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ORIGINAL RESEARCH

Comparative Evaluation of Long-Term Outcomes in Single-Sitting Versus Multiple-Visit Root Canal Treatment: A Clinical and Radiographic Assessment

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ABSTRACT

Background: Endodontic treatment aims to eliminate infection and preserve the function of teeth. Single-sitting and multiple-visit root canal treatments (RCTs) are widely practiced; however, their long-term outcomes in terms of clinical success and patient satisfaction remain a topic of debate. This study evaluates and compares the shaping curve, clinical outcomes, and patient-reported outcomes of single-sitting versus multiple-visit RCTs over a 12-month follow-up period. **Materials and Methods:** This prospective study involved 120 patients aged 20-50 years requiring RCT for non-vital mandibular molars. Patients were randomly allocated into two groups: Group A (single-sitting, n=60) and Group B (multiple-visit, n=60). Root canals were shaped using a standardized protocol with rotary NiTi files. Post-operative pain, healing of periapical lesions (assessed radiographically), and shaping efficiency (evaluated using canal taper and curvature maintenance) were analyzed. Data collection included clinical assessments at baseline, 6 months, and 12 months, and patient-reported outcomes measured via a visual analog scale (VAS). Statistical analysis was conducted using paired t-tests and chi-square tests, with significance set at $p<0.05$. **Results:** Group A showed a shorter mean treatment time (45 ± 5 minutes) compared to Group B (120 ± 10 minutes). Post-operative pain at 24 hours was significantly lower in Group A (VAS score: 3.2 ± 0.8) than in Group B (VAS score: 4.5 ± 0.7). Radiographic healing rates at 12 months were comparable (Group A: 92%, Group B: 90%; $p>0.05$). The shaping curve analysis indicated similar canal taper and curvature maintenance across both groups. Patient satisfaction scores were higher for Group A (mean score: 8.5 ± 1.2) compared to Group B (mean score: 7.0 ± 1.5; $p<0.01$). **Conclusion:** Single-sitting RCT provides comparable long-term clinical and radiographic outcomes to multiple-visit RCT while reducing treatment time, post-operative pain, and improving patient satisfaction. It may be preferred in suitable cases, provided proper aseptic protocols are followed. Further multicenter studies with larger sample sizes are recommended to confirm these findings.

Keywords: Root canal treatment, single-sitting endodontics, multiple-visit endodontics, shaping curve, long-term outcomes, patient satisfaction, post-operative pain.

INTRODUCTION

Endodontic treatment, commonly known as root canal therapy (RCT), is a crucial procedure aimed at eliminating infection within the root canal system, preventing reinfection, and preserving the natural dentition. Advances in materials and techniques have made RCT highly predictable, with success rates ranging from 85% to 97% (1,2). However, the debate persists regarding the optimal approach: single-sitting or multiple-visit RCT. While single-sitting RCT offers the advantages of reduced chairside time, fewer patient visits, and potentially lower costs, concerns about post-operative pain and compromised healing persist (3,4).

Multiple-visit RCT, traditionally considered the gold standard, involves the use of intracanal medicaments between appointments to reduce microbial load and facilitate healing. Proponents argue that this approach ensures better microbial control and healing, particularly in cases with periapical lesions (5).

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However, this method may result in prolonged treatment times, increased patient inconvenience, and higher costs (6).

The shaping curve is a critical parameter in endodontic treatment, reflecting the efficiency and safety of root canal preparation. Proper shaping maintains the original curvature of the canal while providing adequate space for irrigation and obturation. The impact of different treatment protocols on shaping efficiency and long-term clinical outcomes remains an area of active research (7,8).

This study aims to evaluate and compare the long-term outcomes of single-sitting versus multiple-visit RCTs in terms of shaping curve efficiency, post-operative pain, radiographic healing, and patient satisfaction. By addressing these parameters, this study seeks to provide evidence-based guidance for clinicians in selecting the appropriate RCT protocol for their patients.

MATERIALS AND METHODS

A total of 120 patients aged 20–50 years requiring root canal treatment for non-vital mandibular first molars were enrolled. The patients were randomly selected from dental department of lokmanya tilak nursing home kores hospital (Thane Municipal Corporation) Vartak Nagar Thane. The inclusion criteria were:

1. Patients with radiographic evidence of non-vital teeth and periapical radiolucency.
2. Absence of systemic conditions affecting wound healing (e.g., diabetes).
3. No prior endodontic treatment on the involved tooth.

Exclusion criteria included teeth with complex anatomy, severe calcifications, or fractures. Participants provided written informed consent before enrollment.

Randomization and Group Allocation

Participants were randomly assigned into two groups using a computer-generated randomization sequence:

- **Group A (Single-Sitting RCT):** 60 patients received complete root canal treatment in one visit.
- **Group B (Multiple-Visit RCT):** 60 patients underwent root canal treatment over two or more visits with calcium hydroxide intracanal medicament placed between appointments.

Procedure

All procedures were performed by a single experienced operator to minimize variability. The protocol was standardized as follows:

1. **Access Cavity Preparation:** Access cavities were prepared under rubber dam isolation using a high-speed handpiece and round carbide burs.
2. **Canal Preparation:** Canals were prepared using rotary NiTi files (ProTaper Universal, Dentsply Sirona). The shaping curve was evaluated by measuring pre- and post-operative canal taper and curvature.
3. **Irrigation Protocol:** 5.25% sodium hypochlorite and 17% EDTA were used alternately during instrumentation. Final irrigation was done with saline.
4. **Obturation:** Canals were obturated using gutta-percha and a bioceramic sealer (AH Plus, Dentsply).
5. **Restoration:** Teeth were restored with a composite resin core and full-coverage crown.

Outcome Measures

The following parameters were assessed:

1. **Post-Operative Pain:** Measured using a Visual Analog Scale (VAS) at 24 hours, 48 hours, and 7 days post-treatment.
2. **Radiographic Healing:** Periapical radiographs were taken at baseline, 6 months, and 12 months to evaluate periapical healing using the Periapical Index (PAI).
3. **Shaping Curve:** Pre- and post-operative cone-beam computed tomography (CBCT) scans were analyzed to assess canal taper and curvature maintenance.
4. **Patient Satisfaction:** Assessed at the 12-month follow-up using a structured questionnaire.

Statistical Analysis

Data were analyzed using SPSS version 25. Descriptive statistics (mean and standard deviation) were calculated for continuous variables. Paired t-tests were used for within-group comparisons, and independent t-tests for between-group comparisons. Chi-square tests were used for categorical variables. Statistical significance was set at $p<0.05$.

RESULTS

1. Demographic Characteristics

The study included 120 patients, equally divided into two groups. The mean age of participants was 34.5 ± 7.2 years in Group A and 35.2 ± 6.9 years in Group B. Gender distribution was comparable between groups (Table 1).

Parameter	Group A (Single-Sitting)	Group B (Multiple-Visit)	p-value
Mean Age (years)	34.5 ± 7.2	35.2 ± 6.9	0.68
Gender (M/F)	32/28	30/30	0.78

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2. Post-Operative Pain

Group A reported significantly lower pain levels at 24 and 48 hours compared to Group B. By 7 days, pain levels were negligible in both groups (Table 2).

Timepoint	Group A (VAS score)	Group B (VAS score)	p-value
24 hours	3.2 ± 0.8	4.5 ± 0.7	<0.001
48 hours	1.8 ± 0.6	2.5 ± 0.8	<0.01
7 days	0.2 ± 0.1	0.3 ± 0.1	0.12

3. Radiographic Healing

At 6 months and 12 months, both groups showed comparable periapical healing rates, with no statistically significant difference (Table 3).

Timepoint	Group A (Healing Rate)	Group B (Healing Rate)	p-value
6 months	82%	80%	0.72
12 months	92%	90%	0.85

4. Shaping Curve Analysis

The shaping curve analysis revealed similar results for canal taper and curvature maintenance in both groups, indicating no significant difference in preparation efficiency (Table 4).

Parameter	Group A (Mean ± SD)	Group B (Mean ± SD)	p-value
Canal Taper (%)	95 ± 3.2	94 ± 3.5	0.56
Curvature Maintenance (%)	96 ± 2.8	95 ± 3.1	0.49

5. Patient Satisfaction

Group A showed significantly higher patient satisfaction scores compared to Group B at the 12-month follow-up (Table 5).

Parameter	Group A (Score)	Group B (Score)	p-value
Patient Satisfaction	8.5 ± 1.2	7.0 ± 1.5	<0.01

SUMMARY OF RESULTS

Single-sitting RCT resulted in lower post-operative pain, shorter treatment duration, and higher patient satisfaction compared to multiple-visit RCT, while achieving similar radiographic healing rates and shaping curve outcomes.

DISCUSSION

This study compared the long-term outcomes of single-sitting and multiple-visit root canal treatments (RCT) in terms of post-operative pain, radiographic healing, shaping curve efficiency, and patient satisfaction. The findings provide valuable insights into the clinical effectiveness and patient-centered outcomes of both approaches.

Post-Operative Pain

The study demonstrated that patients in the single-sitting group reported significantly lower pain levels at 24 and 48 hours post-operatively compared to the multiple-visit group. This aligns with previous studies suggesting that single-sitting RCT reduces microbial load and inflammatory mediators in a single procedure, thereby minimizing pain (1,2). Conversely, multiple-visit RCT often involves the placement of intracanal medicaments, which may contribute to temporary irritation and discomfort (3). However, both groups exhibited negligible pain levels by 7 days, indicating that the overall healing trajectory was similar.

Radiographic Healing

Radiographic healing rates at 6 and 12 months were comparable between the two groups, with no statistically significant differences. This supports existing evidence that the number of visits does not significantly impact periapical healing, provided the infection is adequately controlled (4,5). Studies have also highlighted that proper canal disinfection and obturation are critical for periapical healing, regardless of the treatment approach (6). This finding underscores the importance of standardized treatment protocols in achieving favorable outcomes.

Shaping Curve Efficiency

Shaping curve analysis showed that both groups maintained similar canal taper and curvature, indicating that the preparation efficiency was not influenced by the number of visits. This result is consistent with previous research that demonstrated the effectiveness of rotary NiTi systems in maintaining canal anatomy across different treatment protocols (7,8). Maintaining the shaping curve is critical for adequate irrigation, disinfection, and obturation, ensuring the long-term success of RCT.

Patient Satisfaction

Significantly higher patient satisfaction was reported in the single-sitting group, reflecting the convenience of fewer appointments and shorter overall treatment duration. Patient-centered care has become a cornerstone of modern dentistry, and reducing the

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burden of multiple visits can enhance the overall patient experience (9,10). However, it is important to select appropriate cases for single-sitting RCT to minimize risks associated with incomplete disinfection in complex cases.

Clinical Implications

Single-sitting RCT is a viable option for cases with straightforward canal anatomy and minimal infection, as it offers comparable clinical outcomes to multiple-visit RCT while reducing treatment time and improving patient satisfaction. However, in cases with severe periapical pathology or complex canal systems, multiple-visit RCT with intracanal medicaments may still be preferred to ensure thorough disinfection.

Limitations

This study had certain limitations, including a relatively small sample size and the focus on non-vital mandibular molars. Future studies with larger sample sizes and diverse tooth types are needed to validate these findings. Additionally, the study relied on radiographic assessment of healing, which may not fully capture the histological status of periapical tissues.

CONCLUSION

This study reaffirms that both single-sitting and multiple-visit RCTs are effective in achieving favorable clinical outcomes. The choice of protocol should be guided by the complexity of the case, patient preferences, and operator expertise. Single-sitting RCT may be preferred in suitable cases, provided strict aseptic protocols are maintained.

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