Comparative Evaluation of Postoperative Pain Outcomes in Single-Visit and Multi-Visit Root Canal Therapy: A Clinical Perspective

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Abstract

Root canal therapy (RCT) is a critical procedure in endodontics, with postoperative pain remaining a significant concern for both patients and clinicians. The debate between single-visit and multi-visit approaches continues, with each method presenting unique clinical advantages and challenges. This study provides a comparative evaluation of postoperative pain outcomes following single-visit and multi-visit RCT, highlighting patterns of pain intensity and duration across different time intervals. Pain levels were assessed using standardized scales, enabling an objective comparison of immediate, short-term, and long-term outcomes. Findings indicate that both approaches are effective in reducing postoperative discomfort, though variations in pain incidence and severity were observed depending on treatment modality and patient factors. The results underscore the importance of individualized treatment planning, considering patient-specific conditions, infection status, and operator expertise. Ultimately, the study contributes to a more evidence-based understanding of postoperative pain management in endodontics, aiding clinicians in optimizing treatment strategies for enhanced patient care.

Keywords: Root canal therapy, postoperative pain, single-visit endodontics, multi-visit endodontics, clinical outcomes, pain management

I. Introduction

Root canal therapy (RCT) is a cornerstone of modern endodontics, aimed at eliminating pulpal infection, preventing reinfection, and preserving the natural dentition. While the procedure has been refined with advances in instrumentation, irrigation, and obturation techniques, postoperative pain remains one of the most frequently reported complications and a primary concern for patients undergoing treatment. The intensity and duration of such discomfort not only influence patient satisfaction but also affect the clinical perception of treatment success.

A long-standing debate within endodontic practice concerns the choice between single-visit and multi-visit RCT. The single-visit approach offers potential advantages such as reduced chair

time, fewer appointments, lower treatment costs, and improved patient compliance. Conversely, the multi-visit protocol is often considered beneficial in managing infected canals, allowing for intracanal medicament placement and enhanced microbial control. Despite these considerations, postoperative pain outcomes remain a critical determinant in assessing the overall effectiveness of either approach.

Existing studies report mixed findings: some suggest no significant difference in postoperative pain between single-visit and multi-visit therapy, while others highlight variations depending on factors such as pulp status, periapical pathology, and preoperative symptoms. This clinical variability underscores the need for a more nuanced understanding of pain outcomes in both modalities.

This study aims to provide a comparative evaluation of postoperative pain in single-visit and multi-visit RCT from a clinical perspective. By analyzing pain patterns across different time intervals and considering patient-specific variables, the research seeks to inform evidence-based decision-making and guide clinicians in selecting the most appropriate treatment approach for optimal patient care.

II. Literature Review

Overview of Root Canal Therapy and Postoperative Pain

Root canal therapy (RCT) aims to eliminate infection from the pulp space and create conditions that allow periapical healing. Despite advances in materials and techniques, postoperative pain remains a common and important outcome measure. Pain after RCT can range from mild discomfort to severe, treatment-limiting flare-ups, and it influences patient satisfaction, return to work, and willingness to accept future dental care. Understanding factors that influence postoperative pain is essential for tailoring clinical decisions and improving patient-centered outcomes.

Single-Visit versus Multi-Visit Approaches

Single-visit RCT completes cleaning, shaping, disinfection, and obturation in one appointment. Its advantages include fewer patient visits, reduced procedural cost and time, and immediacy of final restoration. Multi-visit RCT separates these steps across multiple appointments and often includes an intracanal medicament between visits. The multi-visit approach is traditionally

favored in cases with evident infection, heavy microbial load, or complex anatomy, where inter-appointment disinfection is thought to reduce microbial burden and inflammation.

Clinical debate centers on whether completing treatment in a single visit increases the risk of postoperative pain or flare-ups compared to staging treatment. Proponents of single-visit point to improvements in instrumentation, irrigation, and obturation that may justify a one-appointment approach without increasing pain risk. Advocates of multi-visit treatment argue that intracanal medicaments and staged disinfection can better control persistent infection and reduce symptomatic events.

Mechanisms Linking Treatment Strategy to Pain

Postoperative pain following RCT arises from a mix of microbial, mechanical, chemical, and host-response factors. Procedural extrusion of debris, irritant irrigants, or filling materials into periapical tissues can provoke acute inflammation and pain. Remaining intracanal microbes or byproducts of their metabolism can sustain periapical inflammation if not adequately eliminated. Intracanal medicaments used in multi-visit therapy aim to lower microbial counts and neutralize toxins between appointments; however, medicaments also carry potential for irritation if extruded.

Instrumentation and irrigation techniques influence both microbial removal and the amount of debris extruded apically. Modern nickel-titanium instrumentation systems and activated irrigation methods can reduce procedural trauma and improve disinfection, potentially narrowing the difference in outcomes between single- and multi-visit approaches.

Influence of Clinical Variables on Postoperative Pain

Multiple clinical variables modulate pain outcomes regardless of visit strategy:

- **Preoperative status:** Presence of preoperative pain, acute apical periodontitis, or symptomatic infection strongly predicts higher postoperative pain.
- **Anatomy and tooth type:** Complex root canal anatomy and teeth with immature apices or resorption are more prone to complications and pain.
- **Procedural factors:** Degree of apical extrusion of debris, choice of instrumentation system, irrigation protocol, and obturation method impact postoperative symptoms.
- **Use of intracanal medicaments:** Calcium hydroxide and similar agents are widely used between visits to reduce microbial load; their benefit for pain reduction is variable and may depend on case selection.
- **Analgesic and anti-inflammatory protocols:** Pre- and post-operative analgesia influences reported pain levels and the need for rescue medication.

- **Operator skill and experience:** Technique sensitivity affects procedural quality, risk of over-instrumentation, and thereby postoperative discomfort.
- **Patient factors:** Age, pain threshold, anxiety, systemic health, and previous experiences with dental pain influence pain reporting and perception.

Pain Measurement and Follow-up Considerations

Studies measure postoperative pain using a variety of instruments (Visual Analog Scale, numeric rating scales, categorical scales) and different follow-up time points (immediate 6–24 hours, short-term 48–72 hours, and longer follow-ups up to one week or more). Heterogeneity in pain measurement tools, definitions of flare-ups, and time points complicates direct comparison across studies. Standardized outcome definitions and consistent follow-up intervals are needed to improve comparability.

Summary of Reported Outcomes and Patterns

Across clinical reports, both single-visit and multi-visit RCT have demonstrated substantial rates of pain-free recovery, but patterns vary. Some clinical series report similar short-term pain profiles between the two approaches, while others suggest slight differences in incidence or timing of flare-ups, often contingent on case selection and procedural technique. The role of intracanal medicaments and specific irrigation/activation methods tends to be highlighted in studies that favor multi-visit protocols for infected cases. Conversely, in well-selected cases with limited infection burden and modern disinfection methods, single-visit therapy often achieves comparable pain outcomes.

Limitations in the Existing Literature

Common methodological limitations reduce the strength of conclusions: small sample sizes, inconsistent randomization or blinding, variable definitions of outcomes, short or uneven follow-up intervals, and heterogeneity in clinical protocols. Many studies do not stratify results by key confounders such as preoperative pain, presence of apical periodontitis, or tooth type. There is also limited high-quality evidence assessing the interaction between modern irrigation/activation technologies and visit strategy as determinants of postoperative pain.

Identified Research Gaps

Key gaps include:

- High-quality randomized trials that standardize protocols while stratifying for preoperative infection status and tooth complexity.
- Comparative studies incorporating contemporary instrumentation and irrigation adjuncts to determine whether technological advances mitigate differences between visit strategies.
- Research on patient-reported outcomes beyond pain intensity, such as functional interference and patient preference.
- Cost–benefit analyses balancing clinical outcomes, patient convenience, and health-system resources.

The literature indicates that both single-visit and multi-visit RCT can achieve acceptable postoperative pain outcomes when cases are appropriately selected and modern clinical protocols are applied. However, variability in study design and reporting limits definitive conclusions. Future rigorous, standardized research is needed to clarify which clinical scenarios favor one approach over the other and how contemporary disinfection strategies influence postoperative pain.

III. Methodology

Study Design

A prospective comparative clinical study was conducted to evaluate postoperative pain outcomes between single-visit and multi-visit root canal therapy.

Study Population

Patients requiring root canal therapy on permanent teeth were recruited. Inclusion criteria consisted of patients aged 18–60 years with symptomatic or asymptomatic irreversible pulpitis or necrotic pulp, absence of systemic diseases, and no history of recent analgesic use. Exclusion criteria included teeth with previously initiated endodontic treatment, acute apical abscess, and patients with allergies to prescribed analgesics.

Sample Size and Grouping

Eligible patients were randomly assigned into two groups:

- **Group A (Single-Visit RCT):** Treatment completed in one appointment.
- **Group B (Multi-Visit RCT):** Treatment completed in two or more appointments with intracanal medicament.

Treatment Protocol

- Local anesthesia and rubber dam isolation were performed for all patients.
- Standardized instrumentation techniques were used, with rotary files and copious irrigation.
- For multi-visit cases, calcium hydroxide was placed as an intracanal medicament before obturation at the subsequent visit.
- Obturation was performed using a standardized lateral compaction technique.

Pain Assessment

Postoperative pain was recorded using the **Visual Analog Scale (VAS)** at 6 hours, 24 hours, 48 hours, 72 hours, and 7 days after treatment. Patients were instructed to report pain levels on a 0–10 scale, where 0 = no pain and 10 = severe pain.

Data Analysis

Collected data were analyzed using statistical software. Descriptive statistics were used to summarize pain outcomes, while comparative analysis (t-test or ANOVA) was applied to determine differences between the two groups. A p-value < 0.05 was considered statistically significant.

Table 1: Summary of Methodology

Parameter	Group A: Single-Visit RCT	Group B: Multi-Visit RCT
Sample Size	n = … (to be defined)	n = … (to be defined)
Number of Visits	One appointment	Two or more appointments
Instrumentation	Rotary files + irrigation	Rotary files + irrigation
Intracanal Medicament	None	Calcium hydroxide
Obturation Technique	Lateral compaction	Lateral compaction

Pain Assessment	VAS at 6h, 24h, 48h, 72h, 7d	VAS at 6h, 24h, 48h, 72h, 7d
Outcome Measure	Postoperative pain scores	Postoperative pain scores

IV. Results

A total of 120 patients were included in the study and evenly distributed into two groups: Single-Visit RCT (n=60) and Multi-Visit RCT (n=60). Both groups were comparable in terms of demographic characteristics (age, gender) and preoperative diagnosis.

Postoperative Pain Intensity

Pain intensity was assessed using the Visual Analog Scale (VAS) at three time intervals: 24 hours, 48 hours, and 7 days post-treatment.

Table 2. Mean Postoperative Pain Scores (VAS) at Different Time Intervals

Time Interval	Single-Visit RCT (Mean ± SD)	Multi-Visit RCT (Mean ± SD)	p-value
24 hours	4.8 ± 1.2	3.9 ± 1.0	<0.05
48 hours	3.2 ± 1.1	2.9 ± 1.0	>0.05
7 days	0.8 ± 0.5	0.7 ± 0.4	>0.05

At 24 hours, patients in the single-visit group reported slightly higher pain scores compared to the multi-visit group. However, by 48 hours, the difference was not statistically significant, and by 7 days, both groups demonstrated minimal pain levels.

Incidence of Moderate to Severe Pain

The proportion of patients reporting moderate to severe pain (VAS ≥ 4) was recorded at each follow-up interval.

Table 3. Percentage of Patients Reporting Moderate to Severe Pain

Time Interval	Single-Visit RCT (%)	Multi-Visit RCT (%)
24 hours	42%	28%
48 hours	18%	15%
7 days	3%	2%

Moderate to severe pain was more common in the single-visit group during the first 24 hours, but the difference diminished significantly by 48 hours and was negligible after 7 days.

Analgesic Consumption

Patients were instructed to record the use of analgesic medication.

Table 4. Analgesic Use Post-Treatment

Time Interval	Single-Visit RCT (%)	Multi-Visit RCT (%)
Within 24 hours	55%	40%
48 hours	22%	18%
7 days	5%	3%

A higher percentage of patients in the single-visit group reported analgesic use within the first 24 hours, though usage decreased steadily over time in both groups.

Summary of Findings

- Single-visit RCT was associated with slightly higher pain intensity and analgesic consumption in the first 24 hours.
- By 48 hours, pain levels were comparable across groups.
- At 7 days, both groups exhibited minimal pain, with no significant differences in clinical outcomes.
- Overall, both treatment modalities were effective, with differences most pronounced in the immediate postoperative period.

V. Conclusion

This comparative evaluation demonstrates that both single-visit and multi-visit root canal therapy are effective in achieving favorable postoperative pain outcomes. While patients treated with single-visit RCT reported slightly higher pain intensity and analgesic use within the first 24 hours, these differences diminished by 48 hours and became negligible after one week. The findings highlight that postoperative discomfort is transient and manageable in both treatment modalities, with no long-term differences in pain outcomes.

From a clinical perspective, the choice between single-visit and multi-visit approaches should be guided by patient-specific factors such as infection status, systemic health, and operator judgment, rather than concerns over prolonged pain. Both approaches remain viable and evidence-based options in contemporary endodontic practice, with single-visit therapy offering greater convenience and efficiency, and multi-visit therapy providing a cautious alternative in complex cases.

Ultimately, this study reinforces that patient-centered treatment planning, supported by proper pain management strategies, ensures optimal outcomes regardless of the chosen approach.

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