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ENDODONTIC TREATMENT IN ONE SESSION VERSUS MULTIPLE SESSIONS: AN UPDATE REVIEW

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Abstract: Objectives: This study aimed to analyze, through a literature review, the microbiological aspects of necrotic teeth, painful postoperative symptoms, intracanal medication action, and the interference of these factors in the success rate of endodontic treatment. **Methods:** It was carried out a literature search covering articles published in dental journals from January 2009 to June 2023 in resorting to electronic databases such as Pubmed, Scielo, Medline, Web of Science, Scopus, Elsevier inserted in CAPES journals. The relevant articles were initially evaluated based on their titles and abstracts. Later, the selected studies were subjected to a full text evaluation and review for compliance with the inclusion and exclusion criteria. In possession of the selected articles, data extraction was carried out, the assessment of methodological quality, synthesis and analysis of data were done. **Results:** Initially, considering only the title, 93 articles were found, of which 62 did not meet the inclusion criteria. The 21 articles selected for full reading were related to the number of sessions, endodontic post-treatment pain, intracanal medication, resident microorganisms in the root canal, and factors related to success or endodontic failure. **Conclusion:** Studies have shown that the endodontic treatment in one session has no difference in terms of periapical repair and microbial control, moreover in the pain incidence when compared to endodontic treatment performed in more than one session.

Keywords: Endodontic treatment; one session; multiple sessions; endodontic microbiology.

INTRODUCTION

The endodontics is a key specialty in dentistry, because through it, it is possible to achieve complete removal of the pulp tissue promoting disinfection of the root canal system. To be successful in the treatment provided it is required to be followed scientific, mechanical and biological principles. These principles and clinical steps are directly related to the successes and failures of the endodontic treatment [14].

The introduction of new technologies in endodontic therapy made its operative steps being performed faster. New concepts have been formed in this and increasingly endodontic treatment has been performed in a single session [21].

The choice of the number of sessions for endodontic treatment should be made after the observation of objective factors such as preoperative diagnosis, the ability to get the infection control, anatomy of the root canal, procedural complications and subjective factors such as patients signs and symptoms [3,15].

Microbiological factor has been highlighted in the literature, since most of the pulpal diseases and periapical tissues is directly or indirectly related to the growth of microorganisms. Still, it is relevant to consider the inability of the treatment to eliminate some species of microorganisms, which are resistant to chemical and surgical procedures for the instrumentation of the root canal system and also the local and systemic medication. This invariably incurs the perpetuation of the infectious processes [9].

There is resistance from some professionals to perform endodontic treatment in one session. The most common justifications are that this procedure produces a higher incidence of postoperative pain and lower percentage of success. Additionally, some professionals also claim that the teeth with periapical pathologies who cause more complications have a worse prognosis when treated in one session [24].

Following another philosophy, other studies [2,7,24,31] have shown that instrumentation and irrigation of the root canal by itself,

dramatically decreases the number of bacteria within the root canal system, although there is no complete microorganism's elimination. These studies suggest that the low number of bacteria remaining in the root canals is not sufficient to sustain a periradicular infection since these microorganisms are buried or not feasible, due to lack of nutrition and space after the actual filling of the root canal. Therefore, it was assumed that the additional antisepsis with intracanal medication of calcium hydroxide would make no significant difference in the final outcome [24]. However, studies show that disinfection with calcium hydroxide before the root canal filling, increases the possibilities of periapical repair [21,31].

Established the absence of consensus in the literature on single or multiple sessions to carry out an endodontic treatment of teeth with pulp necrosis and apical periodontitis, the relevance of this study becomes evident. The objective of this work is based on the current literature, analyzing the microbiological aspects of necrotic teeth considering the complex anatomy of the root canal system, the painful symptoms after treatment, the action of the intracanal medication employed, and the interference of these factors in endodontic treatment success rate.

METHODS

In order to perform this study, a survey was conducted covering articles published in dental journals from January 2009 to March 2023, by resorting to electronic databases such as Pubmed, Scielo, Medline, Web of Science, Scopus, Elsevier inserted in Portal Capes journals, using the following descriptors: "Endodontics", "Single Session", "Endodontic Microbiology", "Multiple Sessions", "Endodontic Treatment", "Una Sesión", "One session", "One visit", "Single Visit", which have been surveyed in multiple associations. Related articles and lists of references in literature reviews were individually checked for possible more eligible items.

A proper selection of articles was made following the inclusion criteria: *In vivo* studies; developed in humans; published in English, Spanish, and Portuguese; postoperative pain as variable; pulp necrosis; multiple sessions; intracanal medication. The specific exclusion criteria were: *In Vitro* Studies; developed in animals; multiple sessions; studies carried out without medication; deciduous teeth; and studies with no comparison between single- and multiple-visit.

The relevant articles were initially evaluated based on their titles and abstracts. Later, the selected studies were subjected to a full text evaluation and review for compliance with the criteria for inclusion and exclusion described above. In possession of the articles, a table has been drawn up with some of them in order to perform the assessment of a methodological quality, synthesis and analysis of the data (Table 1).

RESULTS

Ninety-three studies were included in the analysis. None of the studies justified the sample size selection. The majority of the studies did not differentiate preoperative pulpal/periapical status; preoperative pain was not reported either, despite its predictive value for postoperative pain. Amongst the included studies, thirteen were randomized clinical trials comparing single and multiple-visit approaches, two were retrospective cohort studies, five were systematic review, five were review, and the others about basic research (Table 1). Endodontic treatment procedures varied amongst studies in type of instrumentation technique, medication and concentration of sodium hypochlorite used as irrigant. The 36 selected studies to complete reading were related to the number

of sessions, endodontic post-treatment pain, intracanal medication employed, factors related to success and failure of the endodontic treatment, and resident microorganisms in the root canals. Overall, the clinical procedures followed currently accepted standards.

REVIEW

The professional specialized in endodontics area must know the structure of the endodontic microorganisms, its organization and distribution in the root canal system aiming to establish a therapeutic strategy for treating and preventing endodontic infection.

The three clinical conditions that professional handles the day-to-day endodontic practice and require intervention include teeth with irreversible pulpitis, teeth with pulp necrosis, and retreatment cases [7].

TEETH WITH IRREVERSIBLE PULPITIS

In irreversible pulpitis, pulp infection is limited to the surface where there is a localized inflammatory response while in the apical region the microorganisms are not normally present. The pulpectomy, namely the removal of the pulp and replacing it with a filling material, taking into account that inflammation is irreversible, prevents the contamination to reach the apical region of the root canal system. In other words, a prophylactic measure can be considered in order to prevent the development of periapical lesions. In this important respect, the repair will also be favored if there were not employed highly toxic substances during the course of treatment that might trigger or maintain an inflammation of the periradicular tissues [31].

PULP NECROSIS

The root canal with pulp necrosis is devoid of blood vessels which can transport cells and defense molecules, besides systemically administered antibiotics for the infected site. Thus, the success rate of treatment will depend not only on the root canal asepsis, but also on the elimination or maximum reduction of bacteria within the root canal system [31].

MICROORGANISMS IN ENDODONTIC INFECTIONS

The literature confirms the association between microorganisms and cases of failure of the endodontic therapy and it was observed that the type of microorganisms involved is relatively variable according to characteristics of the pathological process. The microbial communities involved in asymptomatic and symptomatic episodes differ, as well as primary and secondary infections. There are microorganisms which are resistant to root canal preparation and intracanal and systemic medications, in addition, recent research using conventional or more modern techniques have allowed the identification of microorganisms involved and even new species and fungi related to maintenance of pulp and periapical diseases. Faced with this evidence, it is important that the professional knows the microbial entities involved in pathological processes in Endodontics seeking the most appropriate intervention [2,9].

In the root canal system, the microorganisms are organized into biofilms [2,25]. The term Biofilm may be defined as a multistage sessile microbial community characterized by cells that are firmly attached to a surface and enmeshed in a self-produced matrix of extracellular polymeric substance generally polysaccharide [11,25,26]. Bacterial cells in biofilms form microcolonies which are embedded and distributed in the extracellular matrix and separated by water canals. The

microcolonies usually have the form of "towers" or "mushrooms." Dental biofilms can reach up to 300 or more cell layers thick. The individual microcolonies can be formed in a single bacterial species but more often are composed of different species in a mixed community. The array is not only important physically but it is also biologically active and can retain nutrients, water and essential enzymes within the biofilme [2,25,26]. The microcolonies that form the biofilm surface are colonized by the planktonic bacterial cells. Aggregated in biofilms they adopt a radically different phenotype compared to planktonic counterparts.

The biofilm infection is one of the most crucial factors for chronic or recurrent disease because the sessile bacteria are more resistant to antimicrobial agents. In the apical part of the root canal, bacteria biofilms also cause many chronic diseases, and infectious persistent or recurrent diseases. It is also known that the main reason for the absence of cure is the survival of microorganisms embedded in a biofilm. *Prevotella intermedia* is able to form biofilms involved in polysaccharides, and to induce serious injuries abscesses in rats when compared to bacteria which do not form biofilms. The Bacteria *Actinomyces sp* are known as the first settlers of the oral cavity involved in biofilm development. Sometimes it causes oral infections such as actinomycosis, periapical abscess, infections of root canals system, and implant infections [2,25,26].

The concentration of antibiotic required to kill bacteria in the biofilm is about 100 to 1000 times higher than that required to kill the same species in planktonic state. One of the mechanisms involved in biofilm resistance is its structure which can restrict the penetration of antimicrobial agents. The deepest bacteria remain intact and biofilm matrix may also agglutinate and retain neutralizing enzymes at concentrations which could disable antimicrobial agent [11].

ENDODONTIC INFECTIONS

Endodontic infections can be classified according to the anatomical location (intra or extraradicular infection). The intraradicular infection is caused by microorganisms that colonize the root canal system and can be subdivided into three categories, according to the time that microorganisms enter the root canal system: Primary infection caused by microorganisms which initially invade and colonize necrotic pulpal tissue (initial infection); Secondary infection caused by microorganisms that are not present in the primary infection but were introduced into the root canal some time after professional intervention (i.e., secondary to intervention); Persistent infection, caused by microorganisms that were members of a primary or secondary infection and that, somehow resisted intracanal antimicrobial procedures and managed to support nutrient deprivation periods in previous treated root canals [25,31]. The extraradicular infection is characterized by microbial invasion of the inflamed periradicular tissue and is a sequel of an intraradicular infection that may be dependent or independent of intraradicular infection.

TREATMENT OF ENDODONTIC INFECTIONS

The privileged anatomical location of the root canal system remains entrenched bacteria inside, away from host defenses. Endodontic infections can only be treated through professional intervention employing chemical and mechanical procedures. The main stages of the endodontic treatment related to infection control are represented by the chemical-mechanical preparation, and medication between sessions. The chemical-mechanical preparation has a fundamental

importance for root canal disinfection, because the instruments and irrigating solutions act mainly in the main canal that has a more voluminous area, and therefore, hosts the largest number of bacterial cells. Sodium hypochlorite (NaOCl) is still the irrigant of choice. Chlorhexidine has no higher antibacterial efficacy than NaOCl, and it does not cause organic matter dissolution. Therefore, it does not have the same capacity of NaOCl in disrupt proteoglycans biofilm, and access the microorganisms inside the biofilm matrix [25,26].

Since residual bacteria can adversely affect the outcome of an endodontic treatment, medication use between sessions has been recommended to complement the antibacterial effects of chemical-mechanical preparation [5,11,27,30]. Calcium hydroxide is arguably the most widely used intracanal medication. In a study by Vera *et al.* (8), assessing histologically the result of a session or two for endodontic treatment of teeth with apical periodontitis they came to some conclusions. The two protocol sessions with intracanal medication of calcium hydroxide for seven days microbiologically improved treatment than one session. Residual bacteria were observed more frequently in branches, isthmus, dentinal tubules of teeth treated without medication between sessions. It reinforced the concept that the instrumentation techniques, and irrigating solutions are not capable of a complete disinfection of the root canals in a single session and the use of antibacterial medication between clinical appointments is necessary to maximize bacterial reduction before filling the root canals [15].

ONE SESSION VERSUS MULTIPLE SESSIONS: INTRACANAL MEDICATION OF CALCIUM HYDROXIDE

Although some authors think that the Endodontic treatment in a single session is the first option, others claim, and have demonstrated the high importance of intracanal medication used in removing microorganisms that chemical-mechanical preparation by itself can not reach [5,11,15,30,31]. According to some authors [3,11,14], if theres no placing of an intracanal medication, such as calcium hydroxide, it is not possible to control the bacterial colonization in the root canal system [15].

Even taking into account that cleaning and shaping of the root canal system are essential phases of the endodontic treatment, root canal medication is considered an important step towards the elimination of residual bacteria [3]. Calcium hydroxide is mentioned an agent for intracanal medication because it is bactericidal and stable for long periods. Its antimicrobial activity is linked to the release of hydroxyl ions (OH^-) in an aqueous medium, creating an alkaline pH environment which inhibits proliferation of the remaining microorganisms in the infected system after the root canal cleaning and shaping processes. Calcium hydroxide also induces the formation of a mineralized barrier, and it is effective in the removal of inflammatory exudates. Furthermore, it has the ability to neutralize endotoxins, to stimulate mineralization, to dissolved organic tissues, and to act as a physical barrier against fluids from both the periapical region, and possible coronary infiltrations [30].

A clinical study was conducted to compare the efficacy of endodontic treatment in one session versus multiple sessions in the removal of endotoxins and bacteria culturable from infected root canals. Forty-

eight infected root canals were selected and randomly divided into 4 groups: G1, NaOCl 1%; G2, 2% chlorhexidine (CHX) gel; G3, 1% NaOCl + Ca $(OH)_2$; and G4 2% CHX gel + Ca $(OH)_2$ (n = 12). G1 and G2 involved treatment in one session, while G3, and G4 the treatment was conducted in two sessions, with the placement of Ca $(OH)_2$ for 14 days. All treatment protocols were effective in reducing the bacterial load of infected root canals. No statistically significant differences were found in reducing the bacterial load when compared to the number of sessions, regardless of irrigation tested ($P > 0.05$), but higher percentages of endotoxin reduction treatment were found in groups G3, and G4 (98.01% and 96.81%, respectively) compared to groups G1, and G2 (86.33% and 84.77%, respectively), and all showed $P < 0.05$. In this clinical trial, it was concluded that both root canal treatment protocols were effective in reducing bacteria and endotoxins, however, they were not able to eliminate them in all root canals analyzed. Furthermore, the protocol with multiple sessions was more effective in reducing endotoxin levels compared to one session groups [34].

Another study analyzed the microbiological status of *In Vivo* root canals of mesial roots of mandibular molars with primary apical periodontitis after endodontic treatment in one or two sessions. In the study methodology, molars with necrotic pulps, and radiographic evidence of apical periodontitis were selected. In two sessions group the mesial canals of seven mandibular molars were included, and disinfection of the tooth and of the operative area was carried out with 5% sodium hypochlorite, which was also employed as the main irrigant solution. To the final cleanliness of the canals 5 ml of 17% EDTA was used, followed by 5 ml of saline solution, and a final wash with 5 ml of 2% chlorhexidine. All canals were subsequently treated with calcium hydroxide, access was sealed with intermediate restorative material, for a period of one week and, after that time, the canals were filled. In the group treated in one session were included the mesial canals of 6 molars treated exactly as described for those in the two sessions group, however, it was not used intracanal medication such as calcium hydroxide. The teeth were extracted seven days following the intracanal procedures. In the search results were found bacteria in the apical and middle third of 11 canals (all 6 roots of the group treated in a single session and 5 of 7 from group 2 in two sessions). The bacteria were present in the isthmus and within the dentinal tubules in 5 of 6 samples of group 1. In group of two sessions, two teeth had their root canal systems free of bacteria, however, bacteria were present in 4 of 7 patients isthmuses. After analyzing the results, the authors found that the protocol performed in two visits using intracanal medication as calcium hydroxide between sessions resulted in a better microbiological status of the root canal system when compared to the protocol made in just one clinical appointment. The authors concluded that the use of an antibacterial agent between sessions is necessary to maximize the reduction of bacteria before filling, and sealing procedures of the root canal treatment [31].

As for endodontic treatment in one session and two sessions of teeth with apical periodontitis analyzed after two years, another research was conducted. Three hundred upper and lower teeth with necrotic apical periodontitis treated in a single visit or two visits were studied. The basic criteria for inclusion were radiographic evidence of apical periodontitis (minimum size ≥ 2.0 x 2.0 mm) and a diagnosis of pulp necrosis confirmed by a negative response to hot and cold tests. Radiographically, all teeth showed small irregular periapical radiolucence before treatment. The healing results were evaluated

clinically and radiographically two years after treatment. According to the results of the study, from all the 300 treated teeth, 18 were lost in the follow-up phase, nine in the group of two sessions and nine in single session group. Of the 282 teeth studied, 146 teeth were assigned for treatment in a single session and 136 teeth for treatment in two sessions. Teeth with persistent symptoms and periapical inflammation were classified as non-healed. Teeth with a reduced periapical rarefaction were judged as uncertain. Teeth with complete restoration of periodontal contours were judged as healed. In the group treated in one session, 141 of the 146 teeth (96.57%) were classified as healed compared with 121 (88.97%) of 136 teeth in multiple sessions group. Eleven cases were classified as uncertain in two sessions group (8.08%) compared to four (2.73%) in one session group. The analysis of the healing results showed no significant difference between groups. According to the authors, this study provided evidence that there are no statistically significant differences between the two types of treatment [15].

PAIN SYMPTOMS IN ONE SESSION VERSUS MULTIPLE SESSIONS

Postoperative pain causes discomfort to the patient and should be taken into account in the process of adoption the treatment method. The pain during treatment and in the post-operative process can be reported as any type and intensity of pain, which appears right after the start of the endodontic treatment [7,20,23]. In cases of pulp necrosis, there is controversy in the scientific community regarding postoperative pain when opting for conducting the endodontic therapy in only one session [21].

A study at the Faculty of Dentistry, University of Khartoum, Sudan, selected 234 patients, aged between 18-62 years old. Conventional endodontic treatment was performed in these patients by graduate students in one or in multiple sessions (in this case it was used intracanal dressing with calcium hydroxide for 7 to 21 days). Postoperative pain was recorded for each patient using visual analogue scale in well-defined categories of two-time intervals, twelve hours and twenty-four hours. In the results, the overall incidence of postoperative pain was 9.0% after twelve hours and twenty-four hours. Postoperative pain was developed in 15.9% of patients with history of preoperative pain, while 7.1% had postoperative pain among those with no history of preoperative pain and there was no statistically significant difference in postoperative pain between one visit and multiple visits. Within the limitations of this study, the authors assessed that there was no significant difference in pain symptoms after treatment in one session or in more than one session [7].

A retrospective longitudinal research examined the occurrence of postoperative pain in patients with endodontic treatment in one session and multiple sessions. The research evaluated 141 medical records of patients treated endodontically by students of the Advanced Unit Graduate School of Inga / Uningá Passo Fundo, Brazil from February 2008 to May 2010. It was built a database where data on endodontic conditions of the treated teeth (number of sessions and presence of pain) and sociodemographic characteristics of the patients were stored. All this information was taken from the records: survey sheet anamnesis, clinical sheet for postoperative control in endodontics and clinical sheet for endodontics. In the evaluation of the 141 medical records the occurrence of pain was reported by 36.2% of patients treated in one session and 28% of patients treated in multiple sessions with no

statistically significant difference ($P > 0.05$) between single, and multiple sessions. [20].

Another clinical study also found the incidence and intensity of tooth pain after filling endodontically treated teeth in single and multiple sessions. The methodology included two hundred patients aged between 20 and 60 yers old who had need for endodontic treatment in permanent single-rooted teeth with vital and non-vital pulp diagnosis. Patients were randomized into two groups ($n = 100$). The teeth of Group 1 were filled in a single session, while the Group 2 they were filled in two sessions. To measure the painful symptomatology the authors used a visual analogue scale where patients should register the presence of pain at 6, 12, 24 and 48 hours after filling. In the results the incidence and severity of post-filling pain in both groups was gradually reduced over the study period. According to researchers, the findings of the study have shown no significant difference in the incidence of pain after endodontic treatment performed in one and multiple sessions [23].

A systematic review [29] was carried out to compare the healing rate and post-obturation pain of single- versus multiple-visit root canal treatment for teeth with infected root canals. A literature search combined with specified inclusion criteria was performed to identify randomized controlled trials, comparing root canal treatment in single and multiple appointments (2 or more visits) in patients with infected root canals. Ten studies were identified and included in this review. Of these, 6 compared the healing rate, and 5 compared the prevalence of post-obturation pain in single- and multiple-visit root canal treatment on teeth with infected root canals. No significant difference was observed in the healing rate between single- versus multiple-visit root canal treatment, as well as the incidence of medium-term post-obturation pain. As to the short-term follow up, the prevalence of post- obturation pain was significantly lower in single-visit than in multiple-visit group. It was concluded that the healing rate of single- and multiple-visit root canal treatment is similar for infected teeth. Patients experienced less frequency of short-term post-obturation pain after single-visit than those having multiple-visit root canal treatment.

Aiming to investigate whether the effectiveness and frequency of short-term and long-term complications are different when endodontic procedure is completed in one or multiple visits, a systematic review was held. Randomized and quasi-randomized controlled trials enrolling patients undergoing endodontic treatment were identified by searching biomedical databases and hand-searching relevant journals. The following outcomes were considered: tooth extraction as a result of endodontic problems and radiologic failure after 1-year, postoperative discomfort, swelling, analgesic use, or sinus track. Twelve studies were included in the review. No detectable difference was found in the effectiveness of root canal treatment in terms of radiologic success between single and multiple visits. Neither single-visit root canal treatment nor multiple-visit root canal treatment can prevent 100% of short-term and long-term complications. Patients undergoing a single visit might experience a slightly higher frequency of swelling and refer significantly more analgesic use [8].

DISCUSSION

The successful endodontic treatment depends on important factors such as the correct diagnosis of the case to be treated and a thorough implementation of the chemical-mechanical preparation technique paying attention to the complex morphology of the root canal system and the difficulties of access

and cleaning effectively this area [26].

Two protocols have been proposed by the endodontic science in order to reduce the residual infectious material from the root canal system to levels that enable the recovery of the individual and consequently get to successful treatment. One is based on the application of intracanal medication in the root canal system for a certain time; this technique will require more than one clinical appointment. The other protocol is to conduct the definitive root canal filling in a single session [31,25,26].

The literature confirms the relationship between microorganisms and cases of failure of the endodontic treatment, since the microorganisms involved are variable according to the characteristics of the pathological process [9,12,16,27]. Knowledge of the microbial community present in the root canal systems of infected teeth will enable the development of more effective strategies for the root canal treatment [1,13,31]. Endodontic procedures such as root canal instrumentation, intracanal medication, and filling, have the purpose to eradicate the infection of the root canal system preventing secondary infection. However, the methods used do not always achieve the complete elimination of endodontic microorganisms. What you get with these procedures is a reduction in bacterial population within the root canal, to a level below that required to maintain the disease process [25,26]. This happens due to the immune system which is unable to eradicate the bacteria in necrotic root canal, which lacks an active microcirculation and therefore beyond the scope of the host defenses [18 SINGH]. Specific conditions of survival and resistance of bacteria to the root canal disinfection measures are directly related to the anatomical complexity of the root canal system as isthmuses, ramifications, deltas, irregularities and dentinal tubules [26,27].

Secondary infection is understood as a community of microorganisms that still are in the root canal system after primary endodontic treatment and can lead to the development of assintomatic apical periodontitis [27,29]. The root canal in necrotic conditions is a favorable environment for the installation of microorganims dominated by anaerobic bacteria [25,26]. Culture and molecular microbiology studies have revealed the high prevalence of *E. faecalis* in cases of failure of the endodontic treatment [22,23]. The literature also points to the detection of a wide variety of *Treponema sp* indicating that the root canal microflora seems to be even more complex in teeth with failed of the endodontic treatment than previously reported [13].

Although some authors claim that endodontic treatment in a single session should be the first option, others affirm, and demonstrate the high importance of intracanal medication in eliminating microorganisms since the chemical-mechanical preparation on its own can not reach them [9,15,31]. Vera et al. [31] found in a research that residual bacteria were more frequent and abundant in ramifications, isthmuses and dentinal tubules when root canals were treated without medication between sessions. The bacteria were present in the isthmus and within the dentinal tubules in 5 of 6 samples in the group treated in a single session. Beus *et al*. [1] also showed the prevalence of residual bacteria in the root canal system when teeth were treated in one session. The authors concluded that the use of an antibacterial agent between sessions is necessary to maximize the reduction of bacteria prior to filling the root canal.

Another study compared the efficacy of endodontic treatment protocols in the removal of endotoxins and culturable bacteria of infected root canals and found that both treatment in one session and in more than one session were effective in reducing bacteria and

endotoxins, but both were unable to eliminate microorganisms in all analyzed root canals. However, there was a greater reduction in endotoxins in root canals treated in multiple sessions. The authors attributed this finding to the use of calcium hydroxide as intracanal medication between clinical appointments [34].

There is difference of opinion as regards the choice of the number of sessions for endodontic treatment and its relation to postoperative pain [20,21,23]. Since 2000, Resende *et al.* [18], have said that the number of sessions did not produce increased painful experience after endodontic treatment. In the study carried out by Rigo *et al.* [20] it was not identified an statistically significant difference ($P > 0.05$) between single session and multiple sessions. In the evaluation of the 141 records the occurrence of pain was reported by 36.2% of patients treated in one session and 28% of those treated in multiple sessions. However in the systematic review of Estrela *et al.* [6] in 2008 it was reported that the clinical success of the treatment is directly related to the sanitization process of canals and including the appropriate use of intracanal medications. These two observed points lead to a high rate of absence of postoperative pain and therefore to the success of the endodontic treatment. Already Paredes-Vieyra *et al* [15] reported that patients undergoing treatment in a single visit showed postoperative pain less often (1.35%) than those in multiple visits (2%). Regarding the post-filling period in the medium term the incidence of pain, both in single as multiple sessions was reduced, and the difference between the two procedures was not significant [9,11,25,26,28]. Studies have found that treatment performed in a single session result in post-operative pain [20,21]. On the other hand, Wong *et al* [33] showed that in the group of patients treated in one session there was less severe pain after one day and after seven days, compared to the group treated in multiple sessions.

Importantly, some studies did not consider the condition of the pulp before treatment [20,32]. The absence of this information goes against the philosophy of authors who consider the pathological condition of the pulp an essential factor in choosing the treatment technique. Chugal et al. [3] developed an historical Prospective Cohort study where they asserted that numerous studies have addressed a wide range of factors with potential impact on endodontic treatment outcome having in common the pulpal and periapical diagnosis. Nowadays, some studies do not consider these variables. Therefore, they should be given importance since the major biologic factors influencing the outcome of endodontic treatment appear to be the extent of microbiological insult to the pulp and periapical tissue, as reflected by the periapical diagnosis and the magnitude of periapical pathosis.

The results achieved in the endodontic treatment in one session and multiple sessions are not significantly different [10,17]. For the most part, complications are similar when referring to frequency although patients treated in a single session are affected by swelling in greater numbers and are more likely to require analgesic medication [3,19,22,28,35]. Therefore, the efficacy for endodontic treatment can be achieved both in single or multiple sessions. However, given the reduced number of visits and the associated treatment efforts (ie, no repeated application of anesthetics, no intermediary restorations, and no canal medication) as well as material costs, single-visit treatment might be attractive from a patient's, dentist's, and payer's perspective [27,28]. On the other hand, it might also result in higher risks of complications like swelling [3], sinus tract formation, or periapical bone resorption

because single-visit treatment might not be as effective as multiple-visit treatment for disinfecting the root canal system.

CONCLUSION

In clinical practice, professionals must be judicious in selecting cases to be completed in one session. Some factors, such as pulp diagnosis, the time available, both the professional and the patient time, in addition to the necessary technical training should be considered. Other medical conditions such as characteristics of the endodontic retreatment (technical and anatomical difficulties and presence of microorganisms) influence the decision-making and planning for endodontic treatment in one or multiple sessions.

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ARTICLE	OUTCOME MEASURE	RESULTS FAVORABLE TO SINGLE OR MULTIPLE SESSIONS OR WITH NO DIFFERENCE BETWEEN BOTH MODALITIES	STUDY DESIGN
Silva *et al.,* 2013	Pulp necrosis: endodontic treatment in single or multiple sessions.	Single session	Review
Paredes-Vieyra *et al.,* 2012	Successful rate in one session and two sessions of teeth with apical periodontitis	No difference	Clinical trial
El Mubarak *et al.,* 2010	Postoperative pain	No difference	Clinical trial
Vera *et al*., 2012	Microbiological status of root canals *In Vivo* in primary apical periodontitis	Multiple sessions	Clinical trial
Tavares *et al*., 2012	Intracanal medication	Multiple sessions	Clinical trial
Delgado *et al*., 2010	Intracanal medication	Multiple sessions	Clinical trial
Xavier *et al.,* 2013	Efficacy of endodontic treatment in single and multiple sessions	Multiple sessions	Clinical trial
Rigo *et al.,* 2012	Postoperative pain	Multiple sessions	Clinical trial
Singh *et al.,* 2012	Postoperative pain	No difference	Clinical trial
Wang *et al*., 2010	Postoperative pain	No difference	Clinical trial
Wong *et al*., 2015	Post-operative pain	No difference	Clinical trial
Rao *et al.,* 2014	Postoperative pain	No difference	Clinical trial
Ince *et al*., 2009	Postoperative pain	No difference	Clinical trial
Su *et al.,* 2011	Post-operative pain	Single session	Systematic review
Figini *et al.,* 2008	Efficacy of endodontic treatment performed in single session and multiple sessions	No difference	Systematic review
Rosso *et al.,* 2012	Postoperative pain	Multiple sessions	Systematic review
Estrela *et al*., 2008	Postoperative pain	Multiple sessions	Systematic review

Table 1 - Result summary of included studies related to endodontic treatment in single or multiple sessions.

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