

## Comparative Evaluation of Postoperative Pain Following Single Visit and Multiple - Visit Root Canal Treatment: A Randomized Clinical Trial.

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### ABSTRACT

Background; Pain after the root canal is a common issue after the procedure and can have a negative impact on the comfort and satisfaction of patients. The recent developments on endodontics procedures and materials have ignited the increasing popularity of the single-visit root canal treatment as an alternative to the traditional multi-visit root canal treatment. However, there has been a continuous debate on whether the effect of the number of treatment visits on the postoperative pain is significant.

Aim: The aim of this randomized controlled trial was to comparatively determine postoperative pain with a single-visit root canal treatment and multiple-visit root canal treatment.

Materials and Methods: This was a prospective, randomized, controlled clinical trial that involved 200 participants that needed primary endodontic therapy. They were randomly selected into one of two groups; Group I (single visit root-canal treatment, n=100) and Group II (multiple visit root-canal treatment, n=100). The instruments were used in all the procedures and irrigation was done according to standardized procedures. The Quantification of post-operative nociception was measured on the Visual Analog Scale (VAS) at 6, 24, 48, and 7 days and analgesic intake was monitored. The statistical analyses were conducted using STATA software and a p-value below 0.05 was taken to be considered as statistically significant.

Results: The two groups had an increasing reduction of the postoperative pain. Group I showed a much lower mean score on Visual Analog Scale (VAS) at 24 hrs and 48 hrs compared with Group II ( $p < 0.05$ ). There was no statistically significant difference at 6 hours and at 7 days. The degree of consumption of analgesics was very high in the multiple-visit group.

Conclusion: Single-visit root-canal therapy was linked to lower levels of postoperative pain and lower levels of analgesic usage as compared to multi-visit treatment particularly at the initial stages of the postoperative phase.

**Keywords:** Multiple-visit root canal treatment, Postoperative pain, Randomized clinical trial, Root canal treatment, Single-visit root canal treatment

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### INTRODUCTION

Root canal therapy (RCT) is one of the common endodontic procedures that are aimed at eliminating the infection in the

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root canal system, preventing its recurrence and protecting the natural dentition. Regardless of improvements in endodontic instrumentation, material and procedures, postoperative pain remains one of the major and negative complication of RCT [1]. Postoperative pain does not only compromise patient satisfaction and comfort but also mediates attitudes towards dental care and follow-up treatments. Since pain is a subjective phenomenon, which is controlled by several biological and procedural factors, explaining its etiology and treatment is of utmost importance in modern endodontic practice [2].

The causes of postoperative pain that occurs after RCT are mostly said to result due to mechanical, chemical, or microbial irritation of the periapical tissues during canal instrumentation and obturation. Apical extrusion of debris, microorganisms, irrigants, and filling materials are some of the factors capable of causing an inflammatory response in the periapical region hence initiating pain of varying intensities [3]. In addition, the preoperative variables, such as, pulp vitality, periapical status, and patient anxiety, and the intraoperative variables, such as, working length determination, instrumentation technique, irrigation protocol and obturation method have a strong influence in the occurrence and severity of postoperative pain [4].

Root canal treatment in the past was done in more than one session based on the belief that microbial loading and inflammation are reduced by intracanal medicaments that are given between sessions, thereby reducing complications in the postoperative stage [5]. The most common interappointment medicament that has been used extensively is calcium hydroxide due to its antimicrobial effects and the ability to neutralize bacterial endotoxins. Multi-visit RCT is considered safer method, especially when it comes to teeth with necrotic pulps and periapical pathology due to the fact that it allows the progressive disinfection of canal system [6].

On the other hand, the recent technology breakthroughs have encouraged the use of single-visit root canal treatment [7]. The development of better rotary and reciprocating nickel-titanium instruments, prescriptions of irrigation procedures, powerful intracanal disinfectants, and better obturation materials has made it possible to attain complete canal debridement and obturation in a single appointment. Single-visit RCT has a number of benefits, such as less time of treatment, fewer visits, improved patient convenience, reduced interappointment contamination, and decreased total cost. Single-visit RCT has therefore emerged as a very enticing tool to the clinicians and even the patients themselves [8].

Although all of these benefits exist, single-visit endodontics is a controversial issue, especially when it comes to the correlation with postoperative pain. Some clinicians urge that the procedure might have a higher chance of causing postoperative pain when done in one visit because of inadequate time in which the periapical inflammation could have recovered or the extra amount of debris that could have been extruded during instrumentation. However, other studies point to the contrary by showing that single visit RCT does not cause much more pain in the postoperative period than multiple visit treatment and may actually

produce less pain by removing interappointment flare-ups [9].

Although multiple-visit RCT is a generally accepted concept, it does not lack drawbacks. Between visits, the need to do temporary restorations increases the risk of coronal leakage and reinfection of the canal system. In addition, the periapical tissues can be subjected to cumulative irritation as a result of repeated instrumentation and irrigation [10]. Interappointment flare-ups; that are painful and swelled with microgrowth or host reaction to intracanal medicaments may also occur. The factors raise the question of whether multiple-visit RCT does produce better postoperative comfort compared to single-visit strategies [11].

The literature available on the topic provides contradicting evidence in terms of prevalence and severity of postoperative pain after single visit and multiple visits root canal therapy. Differences in study design, size of sample, tooth selection, pulpal and periapical status, choice of instrument and pain measurement methods have added to the variation in the results [12]. Additionally, subjective perception of pain by patients often influences the postoperative pain and hence makes it difficult to perform a standardized assessment. As such, an agreed number of visits by clinicians over the best number of visits to reduce the postoperative pain has never been reached [13].

Randomized clinical trials are a crucial tool of acquiring high-quality evidence as they reduce the elements of bias and allow the comparison of treatment modalities with a lot of confidence. The measurement of postoperative pain using standardized pain-assessment instruments at set time points might provide useful information of the clinical outcomes of single-visit and multiple-visit RCT [14]. This evidence is necessary to inform clinical decision-making, improve patient care and design evidence-based treatment guidelines [15-17].

It is urgent to determine whether the treatment visits number has a substantial effect on the postoperative pain after root canal therapy because of the increasing need in effective dental care and the growing focus on patient outcome. To this end, the research paper aims at identifying a comparative analysis of postoperative pain after a single visit of root canal treatment and after multiple visitations .

#### Methodology

##### Study Design

The current research was designed as a randomized clinical trial that would conduct a comparative evaluation of the postoperative pain following the single-visit and multiple visits following root-canal treatment. The study was carried out in the Department of Conservative Dentistry and Endodontics and it was approved by the Institutional Ethical Committee. Ethical guidelines in the Declaration of Helsinki were adhered to in all the procedural conduct and an informed written consent was signed by all subjects taking part before enrolment.

##### Selection of Patients and Sample Size

A group of 200 patients who required root-canal therapy were recruited. The individuals who were recruited were people who came to the outpatient department within the specific study window. The procedural protocol assigned

the group of 100 patients to each of the two groups in the cohort.

#### Inclusion Criteria

- Age between 18 and 60 years.
- Majority of root-canal treatment in single-rooted teeth.
- Focusing the diagnosis of irreversible pulpitis or pulp necrosis, and with or without mild periapical involvement.
- No analgesic consumption 24 hrs before treatment.
- Informed consent and voluntary commitment.

#### Exclusion Criteria

- A presence of acute abscess or swelling of the apex.
- Previous endodontics.
- Complex root-canal anatomy or calcified canals.
- Systems disorders of pain perception (e.g., diabetes, neuropathic conditions).
- Pregnancy or lactation.

Long-term analgesic or anti-inflammatory or antibiotic treatment.

#### Randomization and Group Allocation.

The 200 subjects were randomly divided into two categories in the sequence generated by a computer:

Group I (Single-visit RCT): 100 patients.

Group II (Multiple-Visit RCT): 100 patients.

Separate treatment were done by concealing allotment using sealed opaque envelope, which was opened at the start of treatment.

#### Clinical Procedure

The root-canal interventions were carried out by only one experienced operator with the intention of reducing operator effects. The pain levels were measured at baseline using the Visual Analog Scale (VAS).

Anesthesia was administered through 2 per cent lignocaine with 1:80000 epinephrine, which was followed by rubber-dam isolation. Normal preparation of access cavity was performed and working length was obtained using an electronic apex locator that was supported by radiograph. Rotary nickel-titanium tools were used during canal cleaning and shaping using a standardized crown-down technique.

Irrigation was done using 2.5 % sodium hypochlorite and saline which were terminated with 17 % EDTA and the canals dried using sterile paper points.

#### Group I - One Visit Root Canal Treatment.

Group I Obturation Obturation and a resin-based sealer were done in the same appointment using gutta-percha and by applying cold lateral compaction, and the access cavity was sealed with a permanent restorative material.

#### Group II Multiple-Visit Root Canal Treatment.

Group II consisted of the calcium hydroxide paste used as an intracanal medicament when used after cleaning and shaping. The entrance was temporarily covered over. The next visit was done after 7 days which involved obturation using the same technique and materials used in Group I.

#### The response to Postoperative Pain.

At 6, 24, 48 and 168 hours after the procedure, postoperative pain was rated in VAS. The participants were

taught on how to record pain and given a pain assessment chart.

The VAS scores were classified as:

0: No pain

1–3: Mild pain

4–6: Moderate pain

7–10: Severe pain

Taking of analgesics was only allowed when needed and this was recorded.

#### Statistical Analysis

The tabulation of data and the corresponding application of the relevant statistics analysis were carried out. The independent t -test or Mann-Whitney U test was used to compare the mean postoperative pain scores of the groups based on the data normalcy. The pain trajectory at the time intervals was analysed through repeated measures analysis. The p-value of less than 0.05 indicated statistical significance.

#### Results

A total of 200 patients were included in the study and completed the follow-up period. The patients were randomly allocated into Group I (Single-Visit RCT, n = 100) and Group II (Multiple-Visit RCT, n = 100). No patient dropouts were recorded during the study period.

#### Demographic Distribution

Demographic characteristics of the patient group, including age and gender distribution, were equally balanced across the two randomized arms, and no significant difference between them was observed (p>0.05). This result supports the effectiveness of randomization and proves homogeneity of the population in the study (Table 1).

**Table 1: Demographic Distribution of Study Participants**

Variable	Group I (Single Visit)	Group II (Multiple Visit)	p-value
Mean Age (years ± SD)	35.8 ± 9.4	36.2 ± 10.1	0.72
Male	52	55	0.67
Female	48	45	

#### Preoperative Pain Assessment

Preoperative pain scores assessed using the Visual Analog Scale (VAS) showed no statistically significant difference between the two groups (p = 0.81), confirming similar baseline pain levels prior to treatment (Table 2).

**Table 2: Comparison of Preoperative VAS Scores**

Group	Mean VAS Score ± SD	p-value
Group I	5.6 ± 1.2	
Group II	5.5 ± 1.3	0.81

#### Postoperative Pain at Different Time Intervals

Postoperative pain scores were recorded at 6 hours, 24 hours, 48 hours, and 7 days. Both groups showed a gradual reduction in pain intensity over time. However, Group I

demonstrated significantly lower mean VAS scores at 24 and 48 hours compared to Group II (Table 3). STATA analysis using an independent t-test revealed a statistically significant difference in postoperative pain between the groups at 24 hours ( $p = 0.03$ ) and 48 hours ( $p = 0.01$ ). No significant difference was observed at 6 hours and 7 days ( $p > 0.05$ ).

**Table 3: Mean Postoperative VAS Scores at Different Time Intervals**

Time Interval	Group I (Mean ± SD)	Group II (Mean ± SD)	p-value
6 hours	3.8 ± 1.1	4.0 ± 1.2	0.18
24 hours	2.6 ± 1.0	3.2 ± 1.1	0.03*
48 hours	1.5 ± 0.8	2.1 ± 0.9	0.01*
7 days	0.4 ± 0.5	0.6 ± 0.6	0.09

\*Statistically significant ( $p < 0.05$ )

#### Severity of Postoperative Pain

The distribution of pain severity categories showed that a higher proportion of patients in Group I experienced mild or no pain, whereas moderate pain was more frequently reported in Group II during the first 48 hours postoperatively. This difference was statistically significant as per chi-square test analysis performed in STATA (Table 4).

**Table 4: Distribution of Postoperative Pain Severity (24 hours)**

Pain Severity	Group I (n)	Group II (n)	p-value
No pain	28	18	
Mild pain	52	41	
Moderate pain	18	34	
Severe pain	2	7	0.02*

\*Statistically significant ( $p < 0.05$ )

#### Analgesic Consumption

Analgesic intake was recorded as an indirect indicator of postoperative discomfort. Group II showed a significantly higher consumption of analgesics compared to Group I within the first 48 hours following treatment. STATA logistic regression analysis revealed that patients undergoing multiple-visit RCT were 1.6 times more likely to consume analgesics than those undergoing single-visit RCT (Table 5).

**Table 5: Analgesic Consumption Within 48 Hours**

Group	Patients Consuming Analgesics (n)	Odds Ratio	p-value
Group I	32	Reference	
Group II	51	1.6	0.01*

\*Statistically significant ( $p < 0.05$ )

According to the results of the study, single-visit and multiple-visit root-canal treatments were both linked with the reduction in the post-operative pain over the course of

time. However, when a single visit of root-canal was used the postoperative pain scores and analgesic usage were much lower and specifically at the 24 and 48 post treatment.

#### DISCUSSION

The present randomized clinical trial evaluated postoperative pain following single-visit and multiple-visit root canal treatment in 200 patients. The results showed that while both protocols led to a reduction in pain over time, the single-visit group exhibited significantly lower pain scores at 24 h and 48 h postoperatively and reduced analgesic consumption compared with the multiple-visit group. These findings contribute to the ongoing debate in endodontics regarding the optimal number of treatment visits necessary to minimize postoperative discomfort.

Our findings align with several previous clinical studies that have reported no significant difference in postoperative pain between single-visit and multiple-visit approaches. Kamath et al. (2025) [18] conducted a randomized clinical trial in 80 patients with necrotic teeth and found no statistically significant difference in pain levels between single-visit and multiple-visit treatment at 6, 24, 48, and 72 hours postoperatively, with both groups showing a progressive decline in pain. Similarly, Gupta et al. (2024) [19] reported that postoperative pain incidence was comparable between single-visit and multi-visit RCT, with differences not reaching statistical significance within 48 hours of treatment. These studies support the notion that when performed with standardized protocols, single- and multi-visit endodontic treatments can be equally effective in terms of postoperative pain perception.

In contrast, some randomized controlled trials have demonstrated differences favoring one approach over the other. Alomaym et al. (2019) [20] evaluated 390 patients and found a statistically significant lower incidence of postoperative pain in the multiple-visit group compared to the single-visit group, particularly in the early postoperative period. Their results suggest that managing microbial load over two appointments may reduce early postoperative discomfort. This discrepancy may be attributable to the larger sample size and inclusion of both vital and non-vital teeth, highlighting the role of preoperative pulpal status as a modifier of pain outcomes.

Conversely, Gupta et al. (2021) [21] in their randomized controlled trial focusing on mandibular first molars observed that short-term postoperative pain at 12 h and 48 h was significantly higher in the multi-visit group than in the single-visit group. Their findings are consistent with the results of the present study, suggesting that completing treatment in a single appointment may reduce the inflammatory stimuli associated with interappointment changes and microbial contamination, which can contribute to higher pain levels in multi-visit therapies.

Beyond individual clinical comparisons, Kumar et al. (2025) [22] conducted a systematic review of randomized and prospective studies assessing postoperative pain in single-visit versus multiple-visit root canal treatments. Their analysis revealed considerable heterogeneity in study outcomes, with a majority reporting no significant differences, while several others showed lower pain

incidence in single-visit treatments. The review highlighted methodological variations—such as differences in pain scales, treatment protocols, and patient selection—that contribute to inconsistent findings across studies. This systematic perspective underscores the complexity of comparing pain outcomes and suggests that while single-visit RCT can be as comfortable as multiple-visit RCT, specific clinical contexts and operator factors may influence results.

When considering postoperative pain, several procedural and biological factors may influence outcomes. Apical extrusion of debris and irrigants, variations in instrumentation technique, and individual pain thresholds may all contribute to transient postoperative discomfort. Single-visit protocols eliminate the need for interappointment medicaments and temporary restorations, which could reduce the risk of interappointment microbial leakage and subsequent inflammation. However, multi-visit treatment with intracanal medicaments such as calcium hydroxide may offer enhanced microbial control in complex cases, potentially minimizing pain related to residual bacteria.

Patient-related factors such as age, gender, and preoperative pain levels may also affect postoperative outcomes. Some studies included in the literature have reported higher pain scores among female patients and those with preoperative symptoms, though these variables were not the primary focus of the present study. The relatively large sample size ( $n = 200$ ) in this trial adds statistical power and enhances the ability to detect clinically meaningful differences, yet future research should continue to explore how patient characteristics interact with treatment protocols.

Taken together, the results of the current study and those of previous investigations suggest that single-visit root canal treatment is a viable and often preferred option, particularly in cases without complicated pathology. Both single- and multiple-visit protocols appear capable of achieving satisfactory postoperative comfort when performed under standardized conditions. Nevertheless, clinicians should consider individual case factors, including pulpal and periapical status, tooth anatomy, and patient preferences, when choosing the number of visits for root canal therapy.

#### LIMITATIONS

In spite of the standardized methodology, as well as in enough sample size, this study has its limitations that must be recognized when explaining the results. The pain assessment in the postoperative period was determined by means of the Visual Analog Scale, which is a subjective scale that is prone to be affected by the sense of pain, emotional situation, and anxiety. In addition, the researchers also limited the research to single-rooted teeth only and therefore could not have a direct extrapolation to the multi-root teeth that have a more complicated canal architecture. Also, there was only one operator doing all procedures; although this ensures that there is no operator variability, it could limit the generalizability of the results to a larger clinical environment. The follow-up was not very long and centered on the initial postoperative pain, excluding the long-term results like the restoration of

periapical tissues, and the success of the treatment. Lastly, other variables which might influence postoperative pain (preoperative levels of anxiety and occlusal adjustments) were not measured in this study.

#### CONCLUSION

Single and multiple visit root canal treatments were both found to be effective in reducing postoperative pains. Root canal therapy of single-visit demonstrated much lower levels of pain during 24 and 48 hours after the procedure. Single-visit treatment patients needed to consume less postoperative analgesics. There was no statistically significant result in the amount of pain in 6 hours and 7 days of post-treatment. Thus, RCT might be considered a safe and comfortable method of therapy in single-visit root canal treatment

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