



Outcome and incidence of postoperative pain at single versus multiple visits of endodontic treatment

Gazala Ehtiba¹, Ali Ahtiba²

¹Department of Operative Dentistry and Endodontics, Dental faculty, Sirte University, Libya

²Dental Department, Sirte polyclinic center, Sirte, Libya

Keywords:

Success rate
Postoperative pain
Root canal treatment
Single versus multiple visit

ABSTRACT

Aim: To assess the success rate and the incidence of postoperative pain after single- and multi-visit endodontic treatment of teeth with vital and non-vital pulp. **Methods:** A total of 146 teeth were used in this investigation. The patients were divided into two groups at random and received treatment by two endodontists. Patients in group 1 had their teeth obturated at the same visit, but those in group 2 had their teeth temporarily cemented and obturated after a week. Patients were called back after a week to evaluate their postoperative pain. The criteria of the European Society of Endodontics were used to compare the success rates of the two groups. The Compare means by independent samples, t-test, and descriptive statistics were used to statistically examine the data. The significance level was set at $p > 0.05$. **Results:** The incidence of postoperative pain was (31%) in cases had single visit treatment and (33%) for cases treated under multiple visits, with a slight significant difference ($p = 0.054$). Teeth with vital pulp experienced more postoperative pain (45%) than teeth with non-vital pulp (19%), with statistically significant difference ($p = 0.035$), in both treatment regimen. The success rate was higher in both groups, single visit treatment (88%) and multiple visit treatment (90%) at ($p = 0.043$). **Conclusion:** Within the limitations of the current study, there was a high incidence of postoperative pain after root canal treatment. No significant difference be present in postoperative pain after single-visit or multiple-visit treatment. In addition, neither single-visit nor multiple-visit has great effect over the other in terms of the success rate.

نتائج وحدوث آلام ما بعد العلاج في زيارات واحدة مقابل زيارات متعددة للعلاجات اللبية

*غزالة احطبية¹ و علي احطبية²

¹قسم طب الأسنان الجراحي وعلاج الجذور، كلية طب الأسنان، جامعة سرت، ليبيا

²قسم طب الأسنان، مجمع عيادات سرت، سرت، ليبيا

الكلمات المفتاحية:

نسبة النجاح
آلام ما بعد العلاج
المعالجة اللبية
الزيارات الفردية مقابل الزيارات
المتعددة

الملخص

الهدف: تقييم معدل النجاح وحدوث الألم بعد المعالجة اللبية خلال زيارة واحدة أو زيارة متعددة للأسنان ذات اللب الحيوي وغير الحيوي. الطرق: تم استخدام ما مجموعه 146 سنًا في هذا البحث. تم تقسيم المرضى إلى مجموعتين بشكل عشوائي وتلقوا العلاج من قبل اثنين من أطباء الأسنان. تم حشو أسنان المرضى في المجموعة الأولى في نفس الزيارة، لكن المرضى في المجموعة 2 تم تثبيت أسنانهم مؤقتًا وسدها بعد أسبوع. تم استدعاء المرضى مرة أخرى بعد أسبوع لتقييم آلام ما بعد العلاج. تم استخدام معايير الجمعية الأوروبية لطب الأسنان لمقارنة معدلات نجاح المجموعتين. تم استخدام وسائل المقارنة بالعينات المستقلة، واختبار t، والإحصاء الوصفي لفحص البيانات إحصائياً. تم تحديد مستوى الأهمية عند $p > 0.05$. النتائج: كانت نسبة حدوث الألم بعد العلاج (31%) في الحالات التي عولجت بزيارة واحدة و (33%) للحالات التي عولجت في زيارات متعددة، مع وجود اختلاف طفيف معنوي ($P = 0.054$). شهدت الأسنان ذات اللب الحيوي ألامًا أكثر بعد العملية الجراحية (45%) مقارنة بالأسنان ذات اللب غير الحيوي (19%)، مع وجود فرق كبير إحصائياً ($P = 0.035$)، في كلا

*Corresponding author:

E-mail addresses: gazala.haiba@su.edu.ly, (A. Ahtiba) gazala.haiba@su.edu.ly

Article History : Received 29 May 2023 - Received in revised form 09 October 2023 - Accepted 20 October 2023

نظامي العلاج. وكان معدل النجاح أعلى في كلا المجموعتين، العلاج بزيارة واحدة (88%) والعلاج بزيارة متعددة (90%) عند ($P = 0.043$). الاستنتاج: ضمن حدود الدراسة الحالية، كانت هناك نسبة عالية من آلام ما بعد علاج قناة الجذر. لا يوجد فرق كبير في آلام ما بعد العلاج بزيارة واحدة أو عدة زيارات. بالإضافة إلى ذلك، ليس للزيارة الواحدة ولا للزيارة المتعددة تأثير كبير على الأخرى من حيث معدل النجاح.

Introduction

Pulp infection and subsequent apical periodontitis are primarily caused by bacteria within the root canal system (1-3). Therefore, the goal of root canal therapy is to sufficiently sanitize the root canal system. (4). To achieve this goal, complete chemo mechanical debridement is essential, followed by canal obturation. This can be done either in single visit or multiple visits (two or more). Cleaning, shaping and irrigation with disinfectants can reduce the bacterial count in the root canal system but it is impossible to achieve a bacteria-free root canal space (5, 6). The remaining microorganisms may regrow to the original number in a few days if the canal left empty (5). Many authors believe that intracanal dressing with calcium hydroxide between visits can eliminate the remaining bacteria (7), particularly in cases of non-vital teeth (8, 9). Calcium hydroxide intracanal dressing for one week between visits has been documented to attain the best results in canal disinfection (10). Even though there are still some bacteria in the canal, they are either entombed and destroyed after efficient obturation because of a lack of space and nutrients or the small amount of bacteria present is less than the threshold to maintain the periapical inflammation. (11). However, when the endodontic infection is successfully eliminated prior to root canal filling, the success percentage of root canal treatment is increased (8, 11). As a result, it logically follows that multiple visit root canal treatment with calcium hydroxide dressing should result in a higher success rate with better healing than the single-visit treatment. This is just an supposition, and it is still an extremely controversial matter (12). There are many studies and publications on single-visit endodontic. It started over a century ago, when Dodge (1887) (13) talked about "Immediate Root-Filling" and reported many successful cases. After this paper, many articles were published about the same subject. Recently, single-visit root canal treatment has received great acceptance among clinicians and patients because of time management and lower flare-up rate (14, 15). Most endodontists (70%) in the USA tend to complete root canal treatment in one visit (16). Nevertheless, the widespread practice of single-visit root canal treatment does not mean that this practice is proper. The outcome of two-visit root canal treatment results in an approximately 10% increase in success (9, 11). Histologically, Filho et al. (17) found better repair when a calcium hydroxide dressing was used as compared to immediate obturation. Another study (using animals) has shown significant increase in its success rate when calcium hydroxide is used between appointments (18). On the other hand, a randomized controlled clinical study done by Penesis et al. (19) showed that at 12 months postoperatively, there was no significant difference in periapical healing between one and two visit root canal treatment as measured by the PAI when using calcium hydroxide or chlorhexidine intracanal medicament. Similar result reported by Weiger et al. and Molander et al (20, 21). A systematic review by DeDeus et al. in 2017 concluded that the strongest available evidence shows that there are no differences in healing rates of non-vital pulps that are treated in single versus multiple visits (22).

One of the main issues with endodontic therapy is postoperative pain, which is uncomfortable for both patients and dentist. Although the eradication or reduction of post-endodontic pain is directly proportional to the efficacy of endodontic therapy, various clinical investigations have shown varying levels of discomfort, which range from 25 to 40% (23-25). The literature on single-visit versus multiple-visit endodontic provides conflicting opinions and recommendations (26, 27). Imura et al. found that multiple visits were more predisposed to flare-ups, and the authors attributed this to the fact that non-problematic cases were more likely to be treated in a single visit (15). In contrast, Ng et al. found that single-visit

treatments were associated with increased prevalence of post-obturation pain (28). Figini's review also found that single visit treatment may result in a higher frequency of swelling as well as more analgesic use, but that there was no difference in the healing rate (29).

The aim of this study was to assess the outcome and the incidence of postoperative pain at single and multiple visit of primary root canal treatment.

Methodology

The target population was patients within an age range of 18–65 years, who underwent primary RCT carried out by two endodontists. The study comprised 146 participants who had full access to their medical and dental records. According to a recorded health history and verbal interview, all patients were in good condition. Age, gender, tooth location, tooth type, and the vitality of their teeth were recorded. All treatments were performed through 2018 and 2019, in private Dental Clinic in Sirte, Libya. Both endodontists carried out all initial consultations, examination, and treatment. All patients' verbal and written agreement was requested for ethical reasons once they were informed of the course of treatment and its results. The European Society of Endodontology's evaluation standards were used to assess the effectiveness of the treatment.

Before initiating treatment, each tooth was scored according to clinical complaints, including the presence or absence of pain. Overall, 81 tooth was symptomatic (preoperative pain) and 65 tooth was asymptomatic. Ninety teeth were diagnosed as vital and 56 teeth was non-vital, 49 showed periapical lesions. Nine of the asymptomatic teeth and 41 of the symptomatic teeth received treatment in a single session; the remaining 96 teeth (56 asymptomatic and 40 symptomatic teeth) required multiple visits to complete treatment. Of the 33 teeth with lesions (about 3–5 mm).

At the first session, both groups underwent the same standard technique, which included the isolation of the rubber dam, excavation of the caries, standard access preparation, and local anesthetic with 1.8 mL of 2% by infiltration injection for the maxillary teeth, and by inferior alveolar nerve block injection for the mandibular teeth. In working length measurement, an apex locator (Rootmini ZX®, J. Morita Co., Kyoto, Japan) and periapical radiography were both used. Mechanical preparation was performed with crown-down technique, hand files, rotary file (protaper gold) and Gates-Glidden drills (Dentsply/Maillefer, Ballaigues, Switzerland). To make sure the irrigant approached the apex, each file was followed by a 2 mL irrigation of the canal with sodium hypochlorite (5%) using a 30 gauge close end, double side vent irrigation needle (irriflex®). In obturation, root canal fillings were carried out utilizing vertical compaction of guttapercha (System B, SybronEndo.) and back-filling with the thermoplasticized injectable gutta-percha technique (ObturaII Spartan, Earth City, Mo.). Chemo mechanical preparation was finished on the initial session in cases that required multiple visits (group 2) using the same method for every case. The pulp chamber was filled with a sterile cotton pellet and calcium hydroxide (Metapaste) was injected into the canal. Quick-setting zinc oxide eugenol cement was then used to cover the access cavity. One week later, the teeth were obturated as in (group 1). No systemic medication was recommended, but the patients were told to take a light analgesic (400 mg of ibuprofen) if they felt pain. One independent evaluator, who was blind to the visit group under investigation, assessed postoperative discomfort by using pain scale between 0 – 10 (Fig.1), one week after the obturation appointment.

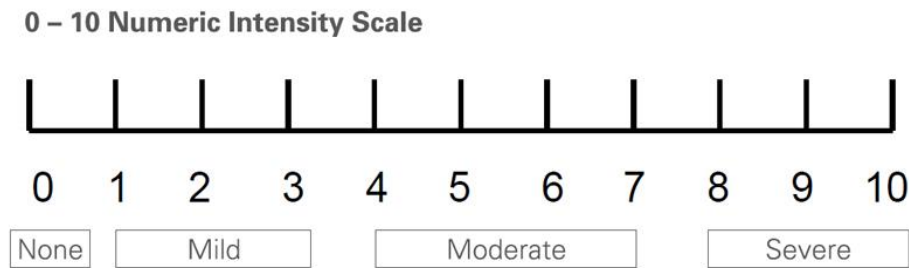


Fig.1 Pain Scale

A follow-up analysis of the clinical and radiographic data was performed at least a year later. The coronal restorations were observed to be of high quality throughout this follow-up interval. The data were analyzed statistically using the Compare means by independent samples, t-test, and descriptive statistics.

Result

Table 1 details the distribution of different patient variables in relation to preoperative and postoperative pain. The total treated patients is 146 (92 females and 54 males). Of the 50 cases in the

single-visit group, 31 were females and 19 were males. The number of patients who were male and female did not differ significantly. As regards to the tooth type, 11 anteriors, 21 premolars, and 18 molars were treated in a single visit; the postoperative pain for these single visits were 8 (73%), 19 (90%), and 18 (100%), respectively. Eleven anteriors, 37 premolars, and 48 molars were treated in the multiple-visit group; the postoperative pain was 3 (27%), 4 (11%), and 41 (85%), respectively (Table2). There is a statistical difference (p=0.046) in postoperative pain between the different tooth type.

Table 1. Distribution of different patient characteristics and the clinical characteristics of teeth in the complete healed group

Variable	Total (n) 146 teeth	Preoperative pain (n)	Postoperative pain (n)	P-value
Female	92 (63%)	48 (52%)	44 (48%)	0.511
Male	54 (37%)	33 (61%)	21 (39%)	0.021
			P-value = 0.044	
Tooth type				
Anterior	22 (15%)	14 (64%)	11 (7%)	0.035
Premolar	58 (40%)	27 (47%)	23 (16%)	0.048
Molar	66 (45%)	40 (61%)	55 (38%)	0.040
			P-value= 0.046	
Vital Pulp	90 (62%)	77 (86%)	65 (45%)	0.047
Non-vital pulp	56 (38%)	4 (7%)	28 (19%)	0.001
			P-value=0.035	
Presence of periapical lesion preoperatively	49 (34%)	18 (37%)	23 (18%)	0.516
Absence of periapical lesion preoperatively	97 (66%)	53 (55%)	68 (47%)	0.034
			P-value= 0.033	
Single visit	50	46 (98%)	45 (31%)	
Multiple visit	96	35 (36%)	48 (33%)	
			P-value= 0.054	

There is a slight statistical significant difference between the two groups (P=0.054) when the incidence of postoperative pain was compared between the groups that received a single visit (31%) and those that underwent several visits (33%) (Table 1). Additionally, a

study of postoperative pain under two treatment protocols in relation to pulpal state (Table 1) revealed that teeth with vital pulp experienced more pain frequently (45%) than teeth with non-vital pulp (19%), with a significant difference (p=0.035).

Table 2: Distribution of tooth type and Clinical characteristics for both vital and non-vital teeth in both treatment groups.

TOOTH type	Single visit				Multiple visit			
	Preoperative pain		Postoperative pain		Preoperative Pain		Postoperative Pain	
	Vital	Non-vital	Vital	Non-vital	Vital	Nonvital	Vital	Nonvital
Anterior	9 (90%)	-	7(70%)	1 (100%)	1 (20%)	4 (67%)	-	3 (50%)
	8 (73%)						3 (27%)	
Premolar	19 (100%)	-	17 (89%)	2 (100%)	8 (62%)	-	-	4 (17%)
	19 (90%)						4 (11%)	
Molar	18 (100%)	-	18 (100%)	-	22 (88%)	-	23(92%)	18 (78%)
	18(100%)						41(85%)	
Total	46 (98%)		42 (89%)	3 (100%)	31 (66%)	4 (67%)	23 (92%)	25 (47%)
			P- value- 0.025				P- value- 0.038	

Following obturation, pain was reported by 42 of the 50 patients with vital pulp in the single-visit group and 23 of the 96 patients with vital pulp in the multiple-visit group (Table 2). Between the two groups, there was obvious difference in the level of pain (P=0.035). On the other hand, only three of the 50 patients in the single-visit group and 25 of the 96 patients in the multiple-visit group who had non-vital pulp experienced pain following obturation (Table 2). This difference was highly significant (P<0.019) as well. Figure 2 shows the different percentage of postoperative pain in both treatment regimens.

At the start of the trial, 49 teeth were determined to have periapical lesions; 18 patients reported experiencing discomfort preoperatively, and 23 patients experienced pain postoperatively. According to Table 1, there was no statistically significant link between the existence of discomfort before to or following treatment and teeth that had preoperative periapical disease (P=0.516). However, there is a significant difference between the presence or absent of apical pathosis in terms of postoperative pain (p= 0.033).

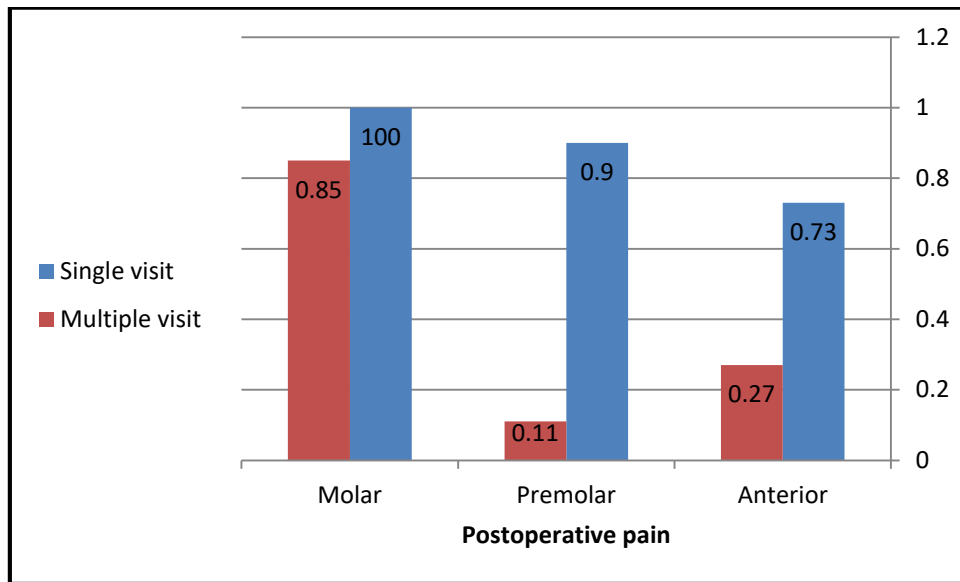


Fig.2: The percentage of postoperative pain in both treatment regimen

Table 3 shows the result that related to the success rate percentage for each group. Success rate for single visit group (88%) and multiple visit group was high (90%) respectively. The statistic difference was a slightly significant (p= 0.043).

Figure 3 shows the success rate percentage in relation to single and multiple visit through different tooth types.

Table 3: Distribution of tooth type and Success rate percentage according to assessment categories in both treatment regimens

Type of Treatment	Tooth Type			Success rate								
	Molar N(%)	Pre molar N(%)	Anterior N(%)	favourable			Unfavourable			Uncertain		
				Molar	Pre molar	Anterior	Molar	Pre molar	Anterior	Molar	Pre molar	Anterior
				N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Single	18 (27%)	21 (36%)	11 (50%)	14 (78%)	19 (90%)	11 (100%)	4 (22%)	1 (5%)	0 (0%)	0 (0%)	1 (5%)	0 (0%)
Multiple	48 (73%)	37 (64%)	11 (50%)	41(85%)	34 (92%)	11 (100%)	5(10%)	2 (5%)	0 (0%)	2 (4%)	1 (3%)	0 (0%)
Total	66 (100%)	58 (100%)	22 (100%)	55(83%)	53 (91%)	22 (100%)	9(14%)	3 (5%)	0 (0%)	2 (3%)	2 (3%)	0 (0%)

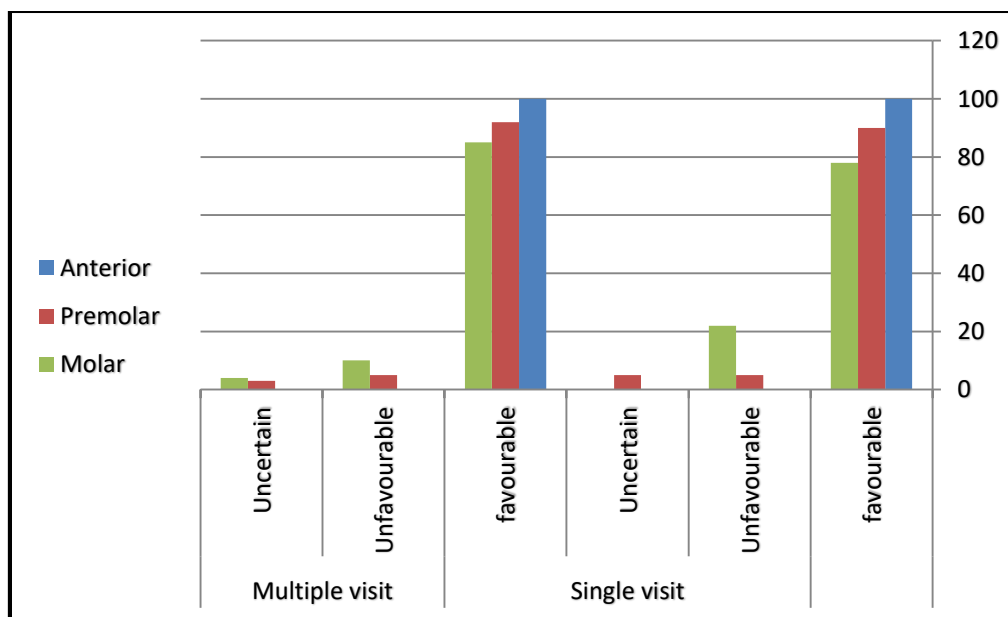


Fig. 3: Outcome of single versus multiple visit in different tooth type

Discussion

This study obviously shown that there was a difference between the two groups in the incidence of postoperative pain associated with two treatment regimens. The multiple visit group had slightly higher incidence of postoperative pain (33%) than the single visit group

(31%) with a slight statistical difference (P= 0.054). This could be as a result of multiple related factors such as periapical tissue damage from mechanical, chemical, or microbiological causes (30). Specifically, in this study the slight difference between both group could be attributed to the difference in the number of cases in single

visit (n= 50) and multiple visit (n=96).

One recent Cochrane review, which include 47 studies that demonstrated no difference in the incidence of postoperative pain between both groups (31). Other studies show conflicting in their results (32, 33). Soltanoff (1978) (32) discovered that endodontic multi-visit therapy reduced post-operative discomfort compared single visit endodontic treatments. However, he recommended that the single visit treatment in cases with vital pulp and without apical pathosis or cases with necrotic pulp has a traced sinus. In contrast, Eleazer & Eleazer (1998) (33) found that multiple-visit treatments have a much higher rate of flare-up.

The incidence of postoperative pain is influenced by the pulpal condition (25). Teeth with non-vital pulps had a greater pain frequency (41%) in comparing with vital pulp teeth, which experienced much lower pain incidence (9%) and no difference between single- and multiple-visit operations. (25). Similar findings in other investigations (34-36) have approved that no appreciable difference between vital and non-vital pulps treated over the course of a single visit or multiple visits in terms of postoperative pain. On the other hand, the results of the current study indicate the exact opposite: vital pulp experienced postoperative discomfort more frequently (72%) than non-vital pulp (50%) in both groups. This conflict could be attributed to that, the vital pulp teeth analysis treating a higher percentage of preoperatively symptomatic teeth than asymptomatic teeth. There is a highly significant difference was shown in postoperative pain between the vital in and non-vital either in single or multiple visit ($p= 0.035$, $p=0.019$), respectively.

Numerous aspects of the etiology of postoperative pain have been studied. Flare-ups, for instance, are a greater probability to take place in necrotic cases (infected) than in vital cases (noninfected), which is a definite indicator of the association between microbial interactions and periapical tissues.(14, 37).

A retrospective study by Smith et al (38) and Jenkins et al (39) found a 5.5% incidence of pain (flare-ups) in individuals with pulp necrosis and asymptomatic periapical lesions. This finding was supported by a study in which only two of 22 teeth with periapical change received endodontic treatment in a single visit before developing postoperative discomfort. (40). However, our findings contradict previous research that suggested cases with necrotic pulp had a higher frequency of postoperative discomfort or flare-ups (33, 41).

According to the result, the success rates of both treatment regimens were high, 88 % with single visit treatment and 90 % with multiple visit treatment, with slightly significant difference between them ($p=0.043$). Several studies (19, 21, 42-44) that demonstrated no significant difference in radiographic evidence of healing between single-visit and multiple visit treatment, as shown in the current study (Fig.3). However, One systematic review with meta-analysis (45) contradicted the previous results and reported that single-visit root canal treatment appeared to be slightly more effective than multiple visit.

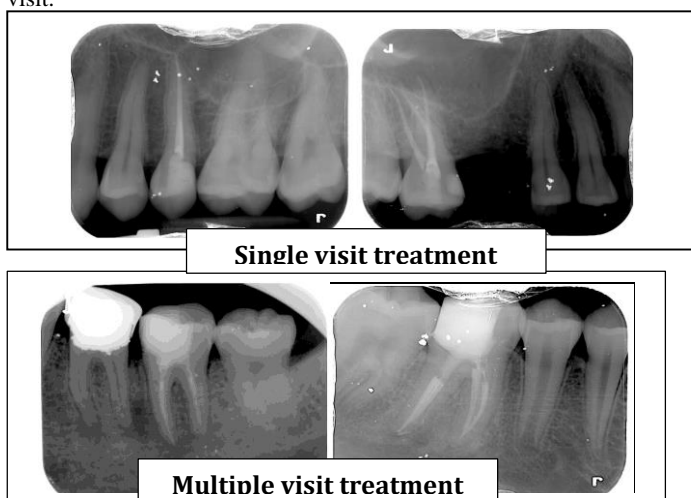


Fig. 3 Postoperative radiograph for single and multiple visit treatment.

One potential limitation of a study examining the outcome of root canal treatment is using periapical radiographs. They provide only

limited information and might result in the clinician misdiagnosing or failing to detect potential disease. Therefore, endodontic treatment planning that is dependent only on intraoral periapical radiographs may not be appropriate or sufficient for the most favourable endodontic treatment planning (46).

A cross-sectional study (47) demonstrated post-treatment apical periodontitis in 35% of teeth using periapical radiography and in 63% of teeth using CBCT. This means that in human teeth the success rate determined by CBCT can be approximately 30% lower than that determined by periapical radiography.

These findings suggest that complete resolution of existing periapical radiolucency on radiographs does not guarantee a healthy periapex. Another study evaluated the sensitivity, specificity, predictive values and accuracy of periapical radiography and CBCT in diagnosing apical periodontitis, using histopathologic findings as a gold standard. The negative predictive value (NPV) of periapical radiography in diagnosing apical periodontitis was 0.25; thus, 75% of cases confirmed healthy by periapical radiography presented apical periodontitis by histology (48).

It is essential to be aware of these limitations when relying on periapical radiographs for evaluating root canal outcome. Incorporating other diagnostic tools, such as cone-beam computed tomography (CBCT) or clinical examination findings, can offer a more thorough evaluation of the root canal condition and periapical health.

Conclusions

It is possible to draw the conclusion that neither single visit endodontic therapy nor multiple visit endodontic therapy could be carried out without producing postoperative pain. In addition, although the success rates of both treatment regimens were high, the multiple-visit root canal treatment appeared to be slightly more effective than single visit on the outcome of root canal treatment.

References

- [1]- Kakehashi S SH, Fitzgerald RJ. The effects of surgical exposures of dental pulps in germ free and conventional laboratory rats. *Journal of Oral Surgery*. 1965;20:340-9.
- [2]- Sundqvist G. *Bacteriological Studies of Necrotic Dental Pulp*. Umea: Umea University. 1976.
- [3]- Moller AJ FL, Dahlen G, Ohman AE, Heyden G Influence on periapical tissues of indigenous oral bacteria and necrotic pulp tissue in monkeys. *Scandinavian journal of dental research*. 1981;89:475-84.
- [4]- Endodontology ESo. Quality guidelines for endodontic treatment: consensus report of the European Society of Endodontology. *International Endodontic Journal*. 2006;39(12):921-30.
- [5]- Bystrom A SG. Bacteriologic evaluation of the efficacy of mechanical root canal instrumentation in endodontic therapy. *Scandinavian journal of dental research*. 1981;89:321-8.
- [6]- Peters LB vWA, Buijs JF, Wesselink PR. Effects of instrumentation, irrigation and dressing with calcium hydroxide on infection in pulpless teeth with periapical bone lesions. *International Endodontic Journal*. 2002;35(13-21).
- [7]- Bystrom A CR, Sundqvist G. The antibacterial effect of camphorated paramonochlorophenol, camphorated phenol and calcium hydroxide in the treatment of infected root canals. *Endodontics and Dental Traumatology* 1, 170-5. 1985;1:170-5.
- [8]- Sjögren U FD, Persson S, Sundqvist G. Influence of infection at the time of root filling on the outcome of endodontic treatment of teeth with apical periodontitis. *International Endodontic Journal*. 1997;30(5):297-306.
- [9]- Sjögren U HB, Sundqvist G, Wing K. Factors affecting the long-term results of endodontic treatment. *International Endodontic Journal*. 1990;16(10):498-504.
- [10]- Sjögren U FD, Spangberg L, Sundqvist G. The antimicrobial effect of calcium hydroxide as a short-term intracanal dressing. *International Endodontic Journal*. 1991;24:119-25.

- [11]- 11. Trope M DE, Ørstavik D. Endodontic treatment of teeth with apical periodontitis: single vs. multi visit treatment. *Journal of Endodontics*. 1999;25:345-50.
- [12]- 12. Weine FS BS. Controversies in clinical endodontics: Part 2. Single appointment vs multiple appointment treatment. *Compendium of Continuing Education in Dentistry*. 1997;18:140-4.
- [13]- 13. Dodge JS. Immediate Root-Filling. *Dental Cosmos*. 1887;29:234-5.
- [14]- 14. Walton R FA. Endodontic interappointment flare-ups: a prospective study of incidence and related factors. *Journal of Endodontics*. 1992;18:172-7.
- [15]- 15. Imura N ZM. Factors associated with endodontic flare-ups: a prospective study. *International Endodontic Journal*. 1995;28:261-5.
- [16]- 16. Whitten BH GD, Jeansonne BG, Lemon RR. Current trends in endodontic treatment: report of a national survey. *Journal of the American Dental Association*. 1996;127:1333-41.
- [17]- 17. Filho M LM, da Silva L,. Effect of irrigating solution and calcium hydroxide root canal dressing on the repair of apical and periapical tissues of teeth with periapical lesion. *Journal of Endodontics*. 2002;28(4):295-9.
- [18]- 18. Silveira AM LH, Siqueira JF, Jr., Macedo SB, Consolaro A. Periradicular repair after two-visit endodontic treatment using two different intracanal medications compared to single-visit endodontic treatment. *Brazilian dental journal*. 2007;18:299-304.
- [19]- 19. Pensis VA FP, Fayad MI, Wenckus CS, BeGole EA, Johnson BR,. Outcome of one-visit and two-visit endodontic treatment of necrotic teeth with apical periodontitis: a randomized controlled trial with one-year evaluation *Journal of Endodontics*. 2008;34(3):251-7.
- [20]- 20. Weiger R RR, Lost C. Influence of calcium hydroxide intracanal dressings on the prognosis of teeth with endodontically induced periapical lesions. *International Endodontic Journal*. 2000;33(3):219-26.
- [21]- 21. Molander A WJ, Reit C, Kvist T. Clinical and radiographic evaluation of one- and two-visit endodontic treatment of asymptomatic necrotic teeth with apical periodontitis: a randomized clinical trial. *Journal of Endodontics*. 2007;33(10):1145-8.
- [22]- 22. De-Deus G CA. Strength of recommendation for single-visit root canal treatment: grading the body of the evidence using a patient-centred approach. *International Endodontic Journal*. 2017;50(3):251-9.
- [23]- 23. Holstein A HK, Neiderman R. Evaluation of NSAIDs for treating post-endodontic pain. *Endodontic Topics*. 2002;3:3-13.
- [24]- 24. DiRenzo A GT, Johnson BR, Rogers M, Tucker D, BeGole EA,. Postoperative pain after 1- and 2-visit root canal therapy. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2002;93:605-10.
- [25]- 25. Albashairh ZS AA. Postobturation pain after single- and multiple-visit endodontic therapy. A prospective study. *Journal of Dentistry*. 1998;26(3):227-32.
- [26]- 26. Pekruhn RB. Single-visit endodontic therapy: a preliminary clinical study. *Journal of American Dental Association*. 1981;103:875-7.
- [27]- 27. Jurcak JJ BR, Loushine RJ,. Successful single visit endodontics during Operation Desert Shield. *Journal of Endodontics*. 1993;198:412-3.
- [28]- 28. Ng YL GJ, Setchell DJ, Gulabivala K, . Prevalence of and factors affecting post-obturation pain in patients undergoing root canal treatment. *International Endodontic Journal*. 2004;37(6):381-91.
- [29]- 29. Figini L LG, Gorni F, Gagliani M. Single versus multiple visits for endodontic treatment of permanent teeth. *Cochrane Systematic Review. Journal of Endodontics*. 2008;34(9):1041-7.
- [30]- 30. Patil AA JS, Bhagwat SV, et al. . Incidence of postoperative pain after single visit and two visit root canal therapy: a randomized controlled trial. *Journal of Clin Diagn Res* 2016;10:9-12.
- [31]- 31. Mergoni G GM, Lodi G, Figini L, Gagliani M, Manfredi M. Single versus multiple visits for endodontic treatment of permanent teeth (Review). *Cochrane Database Syst Rev*. 2022(12 Art. No.: CD00529).
- [32]- 32. Soltanoff W. A comparative study of the single-visit and the multiple-visit endodontic procedure. *Journal of Endodontics*. 1987;11:278-81.
- [33]- 33. Eleazer PD EK. Flare-up rate in pulpally necrotic molars in one-visit versus two-visit endodontic treatment. *Journal of Endodontics*. 1998;24(9):614-6.
- [34]- 34. Fava LR. A comparison of one versus two appointment endodontic therapy in teeth with non-vital pulps. *International Endodontic Journal*. 1989;22:179-83.
- [35]- 35. Roane JB DJ, Grimes EW,. Incidence of postoperative pain after single- and multiple-visit endodontic procedures. *Oral Surgery Oral Medicine Oral Pathology*. 1983;55:68-72.
- [36]- 36. Oliet S. Single-visit endodontics: a clinical study. *Journal of Endodontics*. 1983;9:147-52.
- [37]- 37. Seltzer S NI. Flare-ups in endodontics: I. Etiological factors. *Journal of Endodontics*. 1985;11:472-8.
- [38]- 38. Smith CS SD, Harty FJ,. Factors influencing the success of conventional root canal therapy — a 5-year retrospective study. 1993;26:321-3.
- [39]- 39. Jenkins SM HS, Dummer PMH,. A study of endodontic treatment carried out in dental practice within the UK. *International Dental Journal*. 2001;34:16-22.
- [40]- 40. Fox J AJ, Dinin AP, Greenfield E, Hechtman E, Reeman CA, Salkind M, Todaro CJ,. Incidence of pain following one-visit endodontic treatment. *Oral Surgery Oral Medicine Oral Pathology*. 1970;30:123-30.
- [41]- 41. Mor C RI, Friedman S. . Incidence of interappointment emergency associated with endodontic therapy. *Journal of Endodontic*. 1992;18:509-11.
- [42]- 42. K B. Trial suggests no difference between single-visit and two-visit root canal treatment. *Evidence Based Dentistry*. 2013;14(2):48.
- [43]- 43. Paredes-Vieyra J EF. Success rate of single- versus two-visit root canal treatment of teeth with apical periodontitis: a randomized controlled trial. *Journal of Endodontic*. 2012;38(2):1164-9.
- [44]- 44. Kvist T MA, Dahlén G, Reit C,. Microbiological evaluation of one-and two-visit endodontic treatment of teeth with apical periodontitis: a randomized, clinical trial. *Journal of Endodontics*. 2004;30(8):572-6.
- [45]- 45. C. Sathorn PPHM. Effectiveness of single- versus multiple-visit endodontic treatment of teeth with apical periodontitis: a systematic review and meta-analysis. *International Endodontic Journal*. 2005(38):347-55.
- [46]- 46. Patel S DA, Mannocci F, Wilson R, Pitt Ford T. Detection of periapical bone defects in human jaws using cone beam computed tomography and intraoral radiography. *International Endodontic Journal*. 2009;42:507-15.
- [47]- 47. Estrela C BM, Leles CR, Azevedo B, Azevedo JR. Accuracy of cone beam computed tomography and panoramic and periapical radiography for detection of apical periodontitis. *Journal of Endodontics*. 2008;34:273-9.
- [48]- 48. de Paula-Silva FW WM, Leonardo MR, da Silva LA, Wesselink PR. Accuracy of periapical radiography and cone-beam computed tomography scans in diagnosing apical periodontitis using histopathological findings as a gold standard. *Journal of Endodontic*. 2009;35(7):1009-12.