Continuous variables were reported as mean ± SD, and categorical variables as frequencies and percentages. For continuous variables, dependent-samples and independent-samples t-tests were used to compare variables between the vital and non-vital groups, respectively. For categorical variables, the chi-square test was used. A p-value <0.05 was considered to be significant.

Results

The study included 173 patients: 87 (50.3%) with vital teeth and 86 (49.7%) with non-vital teeth. The overall mean age was 36.8 ± 10.7 years. The mean age of patients with vital teeth was 35.9 ± 10.2 years, while that of patients with non-vital teeth was 37.7 ± 11.1 years, and this difference was not statistically significant (p=0.276). Both groups had a gradual reduction in postoperative pain over the 72 hours. The mean pain score in the non-vital group was significantly greater than in the vital group at 6 hours (3.8 ± 1.6 vs. 3.2 ± 1.4; p=0.012). Similar differences were observed at 12 hours (3.2 ± 1.5 vs. 2.7 ± 1.3; p=0.018) and 24 hours (2.4 ± 1.3 vs. 1.9 ± 1.1; p=0.009). At 48 hours, pain scores decreased to 1.4 ± 1.0 in non-vital teeth and 1.0 ± 0.9 in vital teeth (p=0.006). After 72 hours, pain was similar in both groups, but remained statistically significant (0.6 ± 0.7 vs 0.4 ± 0.6; p=0.041). Patients with non-vital teeth had significantly higher consumption of analgesics (p=0.021). Overall, non-vital teeth were associated with greater post-surgery discomfort, especially during the first 24 hours.

Table 1. Demographic and baseline characteristics of study participants

Variable	Vital teeth (n=87)	Non-vital teeth (n=86)	Total (n=173)	p-value
Age (years), mean ± SD	35.9 ± 10.2	37.7 ± 11.1	36.8 ± 10.7	0.276
Age 18–30 years, n (%)	31 (35.6)	27 (31.4)	58 (33.5)	0.584
Age 31–45 years, n (%)	38 (43.7)	36 (41.9)	74 (42.8)	0.816
Age >45 years, n (%)	18 (20.7)	23 (26.7)	41 (23.7)	0.349
Male, n (%)	47 (54.0)	48 (55.8)	95 (54.9)	0.813
Female, n (%)	40 (46.0)	38 (44.2)	78 (45.1)	0.813

Data are presented as frequency (%) or mean ± standard deviation (SD). The p-values represent comparisons between vital and non-vital tooth groups. A p-value <0.05 was considered statistically significant.

Table 2. Comparison of postoperative pain scores between vital and non-vital teeth

Postoperative time	Vital teeth (n=87), Mean ± SD	Non-vital teeth (n=86), Mean ± SD	Mean difference	p-value
6 hours	3.2 ± 1.4	3.8 ± 1.6	-0.6	0.012
12 hours	2.7 ± 1.3	3.2 ± 1.5	-0.5	0.018
24 hours	1.9 ± 1.1	2.4 ± 1.3	-0.5	0.009
48 hours	1.0 ± 0.9	1.4 ± 1.0	-0.4	0.006
72 hours	0.4 ± 0.6	0.6 ± 0.7	-0.2	0.041

Postoperative pain was assessed using a numerical rating scale from 0 (no pain) to 10 (worst possible pain). Values are presented as mean ± SD. We used an independent-samples t-test for comparison. Bold p-values indicate statistical significance (p<0.05).

Table 3. Distribution of postoperative pain severity according to pulpal status

Postoperative time	Pain category	Vital teeth n (%)	Non-vital teeth n (%)	p-value
6 hours	No/mild pain (0–3)	61 (70.1)	48 (55.8)	0.049
	Moderate/severe pain (4–10)	26 (29.9)	38 (44.2)	
12 hours	No/mild pain (0–3)	70 (80.5)	61 (70.9)	0.128
	Moderate/severe pain (4–10)	17 (19.5)	25 (29.1)	
24 hours	No/mild pain (0–3)	78 (89.7)	69 (80.2)	0.078
	Moderate/severe pain (4–10)	9 (10.3)	17 (19.8)	
48 hours	No/mild pain (0–3)	84 (96.6)	79 (91.9)	0.187
	Moderate/severe pain (4–10)	3 (3.4)	7 (8.1)	
72 hours	No/mild pain (0–3)	86 (98.9)	84 (97.7)	0.548
	Moderate/severe pain (4–10)	1 (1.1)	2 (2.3)	

Pain severity was categorized according to the numerical pain score, with scores 0–3 considered no/mild pain and scores 4–10 considered moderate/severe pain. Data are presented as frequency and percentage. A chi-square test was used. A p-value <0.05 was considered statistically significant.

Table 4. Postoperative analgesic requirement according to pulpal status

Analgesic-related variable	Vital teeth (n=87)	Non-vital teeth (n=86)	Total (n=173)	p-value
Required analgesic medication, n (%)	39 (44.8)	51 (59.3)	90 (52.0)	0.021
Did not require analgesic medication, n (%)	48 (55.2)	35 (40.7)	83 (48.0)	
Mean number of doses ± SD	1.4 ± 0.9	1.9 ± 1.1	1.6 ± 1.0	0.003
No analgesic use at 72 hours, n (%)	82 (94.3)	77 (89.5)	159 (91.9)	0.237

Analgesic consumption was recorded during the 72-hour postoperative follow-up. Continuous data are presented as mean ± SD and categorical data as frequency (%). We used an independent-samples t-test for dose comparisons and a chi-square test for categorical variables. Bold p-values indicate statistical significance ($p<0.05$).

Discussion

This study compared the postoperative pain after single-visit endodontic treatment (SVE) performed with the M3 Larger Taper Gold file system in 173 patients with vital and non-vital teeth. Overall, postoperative pain was mild and tapered off over 72 hours in both groups. Still, in the non-vital group, pain was significantly higher at 6, 12, 24, 48, and 72 hours, and analgesics were needed more often. Neither group had a significant age difference, suggesting that age-related variations were not responsible for differences in postoperative pain levels [10]. Our study of decreasing pain appears to corroborate modern evidence that the pain experienced following endodontics is usually greatest soon after surgery and then subsides. A 2024 systematic review and meta-analysis concluded that moderate to severe pain following a single-visit root canal was rare overall. Still, it was possible that some patients would experience pain for 48–72 hours after their procedure. A similar conclusion was reached by a systematic review, which found that most available studies showed similar or comparatively low levels of postoperative pain following single-visit treatment. Still, significant variation was noted due to differences in pain measurement, treatment protocol, and patient selection. These results are consistent with the gradual decrease seen in the current generation [11]. This significantly higher level of pain in non-vital teeth may be clinically justified, given that necrotic canals often have more microbial contamination and inflamed periapical tissues. Mechanical instrumentation may help extrude microorganisms, dentinal debris, and inflammatory products into the periapical tissues, thereby aggravating the inflammatory reaction. Recent clinical findings support instrumentation-related factors. A 2024 multicenter randomized clinical trial with 240 necrotic teeth showed that periradicular status, overfilling, and rotary instrumentation with or without intentional foraminal enlargement (EFA) affected postoperative pain, with the latter showing lower pain at 24 hours [12]. Our findings also align with recent literature on various NiTi instrumentation systems. In the 2023 study by Kumar et al., they found that the kinematics used during instrumentation may influence postoperative pain and analgesic use. However, the differences among these three methods (rotary, reciprocating, and continuous rotary) were not significant. They focused on apical debris extrusion as a significant factor that may contribute to postoperative discomfort. Likewise, Bhardwaj et al. showed that the various rotary file systems used during single-visit treatment also differed in postoperative pain. This indicates that instrument design and preparation can affect patients' reported experiences [13,14]. The present study is especially relevant in the context of evidence on heat-treated NiTi instruments. Valliappan et al. investigated newer heat-treated rotary and reciprocating systems, which concluded that postoperative pain tends to decrease during follow-up, which can be used in clinical practice. Another randomized clinical trial showed differences in postoperative pain when different single-file kinematics and coronal preflaring approaches were used, further highlighting that preparation technique, not just the brand of the single-file instrument, may influence postoperative symptoms [15,16,17]. Notably, the present results align with the 2024 randomized trial that directly compared the Fanta and M3 Pro+ Gold rotary systems. In that study, postoperative pain was reported after instrumentation, but this was of brief duration, with the highest pain reported at 12 hours and a significant decrease at 24 and 48 hours. This time course is similar to what we see, with the highest pain in the early postoperative period followed by a gradual decrease. A more recent study demonstrated a significant reduction in pain following single-visit treatment with both ProTaper Universal and M-Pro rotary systems, with no significant difference between systems regarding pain or analgesic consumption [17,18,19]. Based on the findings of the present study, the M3 Larger Taper Gold system can be used in single-visit endodontics with an acceptable level of postoperative morbidity. However, as more pain was noted in non-vital teeth, it may be advisable to consider the pulpal status when counseling patients[20]. Differences in canal anatomy, periapical diagnosis, irrigation, working-length control, apical preparation, obturation, and debris extrusion may also affect postoperative pain and should be uniform in future trials[21]. Overall, our results confirmed the clinical feasibility of M3 Larger Taper Gold and reiterated the need for careful case selection and atraumatic canal preparation.

Limitations

This study had several limitations. The study used a single-center design and relatively small sample size, which could affect the generalizability of results. Follow-up was limited to 72 hours (no more). Other factors, such as tooth anatomy, pre-operative pain, periapical status, and operator technique, could also have affected post-operative pain and analgesic use.

CONCLUSION

The M3 Larger Taper Gold file system resulted in gradually decreased postoperative pain for both vital and non-vital teeth. The early postoperative pain and analgesic requirements were significantly higher in non-vital teeth. In conclusion, the system

yielded satisfactory results and can be used to achieve satisfactory outcomes in single-visit root canal therapy.

Disclaimer: None.

Conflict of Interest: None.

Funding: None.

Ethical Approval

Ethical approval for the study was obtained from the Research Evaluation Unit (REU), College of Physicians and Surgeons Pakistan (CPSP), Karachi, under Reference No. CPSP/REU/DSG-2023-002-4560, dated 23 April 2025. The study was conducted in accordance with applicable ethical standards, and written informed consent was obtained from all participants before enrolment.

Authors' Contributions

Mahnoor Baloch: Conceptualization, study design, and supervision.

Dil Rasheed: Critical review and intellectual contribution.

Farzana Abdul Hayee: Data collection, data analysis, and interpretation.

Iqra Saleem: Drafting and preparation of the manuscript.

Mehmoooda Quttab Shah: Drafting and preparation of the manuscript.

All authors: Critical revision of the manuscript, approval of the final version, and accountability for all aspects of the work.

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