

Research Article

Frequency of Post-Operative Pain in Single-visit vs Multiple-visit Root Canal Treatment for Apical Periodontitis: A Randomized Controlled Trial

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ABSTRACT

This randomized control trial was designed to evaluate the frequency and severity of post-operative pain related to single-visit multiple-visit root canal treatments in patients diagnosed with apical periodontitis. This study attempted to evaluate the effect of treatment visits on post-endodontic pain and overall patient satisfaction and comfort. A total of 120 patients aged 18-50 who were clinically and radiographically diagnosed with apical periodontitis were selected based on simple random sampling. The participants were randomly separated into two groups: Group A: underwent single-visit root canal treatment, and Group B: received multiple-visit root canal treatment and an intracanal medicament was placed during the inter-visit period. The study was conducted in the Department of Operative Dentistry and Endodontics of one of the tertiary care dental hospitals for a period of six months. A structured demographic questionnaire, clinical and radiographic examination forms, and the Visual Analog Scale (VAS) were utilized to assess post-operative pain 24 hours, 48 hours, and 7 days after the treatment. Results from the Chi-square test and t-test for independent samples (at $p < 0.05$) showed that patients who underwent single-visit root canal treatment experienced relatively more post-operative pain within the first 24 hours. After 7 days, there was no significant difference in post-operative pain in the two groups. Both treatment modalities were found to be satisfactory in the management of apical periodontitis.

Keywords: periodontics, apical, Post-Operative pain, single visit, multiple visit

INTRODUCTION

Apical periodontitis is an inflammatory disease of the periapical tissues of the tooth. It occurs as a result of infection of the root canal system due to necrosis of the pulp tissue. It can also result from dental trauma and/or from untreated dental caries that lead to periapical tissue and surrounding alveolar bone destruction. Patients suffering from apical periodontitis usually complain of pain and/or tenderness to percussion, swelling and/or periapical radiolucency that is evident on a radiograph. The only way of treating an infected tooth and preserving it is through root

canal treatment (RCT). The goal of endodontic treatment is to eliminate all of the infectious agents within the root canal and to disinfect the canal system to control the infection and to provide a seal to prevent any coronal contamination to the root canal (1).

Postoperative pain is a major concern in endodontic therapy that is commonly reported by both patients and clinicians and produces high levels of anxiety. Apical periodontitis can be treated by root canal treatment (RCT) in a single visit or multiple visits. Single-visit RCT has benefits such as less time spent in the clinic, greater convenience for the patient, and

no risk of reinfection between appointments. However, the multiple-visit method has been the more preferred method in the past because of the use of inter-medicament dressings that allow for the disinfection of the root canal system. Gupta et al. (2021) found that treatment in both settings resulted in a reduction in pain level over a 48-hour period, but multiple-visit endodontic therapy resulted in lower levels and less severe postoperative pain during the first 24 hours when compared to a single-visit endodontic therapy. Thus, for the management of apical periodontitis, to achieve the best possible outcome and comfort for the patient, postoperative pain should be assessed in terms of how frequent it is and how severe it is for the two endodontic therapy methods (2). Traditionally, root canal treatment was performed over several visits to allow the temporary placement of intracanal medicaments (typically calcium hydroxide) to enhance microbial control. However, recent advancements in endodontic rotary nickel-titanium systems, improved irrigation methods, and new materials for canal obturation have stimulated wider acceptance of single-visit root canal therapy. Single-visit root canal treatment offers cleaning, shaping, and obturation of the entire root canal system in one visit, whereas multiple-visit root canals necessitate the temporary placement of intracanal medicaments, with the final obturation performed at a different appointment (3). The efficacy of endodontic protocols hinges on critical appraisal and systematic clinical evidence. As per a critical appraisal assessment by Bryce et al. (2023), generally available high-quality systematic review evidence suggests that single-visit root canal therapy for permanent teeth is comparable in clinical success with respect to post-treatment evaluation of radiographic healing and retention of the tooth, to the multiple-visit root canal therapy. However, the available evidence about the frequency and severity of post-operative pain, a post-treatment patient-oriented outcome, is inconclusive and calls for additional clinical studies with higher levels of control. Although the risk of contamination between treatment sessions is eliminated by using single-visit protocols, it is hypothesized that single-visit root canal procedures may cause an increase in the post-operative pain. More randomized controlled studies are needed to determine the short-term complications and pain for each of the two treatment protocols and develop comprehensive clinical practice guidelines (4).

Pain after root canal treatment is a primary concern that determines patient satisfaction and determines whether the patient will accept further endodontic interventions. Pain after endodontic treatment is due to the extrusion of debris, microbial infections, the irritation of periapical tissues, and the inflammation which is accompanied by instrumentation. Pain after such a procedure may be mild and can be resolved by taking an analgesic, or can be very severe. The occurrence and severity of pain after endodontic treatment is influenced by a number of factors which include, but are not limited to, instrumentation techniques and the number of treatment visits (5).

Recently, there has been many studies focusing on the post-operative pain and treatment satisfaction on single and multiple visit root canal treatments. Some studies claimed that the extrusion of necrotic debris during the complete obturation which is performed at the end of the single visit treatment is responsible for the pain which is felt in the first 24 hours post treatment (2). In contrast to this view, there have been several studies that have shown that there is no significant difference to be observed between the single and multiple visit treatment, especially when proper cleaning and shaping have been performed. Recently, a number of systematic reviews and randomized controlled trials have addressed this issue with conflicting results (6).

A BMC Oral Health systematic review found no significant differences in pain after multi and single visit root canal therapies. Some studies found that multi visit therapies caused more patient discomfort because they required a greater number of visits (7). In the same vein, RoCT completed in a single visit is no different in effectiveness compared to RoCT completed over multiple visits, and after 12 months, pain and complications are no different with either method. That said, RoCT completed in a single visit has been found to result in significantly more post-operative pain after one week than RoCT completed over multiple visits (8).

It is also true for endodontic treatment that exacerbation generally does not impede treatment success. However, it is very undesirable. Intracanal medication in the multi-visit method is associated with greater postoperative pain in the short term, compared to the single-visit method (9).

The growing trend of evidence-based endodontics has highlighted the importance of well-structured randomized controlled trials to identify the ideal treatment options for reducing post-operative pain in patients who have apical periodontitis. Although several pertinent

studies have been conducted worldwide, research has shown that there are many differences in the design of studies, the methods used for assessment of pain, the techniques of instrumentation, and in the selection of patients. These differences have resulted in divergent and inconsistent findings. Moreover, there is a paucity of data on the evaluation of post-operative pain resulting from single-visit and multiple-visit root canal treatments in patients with apical periodontitis. Therefore, this study aimed to evaluate post-operative pain following single-visit and multiple-visit root canal treatment by implementing clinical protocols and pain assessment techniques. This study has the potential to assist endodontists in the selection of treatment options that are likely to enhance the clinical outcomes and comfort levels of patients.

METHODOLOGY

A randomized controlled clinical trial design was adopted to compare the differences in frequency and severity of post-operative pain in patients undergoing single-visit versus multiple-visit root canal treatment for apical periodontitis. The study was conducted in the Department of Operative Dentistry and Endodontics at a dental school's tertiary care hospital for a duration of six months. The participants in the study provided their informed written consent.

The study included a sample size of 120 patients. A simple random sampling technique was used to select patients who presented to the outpatient dental department with symptoms and radiographic findings of apical periodontitis who required root canal treatment. The patients were randomly assigned into two equal groups, with each group containing 60 patients. Group A received single-visit root canal treatment, while multiple-visit root canal treatment with placement of an intracanal medicament was provided to Group B.

The study included patients aged between 18 and 50 years of both genders with apical periodontitis of permanent teeth as confirmed by a clinical examination with the aid of periapical radiographs. Inclusion criteria were patients with apical periodontitis with necrotic pulp, tenderness to percussion, and periapical radio lucency. Exclusion criteria were patients who were medically compromised; pregnant or breastfeeding, presented with an acute apical abscess, had previously commenced root canal treatment, had periodontal disease associated with the tooth, had root fractures, or had taken

analgesics or antibiotics within the 48 hours immediately prior to the commencement of the study.

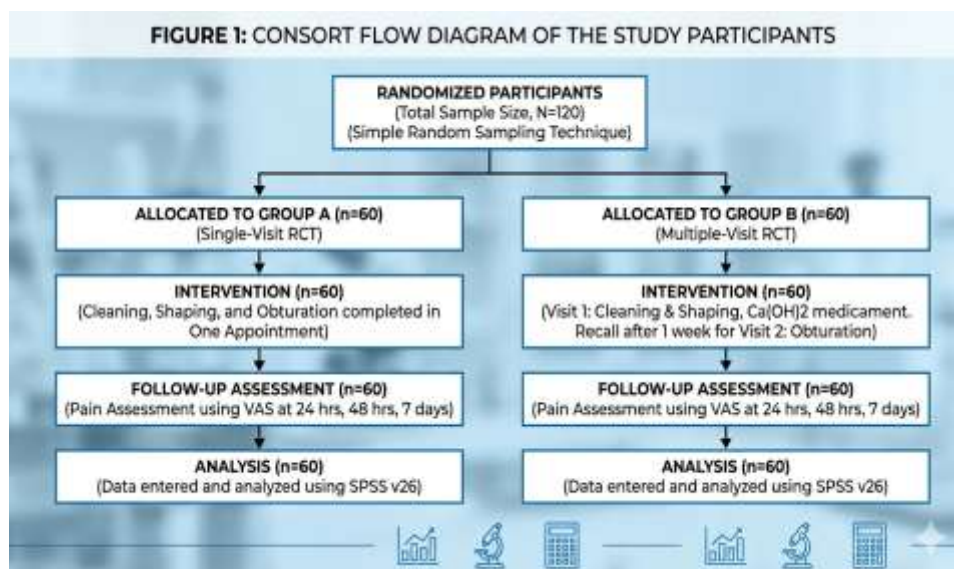
Demographic and clinical data were collected from each participant using a structured questionnaire. A clinical examination form was used to assess the participants. Pre-operative radiographs were obtained to confirm the diagnosis and determine the extent of periapical pathology using a standardized periapical radiographic technique. All participants were administered local anesthesia and a rubber dam was used to ensure aseptic condition during the procedure and to maintain an isolated field.

The single-visit group had their root canal system completely cleaned, shaped, and obturated in one appointment. An apex locator was used to determine the working length and the result was confirmed with a radiographic image. Biomechanical preparation was completed using a rotary nickel titanium instrument along with copious irrigation with sodium hypochlorite and normal saline. After the preparation of the canal, obturation was done using gutta-percha and resin-based sealer through the lateral condensation technique, and a temporary restoration was done.

In the multiple-visit group, the cleaning and shaping procedures were performed in the first appointment using the same instrumentation and irrigation protocols as in the single-visit group. After canals were dried, calcium hydroxide was placed, and the access cavity was sealed with a temporary restorative material. After one week, the inter-canal medicament was removed and canals were obturated with gutta-percha and resin sealer.

In order to assess the post exertion pain, a Visual Analog Scale (VAS) was used, where 0 was considered to be no pain, and 10 was the maximum bearable pain. The pain was assessed 24 hours, 48 hours, and 7 days after the completion of the treatment. The patients were educated about the pain scale during the phone calls or during the follow-up visits to ensure pain scores were documented accurately.

The information was put into the system and analyzed with version 26 of the Statistical Package for Social Science (SPSS). Mean, standard deviation, frequency, and percentage were computed for demographics and pain scores. For the Categorical variables, the Chi square test was used for the two groups, while the independent sample t-test was used to assess the mean differences in pain scores. A p value of less than 0.05 was considered statistically significant.



RESULTS TABLES

Table 1. Demographic Characteristics of Participants (n=120)

Variable	Single-visit RCT (n=60)	Multiple-visit RCT (n=60)	Total	p-value
Age (Mean $\pm$ SD)	34.2 $\pm$ 8.1	35.6 $\pm$ 7.9	34.9 $\pm$ 8.0	0.381
Male	28 (46.7%)	31 (51.7%)	59 (49.2%)	
Female	32 (53.3%)	29 (48.3%)	61 (50.8%)	0.704

Table 2. Distribution of Teeth with Apical Periodontitis

Tooth Type	Single-visit RCT (n=60)	Multiple-visit RCT (n=60)	Total	p-value
Anterior Teeth	14 (23.3%)	12 (20.0%)	26 (21.7%)	
Premolars	18 (30.0%)	20 (33.3%)	38 (31.7%)	0.842
Molars	28 (46.7%)	28 (46.7%)	56 (46.7%)	

Table 3. Frequency of Post-Operative Pain at 24 Hours

Pain Category (VAS Score)	Single-visit RCT (n=60)	Multiple-visit RCT (n=60)	p-value
No Pain	12 (20.0%)	18 (30.0%)	
Mild Pain	25 (41.7%)	29 (48.3%)	
Moderate Pain	18 (30.0%)	11 (18.3%)	0.041
Severe Pain	5 (8.3%)	2 (3.3%)	

Table 4. Frequency of Post-Operative Pain at 48 Hours

Pain Category (VAS Score)	Single-visit RCT (n=60)	Multiple-visit RCT (n=60)	p-value
No Pain	26 (43.3%)	31 (51.7%)	
Mild Pain	24 (40.0%)	22 (36.7%)	
Moderate Pain	9 (15.0%)	6 (10.0%)	0.287
Severe Pain	1 (1.7%)	1 (1.7%)	

Table 5. Frequency of Post-Operative Pain at 7 Days

Pain Category (VAS Score)	Single-visit RCT (n=60)	Multiple-visit RCT (n=60)	p-value
No Pain	54 (90.0%)	56 (93.3%)	
Mild Pain	5 (8.3%)	4 (6.7%)	
Moderate Pain	1 (1.7%)	0 (0.0%)	0.612
Severe Pain	0 (0.0%)	0 (0.0%)	

Table 6. Comparison of Mean VAS Pain Scores Between Groups

Time Interval	Single-visit RCT (Mean $\pm$ SD)	Multiple-visit RCT (Mean $\pm$ SD)	t-value	p-value
24 Hours	3.8 $\pm$ 1.9	2.9 $\pm$ 1.6	2.81	0.006
48 Hours	2.1 $\pm$ 1.4	1.8 $\pm$ 1.2	1.26	0.210
7 Days	0.4 $\pm$ 0.7	0.3 $\pm$ 0.5	0.88	0.381

DISCUSSION

This study was conducted to evaluate and document the frequency and severity of pain experienced after the completion of a root canal with a single visit and a multiple visit procedure in patients with apical periodontitis. The results of this study showed that patients that completed the single visit root canal procedure experienced greater post-operative pain in the first 24 hours as compared to patients that completed the multiple visit procedure. This pain was however not statistically significant after a period of 7 days and the difference in pain between the two groups tended to decrease. This study demonstrates that both the single and the multiple visit root canal procedure are effective in the management of apical periodontitis.

This study found that moderate to severe pain was much more prevalent in the single-visit group within the first 24 hours after treatment. This can happen when the entire root canal is sealed immediately after it is shaped, as it can pack debris, bacteria, and irrigants in the surrounding canal tissues, and be the cause of inflammation and pain. This also occurred in the study by Alves et al. [11]. Alves also reported that pain occurred after treating necrotic teeth with apical lesions and the inflammation was caused by the mechanical irritation and bacteria in the root canal.

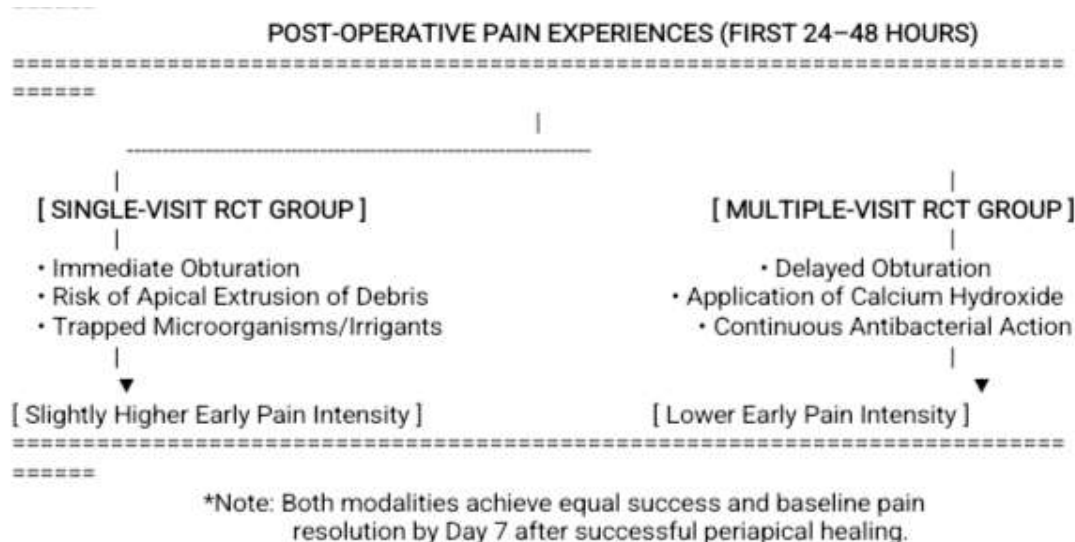
This study's results are also similar to the study by Ahmed et al. which reported that less pain was caused during the first 48 hours after the root canal treatment with more visits due to the calcium hydroxide's antibacterial properties. Calcium hydroxide was the most popular choice because it can also reduce the inflammation in the canal tissues before the root canal system is sealed. It is very likely that in this study, the pain decrease noted in the multiple-visit group is due to the use of calcium hydroxide as the intracanal medication after root canal sealing (12).

Although pain levels in the single-visit group were higher early on, no substantial difference in pain was reported between the two groups after one week. The results of this study are in

line with previous research looking at the long-term outcomes of single and multiple-visit root canal therapies. A systematic review by Moreira et al. noted that, while there may be minor variations in early pain, both therapies yield similar healing results and patient satisfaction when adequate biomechanical preparation and irrigation techniques are used. The reduction in pain levels over time observed in this study shows that infection and periapical inflammation had been resolved in both groups (13).

The other significant finding of this study was the number of patients reporting either no pain, or only mild discomfort, after 48 hours and 7 days post treatment. This indicates the positive impact of rotary instrumentation, better irrigation, and consistent techniques for root canal obturation. Improved endodontic systems and techniques have resulted in patient comfort and significant reduction in post-operative pain and flare-ups in root canal therapy. Similar results were obtained by Kharouf et al. [14].

The current study found no noticeable link between demographics (age and gender) and the level of pain experienced post-operation. This agrees with Yilmaz et. al. in that clinical factors such as the status of the pulp and periapical pathologies influence post-operative pain more than demographic factors. In other studies, it has been noted that the pain perception of female patients tends to be more due to psychological factors and hormones but was not statistically relevant in this study (15). Root canal treatment in a single visit is more efficient as it minimizes the number of visits and decreases the cost of treatment. It also minimizes the chances of infection during the treatment. However, treatment in a single visit is not appropriate in all cases. Predominantly, in canals that are severely infected or contain periapical infections, more than one visit to complete the treatment of the canal with the help of medication placed in the canal is needed. The results of this study show that the management of apical periodontitis can be achieved through any of the treatment models provided the necessary protocols are adhered to.



Limitations

A current analysis is the shortened follow-up period for the assessment of pain which does not allow analysis of long-term radiographic changes. Follow-up periods focused mainly on the assessment of pain postoperatively. Pain perception is subjective and might differ, even with the use of the standardized Visual Analog Scale.

Future Suggestions

Future studies should include multisite studies with larger participants and prolonged studies assessing pain perception and pain-related outcomes to further clarify the long-term effectiveness and healing of both single-visit and multiple-visit root canal treatment.

CONCLUSION

Despite the limitations of the review, it focused on the evaluation of both single-visit and multiple-visit root canal treatment, showing both to be valuable for the treatment of apical periodontitis. Single-visit Treatment reported an increase in post-operative pain for the first 24 hours; on the other hand, after a week, no significant post-operative pain was reported for either treatment group. Both treatment modalities produced a positive clinical result and, therefore, can be used in endodontic practice, with case choice and treatment preference of the clinician being the main determinant.

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