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Original Research Article

A clinical investigation into the incidence of post-operative pain in non- vital mandibular premolars treated with single sitting and two sittings root canal treatment: A comparative analysis

Sumita Bhagwat[1], Monica Panjwani[1*], Lalita Gauri Mandke[1], Anas Ansari[1], Preethi Durairaj[1], Aranya Ray[1]

[1]Dept. of Conservative Dentistry and Endodontics, D.Y. Patil School of Dentistry, Navi Mumbai, Maharashtra, India

Abstract

Background: Managing pain remains a significant challenge. Despite best clinical practices, patients usually experience some level of pain during the procedure. After root canal treatment, postoperative pain is a common complication.

Aim: To evaluate and compare the incidence of postoperative pain in non-vital mandibular premolars treated with single sitting and two sittings root canal treatment.

There is a persistant difference of opinion among clinicians concerning whether root canal procedures should be performed in a single or numerous visits.

Materials and Methods: Sixty adult patients with non-vital mandibular premolars were randomly divided into two groups: Group A (single sitting) and Group B (two sittings). A Visual Analogue Scale was used to assess postoperative pain at various time points after therapy.

Results: Group A showed a mean postoperative pain score of 0.6 at 4 hours which reduced to 0 by 72 hours. GROUP B showed a mean pain score of 0.37 at 4 hours reducing to 0 by 48 hours. There was no significant difference in postoperative pain levels between the two groups.

Conclusion: Both single sitting and two sittings root canal treatments resulted in minimal and comparable postoperative pain in non-vital mandibular premolars.

Keywords: Root canal treatment, Postoperative pain, Single sitting, Two sittings, Mandibular premolars, Endodontics.

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1. Introduction

Pain is a complex sensation that varies from mild discomfort to severe distress and is experienced differently by each individual. In dentistry, particularly during root canal treatment, managing pain remains a significant challenge. Despite best clinical practices, patients typically experience some level of pain during the procedure. Studies show that post-obturation pain occurs in 25-40% of cases.[1]

Pain occurs when tissues are damaged or potentially damaged, detected by specific sensory receptors called nociceptors (C-fibers and Aδ-fibers).[2] After root canal treatment, postoperative pain is a common complication that can be caused by various factors, including inadequate canal preparation, extrusion of materials, pre-existing pain, periapical pathosis and lack of apical patency during the procedure. This unexpected pain can affect the patient-clinician relationship and reduce treatment acceptance.

While medications like NSAIDs, paracetamol, and corticosteroids can help control inflammation and pain, they may cause side effects affecting the gastrointestinal, renal, hepatic, and respiratory systems.[3]

There is a persistent difference of opinion among clinicians concerning whether root canal procedures should be performed in a single or numerous visits. Single-visit treatment offers advantages like reduced mechanical procedures, lower cost, convenience for busy patients, and

*Corresponding author: Monica Panjwani
Email: monicapanjwani26@gmail.com

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eliminate risk of bacterial contamination between appointments. Recent improvements in techniques and equipment, such as rotary nickel-titanium systems and better irrigation methods, have made single-visit treatments more viable. While research generally shows either no difference in postoperative pain between the two approaches or slightly less pain with single-visit treatment in vital teeth, consensus is still lacking for non-vital teeth.

The preponderance of the research to date, has shown either no significant difference in postoperative pain when one-visit root canal treatment is compared with multiple- visit treatment or less pain in single-visit treatment in vital teeth when compared to multiple visit treatment. However, many of them are retrospective studies. Fewer studies have been conducted on non-vital teeth and in many of these studies, no consensus has been reached. Therefore, the more important questions concerning incidence of postoperative pain for non-vital teeth remains unanswered.

The clinical relevance of this question is unarguably important, as the number of patients with non vital teeth at the initial visit is high. It becomes crucial to know which technique will be of benefit to the patient in terms of decreased post-operative pain. With this background, we decided to study the incidence of post-operative pain in non-vital mandibular premolars treated with single and two sittings endodontic treatment to determine if a correlation exists between post-operative pain in both the groups. The degree of post-operative pain was gauged and documented using the Visual analogue scale.

2. Materials and Methods

2.1. Study design

This research involved 60 adult participants in good general health who needed root canal treatment on a lower first premolar due to decay affecting the pulp. None of the participants were on medications that could alter their perception of pain. For each participant, the affected tooth (either tooth #44, 45, 34, or 35) was confirmed to be non-vital using electric pulp and cold tests. Initial assessments included a radiograph to examine the canals and surrounding tissues, along with a thorough clinical examination and medical history.

2.2. Inclusion criteria

1. Healthy controls (American Society of Anesthesiologist 1 or 2)
2. Who required endodontic treatment in non-vital mandibular premolar which respond negatively to vitality tests and are asymptomatic.
3. Teeth without no history of root canal therapy.
4. Teeth with straight canals that are visible clearly on the radiograph.
5. Teeth with sound periodontal apparatus.

2.3. Exclusion criteria

1. Teeth with large restorations, previous endodontic therapy
2. Teeth with periodontal disease
3. Teeth having restorations with poor margins
4. Teeth with sinus tract.
5. Teeth having periapical lesion >2mm
6. Teeth having radiographic evidence of apical periodontitis
7. Vital teeth
8. Teeth with curved canals,receeded pulp or calcified canals.
9. Immuno-compromised and pregnant patients.
10. Patient had taken antibiotics in the past 1 month or required.
11. Antibiotic prophylaxis for the root canal procedure
12. Had a positive history of analgesic use within the past 3 days.

2.4. Methodology

When a patient met the study criteria, they were informed in detail about the study's purpose and procedures, and written consent was obtained. Once the patients had signed the consent form and agreed to be a part of the study, patients were randomly assigned to one of two treatment groups: a single-visit root canal (Group A, 30 subjects) or a two-visit root canal (Group B, 30 subjects). At the start, each patient rated their current pain level using a 10-centimeter Visual Analogue Scale (VAS). The researchers ensured that patients with similar initial pain scores were evenly distributed between the two groups.

All patients received local anesthesia (2% Lignocaine with 1:80,000 epinephrine) via infiltration technique. The standard root canal procedure involved isolating the tooth with a rubber dam, creating an access cavity, and using a #10 K-file with RC Prep to explore the canals. The working length (the distance to the end of the root) was determined using an electronic apex locator (Root ZX™) and confirmed with an IOPA X-ray. In cases of disagreement, the apex locator reading was prioritized. This measurement was repeated with a #15 file. Cleaning and shaping of the canals were performed using Protaper Gold™ rotary files with a crown-down technique, preparing all canals to a standardized size (20/6).

During the cleaning process, both groups received irrigation with saline and 5 ml of a 2.5% sodium hypochlorite (NaOCl) solution after each instrument change, using a side-port irrigation needle. Following instrumentation, the canals were thoroughly rinsed with saline. Paper points were used to check if the canals were dry enough for obturation. Gutta-percha points, matching the size of the final shaping file, were inserted to the determined working length. The fit and resistance of the gutta-percha were verified both clinically and radiographically. AH Plus sealer was applied to the canal

walls, and the canals were filled with gutta-percha using lateral condensation method. A final X-ray was taken after the filling.

All 60 patients received the root canal treatment following the specific protocol for their assigned group. After the procedure, patients were instructed to record any pain they experienced using the VAS. Treatment success was defined as no pain or only mild discomfort (VAS score of 0 or 1) during the initial stages of treatment. Patients were also told to contact the researchers if they experienced any pain. They were given instructions on how to assess and record the intensity and occurrence of pain at specific time points after the appointment: 4, 8, 12, 24, 48, 72 hours, and 7 days. Patients were advised not to take any pain medication without consulting the researchers and to note down details of any analgesic use (number of doses, timing, and effectiveness) on a provided pain form.

2.5. Follow-up

For Group A (single-visit), the 30 participants returned after 7 days, bringing the completed pain questionnaire from the day of treatment, and their final restoration was placed at this visit. For Group B (two-visit), the 30 participants returned after two days for the root canal filling and then again after five days for the final restoration. The pain questionnaires given on the first day were collected at the second appointment. It was confirmed that the patient did not consume any analgesic or anti-inflammatory medication during the post-operative observation period.

3. Results

3.1. Patient demographics and pain assessment

The study included 60 patients, with a slight majority being female (55%) compared to male (45%). The age distribution was fairly even, with approximately 30% of patients in each of the 18-30, 31-40, and 41-50 age groups, and the remaining 10% in the 50-60 age group.

Table 1 and **Table 2** detail how frequently patients in the single-visit (Group A) and two-visit (Group B) root canal treatment groups reported different levels of postoperative pain (none, mild, moderate, or severe). Pain levels were recorded before the procedure and at various time points afterwards: 4, 8, 12, and 24 hours, as well as 2, 3, and 7 days.

3.2. Postoperative pain in the single-visit group (Group A)

Four hours after a single-visit root canal, over half (57%) of the patients reported no pain, while 33% experienced mild pain, 3% moderate pain, and 7% severe pain (**Table 1**). The proportion of patients reporting no pain increased over time. By 8 hours, it was 67%; by 12 hours, 77%; and by 24 hours, 90%. At 48 hours, 93% reported no pain, and by 72 hours and 7 days, all 30 patients in the single-visit group reported no pain (**Table 1**).

3.3. Postoperative pain in the two-visit group (Group B)

In the two-visit group, 4 hours after the first appointment, 77% of patients reported no pain, 13% had mild pain, 7% had moderate pain, and 3% had severe pain (**Table 2**). Similar to the single-visit group, the incidence of no pain increased over time: 80% at 8 hours, 83% at 12 hours, and 97% at 24 hours. By 48 hours, all patients (100%) in the two-visit group reported no pain, and this continued at 72 hours and 7 days (**Table 2**). The final restoration for this group was completed on the seventh day.

3.4. Overall pain incidence and statistical analysis

Table 3 summarizes the number of patients in each group who experienced postoperative pain at each time point. **Table 5** presents a direct comparison of these average pain scores on the Visual Analogue Scale for both groups at each recorded interval.

Statistical analysis using the Mann-Whitney U test (**Table 5**) was conducted to determine if the number of treatment visits significantly affected the incidence of postoperative pain. The results indicate that the majority of patients in both the single-visit and two-visit groups experienced no pain or only minimal pain within the first 24 to 48 hours following the root canal treatment. Both groups had their final restorations completed on the seventh day.

Table 1: Frequency distribution of postoperative pain for Group A (Single Sitting)

	No Pain		**Mild Pain**		**Moderate Pain**		**Severe Pain**	
	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %
4 hrs	17	56.7%	10	33.3%	1	3.3%	2	6.7%
8 hrs	20	66.7%	7	23.3%	2	6.7%	1	3.3%
12 hrs	23	76.7%	5	16.7%	1	3.3%	1	3.3%
24 hrs	27	90.0%	2	6.7%	0	0.0%	1	3.3%
48 hrs	28	93.3%	1	3.3%	1	3.3%	0	0.0%
3 days	30	100.0%	0	0.0%	0	0.0%	0	0.0%
7 days	30	100.0%	0	0.0%	0	0.0%	0	0.0%

Table 2: Frequency distribution of post-operative pain for Group B (Two sittings)

	No Pain		Mild Pain		Moderate Pain		Severe Pain	
	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %
4 hrs	23	76.7%	4	13.3%	2	6.7%	1	3.3%
8 hrs	24	80.0%	4	13.3%	1	3.3%	1	3.3%
12hrs	25	83.3%	3	10.0%	1	3.3%	1	3.3%
24 hrs	29	96.7%	0	0.0%	1	3.3%	0	0.0%
48 hrs	30	100.0%	0	0.0%	0	0.0%	0	0.0%
3 days	30	100.0%	0	0.0%	0	0.0%	0	0.0%
7 days	30	100.0%	0	0.0%	0	0.0%	0	0.0%

Table 3: Number of patients who reported with post-operative pain in each group

	4 hrs	8 hrs	12 hrs	24hrs	48hrs	3 days	7 days
Group A (Single Sitting)	13	10	7	3	2	0	0
Group B (Two Sittings)	7	6	5	1	0	0	0

Table 4: Descriptive statistics

	Group A		Group B	
	Mean	Standard Deviation	Mean	Standard Deviation
4 hrs	.60	.86	.37	.76
8 hrs	.47	.78	.30	.70
12 hrs	.33	.71	.27	.69
24 hrs	.17	.59	.07	.37
48 hrs	.10	.40	.00	.00
3 days	.00	.00	.00	.00
7 days	.00	.00	.00	.00

Table 5: Mann-Whitney u test results

Test Statistics							
	4 hrs	8 hrs	12 hrs	24 hrs	48 hrs	3 days	7 days
Mann Whitney U	367.500	391.500	422.500	420.500	420.00	367.5004450450.000	450.000
Wilcoxon W 832	832.500	856.000	887.000	885.000	885.000	915.000	915.000
Z	-1.467	-1.117	-.594	-1.009	-1.426	.000	.000
p-value	.142	.264	.553	.313	.154	1.000	1.000
a. Grouping Variable: Groups							

4. Discussion

The numerical count and percentage of postoperative pain cases indicated a lower occurrence after two-visit root canal treatment compared to single-visit root canal treatment. However, because this difference was not statistically significant, the conclusion is that there is no noticeable difference in postoperative pain between the two treatment regimens. The potential for postoperative pain is frequently cited as a primary reason by many authorities who advise against completing root canal treatment in a single appointment.

In Sathorn et al. conducted a study involving 60 single-rooted teeth and observed that 8 patients experienced pain following single-visit treatment, while 12 patients experienced pain after multi-visit treatment.[4] The study found no statistically significant difference in the incidence of pain between the one-appointment and multi-appointment treatment groups. This research was among the initial investigations to assess postoperative pain in non-vital teeth

treated with both single-visit and multi-visit root canal treatment protocols.

Wong et al. conducted a study in which 567 teeth were treated using identical procedures and materials, either in a single visit or across multiple visits.[5] This study reported postoperative pain in 156 teeth one day after multiple-visit treatment. The majority of the reported pain in the multiple-visit group was mild to moderate (29%), while 5% of teeth treated in a single visit experienced pain after 7 days. The researchers concluded that there was no statistically significant difference in the incidence of post-obturation pain between single-visit and multiple-visit treatments.

In study by Baghdadi et al. involving 40 patients, the incidence of severe pain in Group I (single visit) was found to be 85% immediately after the procedure and 80% in Group II (two visits). Six hours postoperatively, 90% of patients in both groups reported pain.[6] At 12 hours, 75% of Group I and 60% of Group II experienced pain, and at 24 hours postoperatively, 55% of Group I reported pain compared to 60% in Group II. The study concluded that post-obturation pain is most likely to occur within the first 24 hours and tends to decrease over time. Furthermore, the intensity of post-obturation pain experienced following single- or multiple-visit root canal treatment was not significantly different.

In a study by Patel et al. 29.03% of patients in Group 1 (single visit) and 31.4% of patients in Group 2 (two visits) reported postoperative discomfort after one day, with mean VAS values of 23.68 and 32.24, respectively.[7] Comparing numerous characteristics, the study discovered that non-vital teeth and teeth with apical periodontitis had a decreased incidence of post-obturation pain after one day of treatment. Another observation showed that teeth with lower preoperative pain levels had a decreased incidence of postoperative pain. The majority of patients in both therapy groups reported minimal or minor pain after 24 to 48 hours.

In a 2020 study by Sonakshi et al. involving 40 patients, the mean VAS score after 6 hours in Group I (single visit) was 6.5 and in Group II (two visits) was 7.4. At 12 hours, the mean VAS was 5.2 in Group I and 6.7 in Group II. At 24 hours, the mean VAS was 3.8 in Group I and 4.5 in Group II, and at 48 hours, it was 2.3 in Group I and 3.8 in Group II.[8] The difference in pain scores between the groups was statistically significant ($P < 0.05$). The study concluded that there was a lower incidence of pain in the single-visit group compared to the multiple-visit group.

Albashaireh ZS et al. conducted a prospective study with 300 patients and noted a considerably greater incidence ($P < 0.01$) of post-obturation discomfort in the multiple-visit group (38%) opposed to the single-visit group (27%) within 24 hours following obturation.[9] There was no significant link between post-obturation pain and any other predictor. However, teeth with non-vital pulp prior to treatment had a considerably higher ($P < 0.005$) incidence of post-obturation pain. Pain was much higher in the group that received multi-visit root canal treatments, and it was also strongly linked with nonvital pulp.

In a prospective study by Al-Negrish AR et al. involving 120 patients, it was found that after 2 days in single-visit treated teeth, 90 patients had no pain, 9 had slight pain, 8 had moderate pain, and 5 had severe pain.[10] After 7 days, in the same group, 104 patients had no pain, 4 had minor pain, 3 had moderate pain, and 1 had severe pain. Between one-visit and two-visit endodontic operations, the study did not find a statistically significant difference in the incidence or severity of postoperative pain.

Risso et al. conducted a study in 2008 involving 121 patients and found that the frequencies of post-obturation pain were 10.5% (6 out of 57) in the single-visit group and 23.0% (14 out of 61) in the two-visit group.[11] Despite the numerical difference, the investigation discovered no statistically significant difference between the groups ($p=0.07$). However, the study acknowledged that calcium hydroxide was utilized as an interappointment dressing, which may have impacted the results.

Based on the discussed literature, it is evident that while some studies report results favoring single-visit root canal treatment in terms of pain incidence and others favor multi-visit procedures, the majority of published research comparing single- and multi-visit root canal treatment indicates no significant difference in the level of post-obturation pain between the two approaches. A non-infected pulpal necrosis, which can result from ischemic injury in accidental trauma, is considered less of a concern. Despite past theories attributing major pathogenic roles to decomposed pulp tissue and stagnant tissue fluid in the pulp chamber, substantial clinical and experimental evidence contradicts these claims. Moller et al.'s work provides compelling evidence suggesting that empty or necrotic canal spaces do not lead to apical pathosis unless they are infected.[12]

By comparing traumatized teeth with and without post-traumatic radiographic bone lesions at the apex, both Bergenholtz and Sundqvist provided strong evidence for the association between pulp space infection and periapical pathosis. Therefore, treating non-vital teeth in two visits is considered more beneficial.[13,14]

Under the specific conditions of this prospective study, no difference was found in postoperative pain between patients treated in one appointment and those treated in two appointments. The authors suggest that further clinical research with a larger sample size, in different populations, and in various geographic locations is necessary to better evaluate pain perception following root canal treatment.[15]

5. Conclusion

Following thorough assessment and statistical analysis, this study found no statistically significant difference in how often patients experienced postoperative pain, regardless of if the root canal procedure was finished in one or two visits. The occurrence of pain significantly decreased within one to seven days after the procedure. However, the data suggested a trend towards a lower incidence of substantial pain following a two-visit root canal treatment compared to a single-visit treatment.

The study also indicated that factors such as the patient's age, race, the position of the treated tooth, or the presence of a periapical radiolucent area did not appear to influence the experience of pain.

The authors concluded that the long-term success or failure of the root canal treatment is ultimately more important to both the patient and the dentist than any temporary discomfort during the treatment process. Therefore, they suggest that before broadly recommending single-visit treatment for asymptomatic pulpal necrosis, further long-term clinical research is needed to establish a reliable protocol that offers a predictable and pain-free outcome.

6. Source of Funding

None.

7. Conflict of Interest

None.

Reference

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