

Original Article

Incidence Of Post-Operative Pain After Single-Visit Versus Two-Visits Non-Surgical Endodontic Retreatment: A Randomized Clinical Trial

Muftah Mohammed Akrym¹; Wafaa Ahmed segari²; Madiha Mahmoud Gomaa³; Marwa Mahmoud Bedier⁴.

¹Department of Endodontics, Faculty of Dentistry, Cairo University.

Email: muftah.akrym@dentistry.cu.edu.eg

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Abstract

Aim: This study aimed to assess whether single-visit non-surgical endodontic retreatment (NSER) is associated with a higher incidence of post-operative pain (POP) and a greater number of patients requiring analgesics compared to the two-visit approach for asymptomatic patients with endodontically-treated premolars requiring new restoration construction.

Subjects and methods: 64 patients requiring NSER for asymptomatic previously treated premolar teeth were randomly assigned to either single-visit or two-visit groups. With placed calcium hydroxide as intra-canal medication for 1-wk in two-visit groups. POP was assessed using numerical rating scale at 6,8,12,24,48h and 7-days. Patients were instructed to take prescribed analgesics if severe intolerable pain was experienced. Pain scores and the number of the patients taken analgesic were recorded and subjected to statically analysis.

Results: Both groups showed the highest incidence and pain scores at 6h, which gradually decreased over time and completely resolved after 48h.” since, at 48h, pain started no longer exiting. No patients reported sever pain and only 6% of patients in the single-visit group experienced moderate pain after 6h. Single-visit group reported significantly higher pain scores compared to the two-visits at 6h only ($p<0.05$). Regarding analgesic intake, 4 patients in single-visit group and 2 patients in two-visit group used analgesics because of their fear of increasing pain, especially during sleep.

Conclusion: Within the parameters of this study, a predominant number of patients reported either no pain or mild pain following both single and two-visit procedures. This outcome suggests that both approaches are viable and satisfactory for managing asymptomatic premolars with inadequate primary root canal treatment.

Keywords: Post-operative pain, Retreatment, Single-visit, Intra-canal medicament, Two-visit.

Introduction

Non-surgical endodontic retreatment (NSER) is a procedure aimed at removing root canal filling materials, managing any existence procedural errors followed by

cleaning, shaping, and obturating the root canals. It is performed to address the failure of primary root canal treatment (PRCT) presented by radiographic and clinical signs

and symptoms (American Association of Endodontists) (AAE, 2020).

The mechanism of POP following NSER is similar to PRCT; It is multifactorial and results from irritation of the inflamed periacal tissue. Numerous factors can lead to this tissue irritation, such as mechanical, chemical, and microbiological ones (Alonso-Ezpeleta *et al.* 2012), often interconnected with each other. In comparison with PRCT, retreatment procedure may trigger further tissue irritation because of debris extrusion during removal of the existence filling materials as well due to complexity and diversity of microbial community (Garcia-Font *et al.* 2018, Machado *et al.* 2020, Hou *et al.* 2022). Meta-analysis of some studies have shown that the incidence of post-operative pain (POP) following NSER varies widely, ranging from 4.16% to 68.6% within 24 hours and from 0% to 18.4% within one week (Scardini *et al.*, 2023). Clinicians and patients need to be aware of the potential occurrence and intensity of such pain, as well as the associated or influencing factors. Several studies have investigated the impact of various factors, including the number of treatment visits, on the incidence and intensity of POP during NSER (Yoldas *et al.* (2004) Erdem *et al.* (2018) Uyan *et al.* 2018).

Single-visit root canal retreatment aims to complete the procedure in a single visit while multiple-visits involves performing the procedures over two or more visits, utilizing intracanal medication. From the perspective of POP, single visit offers the advantages of immediate root canal seal particularly the apical part reducing or eliminating the microbial factor contributing to tissue irritation. Additionally, it sidesteps the potential of triggering additional tissue irritation associated with multiple visits which could result from the extrusion of intracanal medicament and repeated instrumentation and irrigation.

On the other hand, multiple-visits root canal retreatment, utilizing intracanal medications like calcium hydroxide (CH), might lead to a lower degree of POP. This can be attributed to various mechanisms. Firstly, it reduces the microbial factor and aids in detoxifying bacterial lipopolysaccharides (Silva *et al.* 2002). Moreover, the alkaline pH established by CH potentially promotes tissue repair (Zerella *et al.*, 2005; Walton *et al.*, 2003) and may has the potential to decrease proinflammatory cytokines (Khan *et al.*, 2008).

Conflicting findings regarding the role of CH medication in POP have been recorded by the published systematic reviews. Wagh *et al.* (2022) reported that the placement of intracanal medicaments doesn't contribute to POP but rather reduces inter-appointment pain during endodontic treatment. In agreement with this review, Hegde *et al.* (2023) recorded that CH as an intracanal medicament was unrelated to the incidence and severity of POP but it is effective in reducing the pain when it is used alone and its effectiveness can be increased when used in combination with other medicaments. Conversely, Ahmed *et al.* (2022) found limited evidence suggesting that CH might be effective for managing inter-appointment pain.

In the context of NSER, direct comparisons through randomized clinical studies investigating the influence of the number of visits on POP are few and have yielded inconclusive results. Yoldas *et al.* (2004) recorded that two-visit endodontic retreatment employing CH-chlorhexidine intracanal medicament significantly reduced POP in previously symptomatic treated teeth and decreased the incidence of flare-ups compared to a single-visit approach. For asymptomatic cases, Erdem *et al.* (2018) recorded a lower incidence of POP following a single-visit approach, whereas Uyan *et al.* (2018) reported reduced pain incidence when utilizing CH and triple antibiotic medications.

Two subsequent systematic reviews on this topic, published after the mentioned studies, reported low levels of evidence and certainty in determining the superior treatment approach for POP (Nunes et al., 2021; Scardini et al., 2023). These reviews called for further randomized clinical studies featuring direct comparisons between the two approaches (Nunes et al., 2021; Scardini et al., 2023).

Therefore, the current study aimed to assess whether single-visit NSER is associated with a higher incidence of POP and a greater number of patients requiring analgesics compared to the two-visit approach for asymptomatic patients with endodontically-treated premolars requiring new restoration construction.

Subjects and Methods

The design of this study was a prospective, parallel, randomized, and single-blinded trial with allocation ratio 1:1. The trial design adhered to the Consolidated Standards of Reporting Trials (CONSORT) statement for reporting clinical trials (CONSORT Statement 2010- checklist: <http://www.consort-statement.org/consort-statement/>) (MacPherson et al. 2010). The study is registered at www.clinicaltrials.gov with the identification number NCT0458862. The protocol and the informed consent were approved by The Research Ethics Committee (REC) of the Faculty of Dentistry, Cairo University, Egypt under the reference number 9-6-20.

The sample size was calculated as a total sample size of 64 patients (32 per group) was required to detect the difference between the two treatment approaches with an effect size of 0.53, a power of 80%, and a significance level of 0.05 using the G*Power program (G Power software). The POP data assessed by the numerical rating scale (NRS) had a standard deviation of 1.51 ± 0.72 . The patients were recruited from the Department of

Endodontics, Faculty of Dentistry at Cairo University from December 2020 to May 2021 for root canal retreatment.

The 64 teeth required for the study were randomly allocated to two groups; single-visit or two-visits using electronic randomization method (<http://www.random.org>). Allocation of the patients to their respective groups was determined based on their enrollment order which was kept by co-supervisor. Allocation concealment was maintained through phone-based communication. The co-supervisor confirmed the eligibility of the patients and informed the operator of their assigned group based on the assigned number. Both the patients and the outcomes assessor were blind to the treatment approach used. Prior to the retreatment procedures, eligible patients were provided with a clear explanation of the study's objectives and the potential benefits and risks associated with the retreatment procedure. The retreatments were carried out by a third year postgraduate student specializing in endodontics (M.M.K.).

Patient selection

The study included patients between the ages of 20 and 45 who have asymptomatic mature single or double rooted mandibular or maxillary premolar teeth requiring endodontic retreatment. The need for retreatment was due to inadequate root canal treatment and or defective restoration, missing coronal restoration for extended time, which necessitated the placement of new restorations. Only the following conditions of inadequate root canal treatment are included in the study; under-filled canal with gutta-percha or cement shorter than 2mm from radiographic apex, root-canal systems that were insufficiently instrumented and sealed by a single-cone or poorly compacted root canal filling and teeth with missing root canals.

Patients were excluded from the study if they met any of the following criteria: being pregnant, younger than 20 years old or older than 45 years old, having taken analgesics, antibiotics, or corticosteroids within 24 hours

prior to the retreatment procedure, having premolar teeth with conditions such as overextended root canal filling, posts, external/internal root resorption, perforation, broken instruments, vertical root fractures, periodontal attachment loss, tenderness to percussion and palpation, associated sinus tract, periapical lesions, or non-restorable teeth, and if the patient did not return to complete the retreatment procedure.

Retreatment procedures

In both groups, the initial step involved administering local anesthesia using a standard inferior alveolar nerve block for mandibular premolars and buccal infiltration for maxillary premolars using 1.5ml of 4% Articaine with 1:100,000 Epinephrine (Art Pharma for pharmaceutical industries, 6th October City, Egypt). Any existing coronal restorations and recurrent caries were removed using a high-speed hand piece with a diamond round bur (Dentsply Maillefer (Ballaigues, Switzerland). If necessary, the access cavity was modified using an Endo-Z bur ((Dentsply Maillefer, Ballaigues, Switzerland)) to ensure direct access to the previously filled root canal orifices or missed canals.

After isolating the teeth with a rubber dam, the access cavities were irrigated with 3ml of 2.5% NaOCl (Clorox, Tenth of Ramadan City, Egypt). The previous root canal fillings were removed using a ProTaper Retreatment Kit (Dentsply Maillefer) following the manufacturer's instructions in conjunction with X-smart endodontic motor (Dentsply, Maillefer, Ballaigues, Switzerland). Throughout the process, root canal irrigation was performed using a 2.5% NaOCl solution delivered with a plastic syringe attached to a 30-gauge side-vented closed-end needle (C-K Dental IND. Co. Korea). No solvents was used during the process. The removal of the filling material was considered complete when there were no remnants of gutta-percha on the instrument flutes or irrigant and no adherent materials were felt on the dentin walls. Working length measurements were determined using a Root ZX apex locator (Root ZX, J.Morita, USA),

with the aid of a size 10-15 K-file and confirmed through periapical radiographic imaging. An initial file was chosen for each root canal, and the master apical file was selected to be one- two sizes larger than the initial apical file.

All root canals were prepared using the ProTaper Universal Rotary System (PTU) (Dentsply Maillefer Ballaigues, Switzerland) according to the manufacturer's instructions. The master apical files were adjusted to be either F3 or F4, depending on the size of the initial apical file. One ProTaper kit was used to prepare four root canals. Throughout the procedure, irrigation was performed using 3 ml of a 2.5% NaOCl solution. The needle was inserted 2mm short of the working length and used to irrigate the canals after each instrument. The canals were then flushed with distilled water, followed by 3 ml of 17% EDTA solution (Prevest DenPro Limited, India) for 1 minute to remove the smear layer, and the canals were flushed with 10 ml of distilled water and dried using a paper point.

In Group (single-visit), after root canal preparation, the root canals were obturated by ProTaper Universal gutta-percha point (Dentsply Maillefer, Ballaigues, Switzerland) using modified single cone technique. Master cone was selected corresponding to the final finishing files (F3 or F4) and its length was verified using a periapical radiograph. Following that, master cone was coated with Adseal sealer (Adseal, Meta Biomed CO., LTD, Korea). A spreader was used to allow space for auxiliary cones in the canal. Obturation was considered completed when the spreader no longer penetrates beyond the cervical line. All the excess sealer and gutta-percha were removed and the access cavity was sealed with temporary filling using Intermediate Restorative Material (IRM) (Maillefer Dentsply, Germany). Following that, post-operative radiograph was taken for each tooth with two angulations (straight in and angulated views) to evaluate the quality of root canal filling in terms of homogeneity and apical extension.

In Group (two-visit), following root canal preparation, the root canals were medicated with calcium hydroxide ($\text{Ca}(\text{OH})_2$) (Metapaste, Meta Biomed, Chungbuk, South Korea) using a Lentulo spiral (No. 2, ISO size 30, Dentsply Maillefer), then access cavity was sealed using a sterile dry cotton pellet and temporary filling (IRM). After 7-days, the teeth were isolated with rubber dam, temporary filling material was removed and access cavity was irrigated with 3ml 2.5% NaOCL. Calcium hydroxide was removed chemo-mechanically using the master apical file in a circumferential filing action coupled with 2.5% NaOCL irrigation followed by flushing the canal with distilled water. Final irrigation was done by 3ml of 17% EDTA solution for 1 minute (to remove the smear layer) followed by 10 ml of distilled water to remove any residual irrigating solution. The root canals were dried, obturated and coronally restored with the same materials and techniques used in the single-visit group. In both groups the patients were referred to fixed prosthesis department for complete final coronal restoration.

Postoperative Pain Evaluation

Patients were regularly contacted by telephone within the first 48h to monitor the POP and remind the patients to record their pain levels using NRS chart. The NRS consist of a scale from zero to 10 and patients were requested to mark the point on the scale that represent their pain level. If patients experienced severe and intolerable pain, they were instructed to take the prescribed analgesic with a minimum interval of 6h after completing the first visit of retreatment. Patients in the two groups were instructed to return 7 days after their first visit to provide their NRS charts and assess the pain.

Statistical analysis

The pain charts were collected from the patients and pain scores were assigned to one of four categorical scores: No pain (0), Mild (1–3), Moderate (4–6) and Severe (7–10).

Categorical data was expressed as a mean, standard deviation, median and range while pain scores was described as percentages and frequencies.

Data was explored for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests. Pain data showed non-parametric (not-normal) distribution, median and range were used for data presentation, and Mann – Whitney U test was used for comparison between the two groups.

Friedman test was used to study the change over time in the same group. When Friedman test was significant, Wilcoxon signed rank test was used for pairwise comparisons. For pairwise comparisons between the two groups, unpaired test was used for the patients age distribution while Chi square test was used for the distribution of the gender, type of the teeth, number of root canals and number of patients taking analgesics during 7-days after completing the first visit of retreatment. The significance level was set at $P \leq 0.05$. Data was analyzed using IBM SPSS advanced statistics (Statistical Package for Social Sciences), version 21 (SPSS Inc., Chicago, IL).

Result

The data collected from the study is summarized in Tables (1 – 3). The patients and teeth' characteristics including age, gender, type of teeth and number of root canals are summarized in table 1 and 2.

Table 1. The mean, standard deviation values and range of age in the two groups and the results of unpaired test for comparison of age distribution between the two groups.

	Group (S-V) n=32	Group (T-V) n=32	P-value
Range	(24-44)	(24-54)	0.8
Age (Mean± SD)	32.37±6.17	31.96±10.39	

Table 2. The patients and teeth' characteristics including gender, type of teeth and number of root canals.

	Group (S-V) N (%)	Group (T-V) N (%)	P-value
Gender			
Female	25 (78.1%)	28 (87.5%)	0.3
Male	7 (21.9%)	4 (12.5%)	
Tooth type			
Mandibular 1st premolar	7 (21.9 %)	4 (12.5 %)	0.67
Mandibular 2nd premolar	6(18.8 %)	9 (28.1%)	
Maxillary 1st premolar	13(40.6 %)	9 (28.1%)	
Maxillary 2nd premolar	6(18.8 %)	7 (21.9%)	
Number of canals			
One root canal	18 (56.3 %)	21 (65.6%)	0.4
Two root canal	14 (43.8 %)	11 (34.4%)	

The majority of patients in both groups recorded mild level of pain after retreatment. At all times interval, none of the patients in the two groups reported severe pain. While at 8, 12, 24, 48h and 7 days intervals, none of the patient reported moderate pain.

For single-visit group, none of the patients reported pain after 48h and 7 days. Mild pain was recorded in 93.8% after 6h, 68.8% after 8h, 56.3% after 12h and 31.3% after 24h. Moderate pain was only reported after 6h in 6.3% of the patients.

For two-visit group, none of the patients reported pain after 48h and 7 days. Mild pain

was recorded in 68.8%, 62.5%, 31.3%, and 15.6% of the patient after 6h, 8h, 12h, and after 24h respectively. None of the patient had moderate pain after all the times interval.

Statistical analysis revealed that patients in the single-visit group had significantly higher percentages of POP scores at 6h compared to the two-visit group ($p < 0.05$). However, there were no significant differences in pain scores at the other time intervals ($P > 0.05$). Four patients in the single visit group (12.5%) and two patients in the two-visit group (6.3%) have taken analgesics from the fear of increasing pain especially during the sleep.

Table 3. Frequency (n), percentage (%) and results of Chi square test for pairwise comparisons between the two groups regarding the different pain categories.

Variables	Pain categories	Groups		p-value
		Group (S-V) n (%)	Group (T-V) n(%)	
6-hrs	No pain	0(0)	16(50)	<0.001*
	Mild pain	30(93.8)	16(50)	
	Moderate pain	2(6.3)	0(0)	
	Severe pain	0(0)	0(0)	
8-hrs	No pain	6(18.8)	20(62.5)	0.098ns
	Mild pain	26(81.3)	12(37.5)	
	Moderate pain	0(0)	0(0)	
	Severe pain	0(0)	0(0)	
12-hrs	No pain	14(43.8)	22(68.7)	0.051ns
	Mild pain	18(56.3)	10(31.3)	
	Moderate pain	0(0)	0(0)	
	Severe pain	0(0)	0(0)	
24-hrs	No pain	22(68.8)	27(84.4)	0.143ns
	Mild pain	10(31.3)	5(15.6)	
	Moderate pain	0(0)	0(0)	
	Severe pain	0(0)	0(0)	
48-hrs	No pain	32(100)	32(100)	1ns
	Mild pain	0(0)	0(0)	
	Moderate pain	0(0)	0(0)	
	Severe pain	0(0)	0(0)	
7 days	No pain	32(100)	32(100)	1ns
	Mild pain	0(0)	0(0)	
	Moderate pain	0(0)	0(0)	
	Severe pain	0(0)	0(0)	

Discussion

NSER is primarily indicated when the PRCT has failed, as indicated by radiographic and clinical signs and symptoms (AAE, 2020). However, even in cases where the initial PRCT shows substandard quality but no clear evidence of failure, retreatment might not be initially necessary unless a new coronal restoration is planned (Terauch, 2019; Roda et al., 2020). Nevertheless, it is worth

considering NSER for such cases, even without the need for constructing coronal restoration, due to potential negative impacts on the overall endodontic outcome (Ng et al., 2008; Azim et al., 2016).

Several studies have identified inadequate aspects of root canal treatment, such as inadequate filling length and density and

presence of missed canals, as significant predictors of negative outcome for PRCT (Sjogren et al. 1990, Ng et al. 2008, de Chevigny et al. 2008, Azim et al. 2016, Baruwa et al. 2020). Even in absence of apparent disease signs and symptoms, these conditions could pose risk of disease development due to the potential presence of microbes and residual debris, providing a conducive environment for microbial growth and the eventual development of periapical disease, albeit over time. Consequently, performing a retreatment procedure before the emergence of a pathological state that could adversely affect the outcome of retreatment is a prudent consideration (Ng et al., 2011; Karaoglan et al., 2022).

The occurrence of POP can be influenced by a range of factors, which can be categorized into patient-related, tooth-related, and retreatment procedure-related factors. Each of these factors encompasses numerous variables, some of which may hold more significant influence than others in affecting POP. However, apart from the presence of POP, establishing a direct causal link between these factors and POP yields contradictory results. (Garcia-Font et al. (2018) Genc et al. (2020 Sadaf et al. (2021).

In this study, efforts were undertaken to minimize the impact of these variables. This was achieved by implementing inclusion and exclusion criteria based on factors such as patient age, medical condition, tooth type, POP, and periapical tissue status. Additionally, steps were taken to ensure a balanced distribution of gender, tooth types, and the number of root canals between the two study groups. Furthermore, selection of retreatment cases with closely-matching criteria, and procedures were standardized to reduce potential variations. Previous studies examining the association between the number of treatment visits and POP either chose multi-rooted teeth like premolars and molars (Yoldas et al. 2004, Uyan et al. 2018) or

encompassed various tooth types (Erdem et al. 2018).

It is important to note that clinical cases requiring retreatment can vary significantly in terms of complexity, potentially necessitating diverse and variable treatment procedures. These procedures may differ in terms of time, effort, required skill, and specialized equipment. In this study, effort was undertaken to standardize the clinical cases through the exclusion of those with specific procedural errors. Examples of such errors include overextended root canal filling, perforations, and separated instruments. Additionally, cases with ledges and blockages that couldn't be directly managed were also excluded. It is important to acknowledge that the presence of these procedural errors might not necessarily affect treatment outcomes if the root canal can still be negotiated and prepared effectively. However, these errors could introduce a higher level of uncertainty in the management process and might require different protocols.

Although ensuring the proximity of all clinical parameters during case selection, such as the type of root canal filling materials, length, and quality of root canal obturation can potentially facilitate the removal of root contents with a similar tendency for debris extrusion and comparable tissue reactions (Seltzer and Naidorf, 1985), achieving such consistency can be challenging. Indeed, it is reasonable to assume that collecting an adequate sample size with precisely matched criteria is a challenge in clinical studies related to NSER.

In the current study, irrespective of the retreatment approach, the predominance of patients experienced either no pain or only mild pain within the 24h post-treatment that subsided by both the 48h and 7-day. This outcome could be attributed, at least in part, to the absence of POP, a factor recognized as a significant predictor of POP. A study conducted by Garcia-Font (2018) reported that patients who were asymptomatic prior to

retreatment generally remained without symptoms following the two- visits procedure. However, the scenario changed when POP was present. **Comparin et al. (2017)**, in their research on single-visit retreatment, and **Erdem (2018)**, for both single and multiple visits, observed a significant higher incidence of POP after 24h. Another explanation for these findings could be associated with the use of rotary systems during the procedure, which might have contributed to a decreased level of debris extrusion (**Topçuoğlu and Topçuoğlu 2017**).

Other studies have also reported a notable incidence of no to mild pain levels within 24h post-retreatment, supporting the findings in the current study. **Yune (2017)** documented this trend in 67.5% of all patients, and **Erdem (2018)** similarly observed high percentages (76% for two-visits and 62% for single-visits). This consistency aligns with the outcomes of a meta-analysis conducted on this topic by **Scardini et al. (2023)**.

Regarding patients who underwent single-visit NSER in our study, there is a significantly higher incidence of mild pain at the 6h compared to the two-visit approach. This finding might be attributed to the cumulative effects of the single-visit retreatment procedure, which includes various steps such as root canal filling removal, cleaning, shaping, and obturation. This sequence of actions could potentially lead to greater tissue irritation. In contrast, the lower pain incidence at 6h in the two-visit group might not be directly related to the antimicrobial effects of calcium hydroxide (CH), which has a slow onset of action (**Anjaneyulu and Nivedhitha, 2014; Ahmed et al., 2022**). The absence of severe pain in the present study could be attributed, once again, to the lack of POP and periapical lesions factors, which are recognized as significant risk factors for endodontic flare-ups (**Akosy et al., 2021**). However, it is important to acknowledge that this lack of these factors in

the inclusions criteria could be considered a limitation of the study.

The similar incidence of POP between the two groups at the other time intervals (24, 48h, and 7 days) contradicts findings from **Yoldas et al. (2004)**, **Yune (2017)**, and **Erdem et al. (2018)**, where the first two studies reported significantly higher pain levels following single-visit compared to two-visit approach, while the third study recorded higher pain levels following the two-visit approach. Furthermore, there are additional discrepancy with the aforementioned studies, including the presence of higher incidences of moderate pain (10-30%) and occurrences of low incidences of severe pain (2.5%-12%) in these studies. These discrepancies may stem from methodological differences among the studies. For instance, regarding **Yoldas et al. (2004)**, their study involved patients with preoperative pain and utilized a combination of calcium hydroxide and chlorhexidine as an intracanal medicament and patients were treated in two or more visits. **Yune (2017)** chose multirrooted teeth with periapical lesions and employed the Heft-Parker Visual Analog Scale (VAS) for pain level recording. In the case of **Erdem et al. (2018)**, there were various variables related to patient selection criteria and treatment procedures, including different types of teeth with or without preoperative pain and periapical disease. Additionally, they used Gates Glidden drills along with hand files for gutta-percha removal. Alongside these variations, discrepancies in research methodology, such as the timing and methods used for pain assessment, contribute to the disagreement between this study and others.

This study has potential limitations. The single-visit retreatment can be applied as a treatment approach for managing inadequately treated asymptomatic teeth. Application of the present results to different clinical studies requires attention because of the limitations of the present study and the limited data in the

literature about this topic. So, further studies are required to prove the results.

Conclusions

Within the parameters of this study, a predominant number of patients reported either no pain or mild pain following both single and two-visit NSER procedures, with a higher incidence of mild pain scores in single-visit compared to the two-visit approach at 6h post-treatment. This outcome suggests that both approaches are viable and satisfactory for managing asymptomatic premolars with inadequate primary root canal treatment.

Conflict of Interest:

The authors declare no conflict of interest.

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Ethics:

This study protocol was approved by the ethical committee of the faculty of dentistry-Cairo university on: 23/6/2020, approval number: 9.6.20

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