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ORIGINAL ARTICLE

Postoperative pain following the use of two different intracanal medications

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Abstract This study evaluated the incidence of postoperative pain after intracanal dressings with either 0.12% chlorhexidine digluconate gel (CHX) or a calcium hydroxide/camphorated paramonochlorophenol/glycerin paste (CH/CPMC). Overall, 138 asymptomatic teeth had their canals instrumented under irrigation with 2.5% NaOCl and then dressed with either CH/CPMC or CHX. The incidence of different intensity levels of postoperative pain was registered for the period between appointments. Data revealed that 84% of the total number of cases treated with either medicament showed absence of any level of pain. No case medicated with CH/CPMC and four cases (5.8%) medicated with CHX were categorized as flare-ups. There were no statistically significant differences between all possible comparisons involving the two medicaments in treatment/retreatment cases and teeth with/without apical periodontitis lesions. The low incidence of postoperative pain after the use of both medications, coupled to their antimicrobial effectiveness, gives support to using one or the other in routine treatment/retreatment.

Keywords Flare-up · Endodontic treatment · Endodontic retreatment · Calcium hydroxide · Chlorhexidine

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Introduction

The occurrence of mild pain following chemomechanical preparation is not a rare event and can develop in about 10–30% of the cases [3, 6, 17]. In most instances, the patient can bear the discomfort or can make use of common analgesics, which are usually effective in relieving symptoms. On the other hand, the development of interappointment severe pain, accompanied or not by swelling, has been demonstrated to be an unusual occurrence [18]. These cases have been referred to as "flare-ups" and usually constitute true emergencies that require unscheduled visits for treatment.

Postoperative pain is associated with inflammation in the periradicular tissues caused by irritants egressing from the root canal during treatment. Irritation can be of biological (microorganisms) or nonbiological (chemical or mechanical) origin [18]. Overinstrumentation is the main example of mechanical irritation leading to postoperative pain. Examples of chemical irritation include apical extrusion of irrigants or intracanal medications. Most irrigants and medications are cytotoxic to the host tissues, and consequently there is virtually a universal consensus that their use should be restricted to the root canal. Clinical trials have shown that substances used for irrigation or intracanal medication may have no influence on the occurrence of postoperative symptoms [4, 9, 25, 26, 28]. However, severe reactions have been reported after extrusion of some commonly used substances to the periradicular tissues [19].

An optimal outcome of the endodontic treatment is dependent upon eradication or at least maximal reduction of the intraradicular infection before filling. Chemomechanical preparation using sodium hypochlorite (NaOCl) as an irrigant has been shown to be a critical step for reduction of bacterial populations in the root canal, but about 40–60%

of the canals still yield positive cultures after instrumentation and irrigation with different NaOCl concentrations [10, 22, 23]. To supplement the antibacterial effects of chemomechanical procedures and eliminate persisting bacteria, the use of an interappointment medication has been recommended [21, 23]. Calcium hydroxide is arguably the most used intracanal medication. However, its effectiveness in significantly increasing the number of culture-negative canals after chemomechanical procedures has been somewhat inconsistent [13, 20, 23], indicating that this substance may have its own limitations when it comes to intracanal disinfection. In an attempt to sidestep its limitations, association of calcium hydroxide with other antimicrobial substances, such as camphorated paramonochlorophenol (CPMC), or the use of alternative substances, such as chlorhexidine, has been proposed [7, 15, 21].

Since microorganisms are the major causative factors of postoperative symptoms, a lower incidence of pain might be expected after the accomplishment of intracanal procedures based on antimicrobial strategies, provided the substances used are also biocompatible. The present study aimed to compare the incidence of postoperative pain after antimicrobial treatment protocols based on intracanal medication with either 0.12% chlorhexidine gel or a calcium hydroxide/CPMC paste.

Materials and methods

This study involved 138 teeth from patients who had been referred for root canal treatment or retreatment to the Clinic of Endodontics, Estácio de Sá University, Rio de Janeiro, Brazil, over a 2-year period. Patients' age ranged from 9 to 72 years (mean, 37 years; median, 40 years). Eighty teeth showed necrotic pulps confirmed by sensitivity thermal tests (hereafter referred to as treatment cases), and the other 58 were root-canal-treated teeth requiring retreatment for diverse reasons, including prosthetic needs, coronal restoration missing for a long period, and failure of the previous treatment. Presence/absence of radiographically detectable periradicular bone destruction was recorded. Only asymptomatic teeth were included in the study. Distribution of the teeth in relation to the test groups, treatment/retreatment and presence/absence of apical periodontitis is shown in Table 1. Approval for the study protocol was obtained from the Ethics Committee of the Estácio de Sá University, and written informed consent was obtained from all patients or their parents.

Rubber dam and an aseptic technique were used throughout the endodontic procedures. Before isolation, all patients were anesthetized using 2% lidocaine chloridrate with 1:100,000 adrenaline, and each tooth had supragingival plaque removed by scaling and cleansing with pumice. Caries and/or coronal restorations were removed with sterile high-speed and low-speed burs. After rubber dam application, dental floss was securely tied around the neck of the tooth. The operative field, including the tooth, clamp, and surroundings were cleaned with 3% hydrogen peroxide until no further bubbling of the peroxide occurred. All surfaces were then disinfected by vigorous swabbing with a 2.5% NaOCl solution. After completing the access with another sterile bur under sterile saline irrigation, the operative field, including the pulp chamber, was then cleaned and disinfected once again the same way as above.

The alternated rotation motion technique was used to prepare all canals [20, 21]. Briefly, the coronal two thirds of the root canals were enlarged with Gates–Glidden burs. Working length was established 1 mm short of the root apex, and the patency length coincided with the radiographic root edge. Apical preparation was completed with hand nickel–titanium files (Nitiflex, Dentsply-Maillefer, Ballaigues, Switzerland) to a size 35 or larger at the working length, always using a back-and-forth alternated rotation motion. How much larger the master apical file was depended upon both root anatomy and initial diameter of the root canal. Apical patency was confirmed with a small file (#15 or #20 NitiFlex) throughout the procedures after each larger file size to avoid blockage of the apical foramen and help clean the most apical part of the canal. Preparation was completed using step-back of 1 mm increments. A

Table 1 Comparisons involving the two test medications

	Intragroup (CHX)	Intragroup (CH/CPMC)	Intergroups (CHX × CH/CPMC)
Treatment cases			
With × without AP	(30×11)	(16×23)	
Teeth with AP			(30×16)
Teeth without AP			(11×23)
All teeth[a]			(41×39)
Retreatment cases			
With × without AP	(18×10)	(15×15)	
Teeth with AP			(18×15)
Teeth without AP			(10×15)
All teeth[a]			(28×30)
Treatment × retreatment cases			
With AP	(30×18)	(16×15)	
Without AP	(11×10)	(23×15)	
All teeth[a]	(41×28)	(39×30)	
Total: treatment+ retreatment (all teeth[a])			(69×69)

Between brackets: number of cases in each group or subgroup
CHX Chlorhexidine; *CH/CPMC* calcium hydroxide+camphorated paramonochlorophenol; *AP* apical periodontitis
[a] With and without apical periodontitis

2.5% sodium hypochlorite solution was used as irrigant during instrumentation. Two milliliters of this solution was used to rinse the canals after each instrument. Irrigant was delivered in the canals by means of a 5-ml disposable syringe with a 23-gauge needle. Retreatment cases were treated the same way as above, except that the previous fillings were removed by using hand files and eucalyptol (Biodinâmica, São Paulo, SP, Brazil).

The smear layer was removed by using 17% ethylenediamine tetraacetic acid in the canal for 3 min followed by irrigation with 5 ml of 2.5% NaOCl. Canals were dried with paper points and then randomly distributed into two groups according to the test interappointment medications. Sixty-nine teeth were medicated with 0.12% chlorhexidine in natrosol gel (Dermage, Rio de Janeiro, RJ, Brazil), while the other 69 teeth received an intracanal medication with calcium hydroxide/CPMC/glycerin paste. This paste was prepared by initially mixing equal volumes of CPMC and glycerin, which was added to dilute CPMC and facilitate paste manipulation and further removal from the canal. Calcium hydroxide powder was then added until a creamy consistency was achieved. Medications were placed in the canals by means of Lentulo spiral fillers and packed with a cotton pellet at the level of canal entrance. The access cavities were filled with at least 4 mm thickness of a temporary cement (Coltosol, Coltène/Whaledent, Cuyahoga Falls, OH, USA). Although no systemic medicament was prescribed, the patients were instructed to take mild analgesics if they experienced pain.

Approximately 1 week after the initial appointment, the patients returned for obturation of their root canals. All cases were obturated with gutta-percha cones and Sealer 26 sealer (Dentsply, Petrópolis, RJ, Brazil) using the lateral compaction technique. In the beginning of this appointment, patients were asked about the occurrence of postoperative pain. The level of discomfort was rated as follows: *no pain*; *mild pain*, which was recognizable, but not discomforting; *moderate pain*, which was discomforting, but bearable (analgesics, if used, were effective in relieving pain); *severe pain*, which was difficult to bear (analgesics, if used, were ineffective in relieving pain). Cases with severe postoperative pain and/or the occurrence of swelling were classified as flare-ups and treated accordingly. All four patients that were included in this category called for treatment within the first 72 h after intervention.

The overall incidence of postoperative discomfort was recorded and expressed as a percentage of the total number of teeth evaluated. Incidence of postoperative pain was also calculated for each test variable, i.e., medications used in cases of treatment or retreatment, with or without radiographic evidence of apical periodontitis. Data were analyzed by the chi-square test with Yates' correction and confirmed by the Fisher's exact test, considering occurrence of postoperative pain of any level irrespective of the intensity. Significance level was established at 5% ($p < 0.05$) for the different comparisons shown in Table 1.

Results

Of the 41 treatment cases where chlorhexidine was used as an intracanal medication, postoperative pain was absent in 32 (78%). Of the nine symptomatic teeth, only two (4.9%) showed severe pain (flare-up). Of the 28 retreatment cases where chlorhexidine was used, 26 (92.9%) were asymptomatic. The other two cases (7.1%) were classified as flare-ups based on both severe pain and swelling. In general, of the 69 cases where chlorhexidine was used, 58 (84.1%) had no postoperative pain, and 11 (15.9%) exhibited some level of pain. Four of these symptomatic cases (5.8%) were flare-ups.

Thirty five out of the 39 (89.7%) treatment cases medicated with calcium hydroxide (CH)/CPMC showed no postoperative pain. None of the four symptomatic cases were diagnosed as flare-ups based on pain intensity. Of the 30 retreatment cases medicated with CH/CPMC paste, 23 (76.7%) exhibited no pain, while the other seven teeth presented mild to moderate pain. In general, of the 69 teeth in which CH/CPMC was used, 58 (84.1%) showed no symptoms. Of the 11 (15.9%) teeth with some level of pain, no one was classified as a flare-up.

Taken together, the results of the 138 studied cases revealed that 116 (84.1%) teeth had no postoperative pain. The incidence of postoperatively asymptomatic cases was the same for the two groups studied, i.e., 58 cases from each group were asymptomatic. All the symptomatic cases diagnosed as flare-ups occurred in the chlorhexidine group. Results are depicted in Table 2.

Teeth with no lesions remained asymptomatic in 31 of 38 (81.6%) and 19 of 21 (90.5%) of the cases medicated with CH/CPMC paste and chlorhexidine, respectively. Teeth with apical periodontitis lesions showed no postoperative pain in 27 of 31 (87.1%) and 39 of 48 (81.3%) of the cases medicated with CH/CPMC paste and chlorhexidine, respectively. No statistically significant differences were observed for these comparisons.

There was no statistically significant difference between the two medications with regard to the incidence of postoperative pain for any of the comparisons shown in Table 1. Statistic data are presented in Table 3.

Discussion

The overall incidence of postoperative pain and particularly of flare-ups was low. In general, there was absence of any

Table 2 Incidence of pain of different intensities after endodontic treatment or retreatment using either 0.12% chlorhexidine gel or CH/CPMC as an intracanal medication (%)

Medication	Postoperative pain	Treatment			Retreatment			Treatment+Retreatment		
		L	NL	T	L	NL	T	L	NL	Total
Chlorhexidine	Absent	22/30 (73.3)	10/11 (90.9)	32/41 (78)	17/18 (94.4)	9/10 (90)	26/28 (92.9)	39/48 (81.3)	19/21 (90.5)	58/69 (84.1)
	Mild	5/30 (16.7)	0/11 (0)	5/41 (12.2)	0/18 (0)	0/10 (0)	0/28 (0)	5/48 (10.4)	0/21 (0)	5/69 (7.2)
	Moderate	2/30 (6.7)	0/11 (0)	2/41 (4.9)	0/18 (0)	0/10 (0)	0/28 (0)	2/48 (4.2)	0/21 (0)	2/69 (2.9)
	Severe	1/30 (3.3)	1/11 (9.1)	2/41 (4.9)	1/18 (5.6)	1/10 (10)	2/28 (7.1)	2/48 (4.2)	2/21 (9.5)	4/69 (5.8)
CH/CPMC	Absent	15/16 (93.8)	20/23 (87)	35/39 (89.7)	12/15 (80)	11/15 (73.3)	23/30 (76.7)	27/31 (87.1)	31/38 (81.6)	58/69 (84.1)
	Mild	1/16 (6.3)	3/23 (13)	4/39 (10.3)	0/15 (0)	3/15 (20)	3/30 (10)	1/31 (3.2)	6/38 (15.8)	7/69 (10.1)
	Moderate	0/16 (0)	0/23 (0)	0/39 (0)	3/15 (20)	1/15 (6.7)	4/30 (13.3)	3/31 (9.7)	1/38 (2.6)	4/69 (5.8)
	Severe	0/16 (0)	0/23 (0)	0/39 (0)	0/15 (0)	0/15 (0)	0/30 (0)	0/31 (0)	0/38 (0)	0/69 (0)

L With apical periodontittis lesion; *NL* with no apical periodontittis lesion; *T* total of cases (L+NL)

level of discomfort in 84.1% of the cases, which is in agreement with our previous report using a different set of data for the same treatment conditions as in the group of CH/CPMC [17]. This incidence was also compatible with most data from the literature [3, 6, 17]. Regarding flare-ups, studies have reported frequencies of this true emergency ranging from 1.4% to 16% [1, 8, 11, 17, 25–27]. The overall incidence of flare-up in the present study was close to the lowest values reported by previous studies—only 2.9% of the cases had severe pain, associated or not with swelling, and requiring an emergency visit.

Microorganisms are allegedly the major cause of flare-ups [18]. Although root canals were not sampled before intervention, the pathologic conditions of both pulp and periradicular tissues suggested that most of the cases were infected. Thus, endodontic procedures were based on an antimicrobial strategy to control the root canal infection. Whereas some investigators have reported that posttreatment pain is neither prevented nor relieved by antimicrobial medicaments such as formocresol, CPMC, eugenol, iodine potassium iodide, Ledermix, or calcium hydroxide [1, 4, 25, 26, 28], others have suggested that the use of antimicrobial intracanal protocols involving application of an interappointment medication can reduce the risks of flare-ups during the treatment of infected canals [6, 29]. Theoretically, the use of an antimicrobial strategy during the endodontic therapy can significantly remove microorganisms from the root canal and prevent postoperative pain, provided antimicrobial substances are not highly cytotoxic and are not extruded to the periradicular tissues. Although a control group with no medication to measure the impact of medication on prevention of postoperative pain was not included, the low incidence of postoperative pain, particularly flare-ups, reported by the present study might also be explained by the effects of antimicrobial

Table 3 *P* values for multiple comparisons involving the two medications

	Fisher's test	Chi-square
Chlorhexidine		
TL × TNL	0.2	0.4
RL × RNL	0.6	0.7
T × R	0.09	0.2
TL × RL	0.07	0.15
TNL × RNL	0.7	0.5
CH/CPMC		
TL × TNL	0.4	0.9
RL × RNL	0.5	1
T × R	0.1	0.25
TL × RL	0.3	0.5
TNL × RNL	0.3	0.5
Chlorhexidine × CH/CPMC		
TL × TL	0.09	0.2
TNL × TNL	0.6	0.8
RL × RL	0.2	0.5
RNL × RNL	0.3	0.6
T × T	0.1	0.3
R × R	0.09	0.2
Total × Total	0.6	0.8

T Treatment with and without lesion (total of cases); *TL* treatment with lesion; *TNL* treatment with no lesion; *R* retreatment with and without lesion (total of cases); *RL* retreatment with lesion; *RNL* retreatment with no lesion; *Total* treatment+retreatment

therapy. However, it should be taken into consideration that only asymptomatic teeth were included in the present study, and this could have accounted for the low incidence of pain reported, as teeth with preoperative pain are in a higher risk for developing postoperative pain [4, 17, 25]. Even so, the main findings to be considered herein refer to comparisons of the incidence of postoperative pain after using the two interappointment medications.

Studies have demonstrated that calcium hydroxide paste in CPMC has a broader antimicrobial spectrum, a larger radius of antimicrobial action, and kills microorganisms faster than mixtures of calcium hydroxide with inert vehicles (water, saline, glycerin) [15, 21]. CPMC is known to be cytotoxic and genotoxic, but both characteristics are significantly reduced or abolished when in a mixture with calcium hydroxide [2]. Favorable responses of the periradicular tissues to intracanal medication with the CH/CPMC paste have also been reported [5]. This association probably owes its biocompatibility to the slow release of PMC from the paste; to the denaturing effect of calcium hydroxide on connective tissue, which may prevent further tissue penetration by PMC, reducing its toxicity; and the fact that the effect on periradicular tissues is probably associated with the antimicrobial effect of the paste, which allows natural healing to occur without persistent infectious irritation [16]. A previous study from our group using a different data set demonstrated a similar low incidence of postoperative pain when using this medication [17].

Chlorhexidine is a widely used antimicrobial agent that has emerged as a potential interappointment medication to be used during the treatment of teeth with apical periodontitis. This substance is highly effective against oral microorganisms [12], has been reported to have low toxicity to host tissues [24], and presents substantivity to dentin, which may result in residual antimicrobial effects for days to weeks [14]. In the present study, of the 69 root canals medicated with a 0.12% chlorhexidine gel, only 4 (5.8%) were classified as flare-ups. In spite of the fact that none of the teeth which had their canals medicated with CH/CPMC paste developed flare-ups, no statistically significant difference was detected between groups. The low incidence of postoperative pain for both groups gives support to the use of one or the other medication during the treatment or retreatment of infected canals.

Some studies have shown that teeth with no apical periodontitis are more susceptible to flare-ups [17, 25]. Higher incidence of postoperative pain in teeth without apical periodontitis lesions might be attributed to a lack of space for pressure release when periradicular bone resorption is absent. However, in the present study, the rate of postoperative pain was not affected by presence or absence of apical periodontitis, regardless of the type of intracanal medication used.

Some studies have reported a significantly higher incidence of flare-ups in teeth that needed retreatment because of posttreatment apical periodontitis [8, 11, 25]. In the present study, no significant differences were observed for any of the comparisons involving retreatment and treatment cases, with or without lesions, in spite of the fact that there was a larger nominal incidence of severe pain in the retreatment cases medicated with chlorhexidine. This lack of significant difference between treatment and retreatment is in consonance with previous reports [17, 27].

In conclusion, the present findings revealed that there was no significant difference between the two medications with regard to the incidence of postoperative pain. The low incidence of pain indicates that both medications either decreased the incidence of pain or at least had no adverse effects on the periradicular tissues. These findings coupled to the antimicrobial effectiveness of both medications give support to their use in routine root canal treatment or retreatment.

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