Postoperative Pain after Endodontic Retreatment Using Rotary or Reciprocating Instruments: A Randomized Clinical Trial

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Abstract

Introduction: The aim of this randomized clinical trial was to evaluate the influence of rotary or reciprocating retreatment techniques on the incidence, intensity, duration of postoperative pain, and medication intake. **Methods:** After power analysis calculations, 65 patients who needed endodontic retreatment were randomly assigned to 1 of 2 groups according to the instrumentation system used: Mtwo (VDW, Munich, Germany) or Reciproc (VDW). Retreatments were performed in a single visit by an endodontic specialist. Participants were asked to rate the incidence and intensity of the postoperative pain on a verbal rating scale 24, 48, and 72 hours after treatment. Patients were also asked to record the number of prescribed analgesic medication tablets (ibuprofen 400 mg) taken. A logistic regression analysis was used to assess both the incidence and duration of pain. Differences in the intensity of pain were analyzed using the ordinal (linear) chi-square test, and the Mann-Whitney *U* test was used to assess differences in the intake of analgesic medication between groups. **Results:** No statistically significant difference was found among the 2 groups in relation to postoperative pain or analgesic medication intake at the 3 time points assessed ($P > .05$). Multivariate analysis showed a significantly higher incidence of pain after 24 hours when preoperative pain was present and a significantly longer duration of pain for men than women independently of the retreatment technique used. **Conclusions:** The reciprocating system and the continuous rotary system were found to be equivalent regarding the incidence, intensity, duration of postoperative pain, and intake of analgesic medication. *(J Endod 2017;43:1084–1088)*

Key Words

Endodontic retreatment, Mtwo, postoperative pain, Reciproc

Significance

The present study evaluated for the first time whether the use of reciprocating or continuous rotary kinematics during endodontic procedures may provide different results in terms of postoperative pain. It was shown that both kinematics are equivalent concerning the incidence, intensity, duration of postoperative pain, and intake of analgesic medication.

During root canal retreatment procedures, even when endodontic instruments do not overpass the apical foramen, products such as dentin flakes, root filling material, irrigants, remaining pulp tissue, and microorganisms tend to extrude into the periradicular tissues (1–3). A relation has been shown between the apical extrusion phenomenon and periradicular inflammation, postoperative pain, flare-ups, and delay of periapical healing (4, 5). Moreover, the rate of flare-ups in retreatment cases is reported to be significantly higher than in initial root canal treatment cases (6–8), emphasizing the importance of the use of a technique that promotes lower postoperative complications.

Although reciprocating systems were not originally designed to remove root filling materials, the assumption that their use can be an effective approach is supported by the high cutting ability and the ability in advancing toward the apex (9, 10). Recent studies showed that single-file reciprocating techniques were as effective as multifile retreatment rotary systems for gutta-percha and sealer removal but in a faster way (11–13). Nonetheless, the continuous research and clinical usage of reciprocating systems for root canal retreatment have brought some concerns, such as the amount of dentin chips, irrigants, remaining pulp tissue, bacteria, and their by-products that may be extruded into the periradicular tissues. Most of the studies showed lower debris extrusion when reciprocating systems were used (14–16); however, Çanakçi et al (17) showed that the Reciproc system extruded significantly more debris than multifile rotary retreatment nickel-titanium systems when retreating curved root canals. However, to the best of the authors' knowledge, no clinical study has shown whether the use of different instrumentation kinematics during endodontic retreatment procedures provides more favorable results in terms of postoperative pain.

Therefore, the aim of this randomized clinical trial was to evaluate the influence of rotary or reciprocating retreatment techniques on the incidence, intensity, duration, and type of postoperative pain. The tested null hypothesis was that there was no difference in postoperative pain reported by patients when these 2 kinds of kinematics were used.

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0099-2399/$ - see front matter

http://dx.doi.org/10.1016/j.joen.2017.02.010

Materials and Methods

A prospective, single-center, single-blind, randomized clinical trial was designed with the protocol approved by the local ethics committee (Grande Rio University, Rio de Janeiro, RJ, Brazil; no. CAAE 56871916.6.0000.5283). All volunteers invited to participate in this clinical trial were informed of the procedure protocols, risks, and benefits and their right to self-determination regarding participation. A written consent was signed, and a copy was delivered to all volunteers.

Sample Size Calculation

A power analysis (G*Power 3.1 for Macintosh [Heinrich-Heine, Düsseldorf, Germany]) was conducted using the results of Relvas et al (18), which compared the incidence of postoperative pain after shaping either with a reciprocating or a rotary system and found no differences 24 hours posttreatment. Sample size calculation estimated that a minimum sample size of 23 individuals per group would be required for an effect size of 0.80 (with an alpha error of 0.05 and a power beta of 0.95) in order to achieve 95% confidence of a true difference between the groups. However, if we calculate that approximately 15% of patients may not respond, the total adjusted sample size required would be 53. Therefore, at least 30 teeth were assigned to each group to ensure a representative sample.

Patient Selection and Allocation

Approximately 460 patients with a noncontributory medical history presented for endodontic retreatment to the Department of Endodontics, Faculty of Dentistry, Grande Rio University between January 2015 and June 2015. Patients under 18 years old or presenting 1 or more of the following conditions were excluded from the study: complicating systemic disease; allergies to local anesthetic agents; presence of severe pain and/or acute apical abscesses; analgesic, anti-inflammatory, or antibiotic intake during the 7 days before treatment; presenting with multiple teeth that required retreatment to eliminate the possibility of pain referral; periodontal pockets deeper than 4 mm; and presence of large intraradicular posts. All selected teeth showed an initial root canal filling no shorter than 4 mm from the apex and radiograph evidence of periapical bone destruction (periapical Index = 4 [19]). All teeth were coronally restored with no evidence of direct exposure of the root canal filling material to the oral cavity (Fig. 1). In cases in which the patient did not report preoperative pain, retreatment was undertaken because there was evidence of periapical bone destruction, and patients were referred by the prosthetic department to perform endodontic retreatment because of the need of changing coronal restoration. Sixty-five patients fulfilled the inclusion and exclusion criteria and were selected to take part in this clinical trial.

A simple randomization procedure (www.random.org) was used in order to have a list of patients randomly assigned to either the Mtwo (VDW, Munich, Germany) retreatment or the Reciproc retreatment group before the patients were received. Once the patient entered the facility and it verified the fulfillment of the inclusion criteria, the list was checked for verification of the group to which the patient would be assigned. Patient-related factors, such as age and sex, as well as preoperative tooth-related factors (tooth group, tooth location, and presence/absence of preoperative pain) were registered.

Root Canal Retreatment Procedures

A single endodontics specialist performed all root canal treatments in a single visit. After the administration of local anesthesia (lidocaine with 1:100,000 epinephrine), the affected tooth was isolated with a rubber dam. Old coronal restorations were removed initially to gain direct access to the root canals. The tooth was then allotted to 1 of the following retreatment techniques:

1. Mtwo retreatment group: gutta-percha root fillings were removed using Mtwo retreatment files 15/0.05 and 25/0.05 with an in-and-out pecking motion. The amplitude of the in-and-out movements did not exceed 3 mm. The working length (WL) was established 1 mm short of the apical foramen with an apex locator (Novapex;

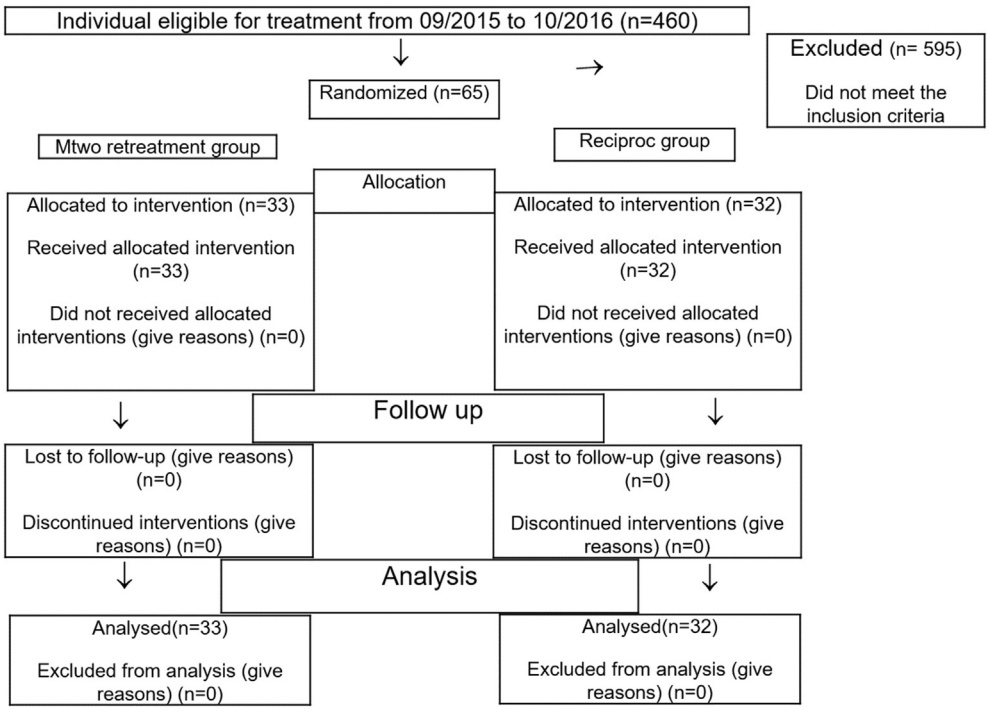

Figure 1. The Consolidated Standards of Reporting Trials Flow diagram for randomized clinical trials.

Forum Technologies, Rishon Le-Zion, Israel) using #10 K-files. If the instruments failed to reach the WL after 3 strokes, they were removed from the canal, cleaned off by insertion into a clean stand with a sponge, and then used again up to the WL. Apical preparation was then performed with Mtwo instruments 30/0.05, 35/0.04, and 40/0.04.

2. Reciproc group: gutta-percha root fillings were removed using R25 (size 25, .08v taper) files (VDW) with a slow in-and-out pecking motion. The amplitude of the in-and-out movements did not exceed 3 mm. The WL was established 1 mm short of the apical foramen with an apex locator (Novapex) using #10 K-files. If the instruments failed to reach the WL after 3 strokes, they were removed from the canal, cleaned off by insertion into a clean stand with a sponge, and then used again up to the WL. Then, the root canals were prepared with an R40 file (VDW) as described for the R25 file.

No solvent was used in either of the groups for root filling material removal. Each set of instruments was used in 1 tooth and then discarded. Patency of the apical foramen was maintained during all the techniques by introducing a #10 K-type file (Dentsply) to a point 1 mm beyond the WL at each instrument insertion. The criteria for the completion of retreatment procedures were smooth canal walls and no evident visualization of any filling material in the root canal under the operative microscope or in the X-ray. The same irrigation protocol was applied in all groups; 2.5% sodium hypochlorite (NaOCl) was delivered using disposable syringes and a 31-G side-vented needle (NaviTip needle; Ultradent Products Inc, South Jordan, UT) inserted into the canal 3 mm short of the WL between each instrument change. A total of 25 mL 2.5% NaOCl was delivered per canal. The smear layer formed during chemo-mechanical preparation was removed by rinsing the canal with 1 mL 17% EDTA and leaving the canal filled with this solution for 3 minutes. Next, the canals were irrigated with 5 mL 2.5% NaOCl and 5 mL saline solution, dried with paper points, and filled with gutta-percha cones and AH Plus sealer (Dentsply Maillefer) using the continuous wave of condensation technique. Finally, coronal access cavity was restored with composite resin. After completing the endodontic retreatment procedure, all patients were given postoperative instructions to take analgesics (400 mg ibuprofen) in the event of pain at a dosage of 1 tablet every 6 hours.

Patient Questionnaire

The patients were informed that they may experience pain in the days immediately after treatment. All participants received a questionnaire to rate the incidence of pain 24, 48, and 72 hours after the root canal retreatment was completed with a verbal rating scale and to register the frequency of analgesic intake.

An evaluator (blinded to the technique used by the operator for the retreatment procedure) gave a telephone call to the research individuals 24, 48, and 72 hours after treatment to monitor postoperative pain and fill out the verbal descriptive scale as follows: 0, no pain or discomfort; 1, mild pain: feeling pain but no oral medication (analgesics) required; 2, moderate pain: feeling pain with oral medication (analgesics) required; and 3, severe pain: feeling pain and is no longer able to perform any type of activity, feeling the need to lie down and rest (analgesics have little or no effect on pain relief). The second question recorded the number of ibuprofen tablets taken by the patient from time 0 to the longer time interval.

Statistical Analysis

IBM SPSS-22 statistical package (IBM SPSS Statistics for Macintosh, Version 22.0; IBM, Armonk, NY) was used for the statistical analysis, and statistical significance was set at $P < .05$. A logistic regression analysis was used to assess both the incidence and duration of pain.

Apart from the operator intervention (type of instrumentation: Reciproc/Mtwo), the multiple patient- and tooth-related factors preoperatively registered were introduced in the analysis as follows for a correct estimation:

1. Patient-related factors: age (in years) and sex (male/female)
2. Tooth-related factors: the presence of preoperative pain (yes/no), group of teeth (posterior/anterior), and location (maxillary/mandibular)

During logistic regression analysis, factors entered into and excluded from the model were selected in a stepwise fashion because this method uses statistical criteria to automatically include in the model the independent variables that are significant and to exclude the ones that are not, which better contribute to its global fitting.

Odds ratios (OR) and their 95% confidence intervals (CIs) were also estimated to measure the magnitude of the effect and quantify the strength of the association of the factor with the occurrence of the event. Differences in the intensity of pain between groups at 24, 48, and 72 hours were analyzed using the ordinal (linear) chi-square test. Differences in the intake of analgesic medication between the 2 groups were assessed with the Mann-Whitney *U* test after confirmation of the violation in the assumption of the normal distribution of data.

Results

Descriptive Statistics

Demographic variables and preliminary pain status were similarly distributed among the retreatment groups as shown in Table 1. Pain was present in 49.2% of the samples before the endodontic retreatment

TABLE 1. Baseline Demographic and Clinical Features of Patients in the Study Groups

Baseline demographic and clinical features	Mtwo retreatment, *n* (%) (*n* = 33)	Reciproc, *n* (%) (*n* = 32)	Total
Male	13 (65)	7 (35)	20
Female	20 (44)	25 (56)	45
Maxillary teeth	16 (41)	23 (59)	39
Mandibular teeth	17 (65)	9 (35)	26
Anterior	12 (44)	15 (56)	27
Premolar	13 (61)	8 (39)	21
Molar	8 (47)	9 (53)	17
Presence of preoperative pain	16 (50)	16 (50)	32
Absence of preoperative pain	17 (51)	16 (49)	33
Age <30	6 (46)	7 (54)	13
Age 30–50	18 (46)	21 (54)	39
Age >50	9 (69)	4 (31)	13

(Table 1). At 24 hours, 65% of the patients presented no pain; 30.1% indicated mild pain, and 7.9% reported moderate pain. At 48 hours, 83% of the patients reported no pain, and 16.9% indicated mild pain. At 72 hours, 95.4% of the sample presented no pain, whereas 4.6% stated mild pain. No intense pain was reported at the evaluation periods.

Inferential Statistics

None of the retreatment systems was found to significantly influence the pain status at 24, 48, or 72 hours after root canal instrumentation. The postoperative pain prevalence associated with each technique used at the different time intervals is shown in Figure 2. However, because multivariate analysis was used to detect the effect of possible confounding factors, several preoperative factors were detected to significantly influence the incidence and duration of postoperative pain. When preoperative pain was present, patients showed significantly more incidence of pain 24 hours after treatment despite the retreatment technique used (P = .009) with an OR of 0.24 (95% CI, 0.08–0.7). At the same time, the duration of pain was significantly longer for males than for females (P = .002) with an OR of 14.33 (95% CI, 2.7–76.6) independently of the retreatment technique used.

No statistically significant difference was found between the 2 groups assessed in the study in terms of frequency and quantity of analgesic medication intake (P > .05). Three patients in the Mtwo retreatment group and 2 patients in the Reciproc groups used ibuprofen (only in the first 24 hours).

Discussion

The aim of this prospective randomized clinical trial was to assess the incidence, intensity, and duration of pain after endodontic retreatment performed using rotary or reciprocating instruments. Because no statistically significant difference was observed between the groups, it can be suggested that the instrumentation systems used in the present study had no influence on postoperative pain during endodontic retreatment procedures. Therefore, both protocols can be applied to promote better disinfection during endodontic retreatment, resulting in treatment predictability concerning short-term follow-up regarding postoperative pain. The present results are in contrast with Nekoofar et al (20), who found higher postoperative pain in treatment performed with the WaveOne reciprocating system (Dentsply-Sirona, Ballaigues, Switzerland) when compared with the ProTaper Universal system (Dentsply-Sirona). However, other studies showed that reciprocating systems produced significantly less postoperative pain (21, 22) or showed no differences in postoperative pain (18, 23) when compared with rotary systems. It is important to emphasize that all mentioned studies were conducted in primary endodontic treatments,

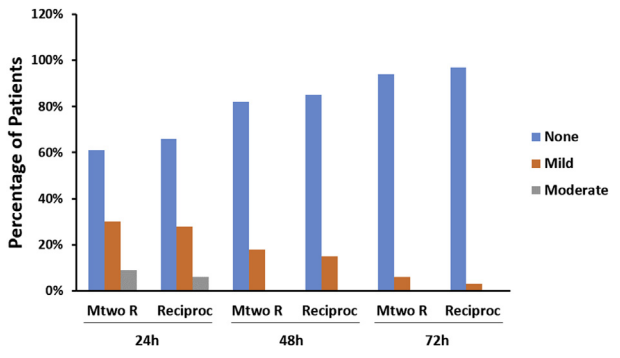

Figure 2. Postoperative pain prevalence.

and to the best of the authors' knowledge, this is the first study that evaluated postoperative pain in endodontic retreatments using different kinematics.

One of the main concerns about studying pain is the subjectiveness of the evaluation. Each person's threshold for pain is unique, which is strongly dependent on the cultural, individual, and economic background of the patient. Therefore, the design of the questionnaire is a critical step, and it must ensure that the questions will be fully understood by patients and easily interpreted by researchers. The questionnaire used in this study asked for the incidence, duration, and intensity of pain through a simple verbal categorization based on its confirmed reliability for pain assessment as recommended in a Cochrane Review (24) defined by the need for and relief from an analgesic and previously validated (25). The design of the present study was carefully explained to each participant.

Ibuprofen was selected in the present study as the medication to take in case of postoperative pain because nonsteroidal anti-inflammatory drugs have been recommended as first-choice medication for postoperative pain management after endodontic procedures (26). Moreover, ibuprofen has been included in several studies on the effect of different techniques and medications on pain relief after endodontic treatment (26). No statistically significant difference was found between the 2 groups assessed in the study in terms of frequency and quantity of analgesic medication intake.

Postendodontic pain is multifactorial in nature and is influenced by factors inherent to patients and teeth conditions (4). Randomization ensured that demographic variables, tooth-related factors, and preliminary pain were similarly distributed between the retreatment techniques. This similarity associated to the adequate sample size results in a high internal and external validity of the present study. However, a multivariable approach was used for the analysis, not only to assess the association between the instrumentation technique and postoperative pain but also to control any possible confounding factor caused by the complexity of pain processes. A multivariate model is the only one that provides information on the concurrent and simultaneous relationships of various factors influencing the outcome under analysis. It is the best approach to analyze real clinical situations in which factors are interrelated and interact with each other and with the outcome in multiple ways despite using accurate randomization procedures.

As shown in the results, preoperative tooth-related (preoperative pain) and patient-related factors (sex) may influence the incidence and duration of postendodontic pain more than the instruments selected for retreatment. Regarding the presence of preoperative pain, previous studies showed a higher incidence of postendodontic pain in cases in which previous pain is associated (3, 4, 7, 8). This association can be explained in 2 different ways: any possible preexisting inflammation in periapical tissues when preoperative pain is present would be made worse by treatment and patients experiencing preoperative pain tend to suffer from postendodontic pain because of the patient's pain expectations (27). The differences between the genders observed in the present study may be explained by differences in the physiological reaction to pain.

In recent years, single-appointment endodontic treatment has gained popularity (28). The popularity of single-visit treatment can be credited to favorable reports that showed no difference in treatment complications or success rates when compared with teeth treated in multiple visits (29, 30). The Toronto study pointed out that teeth with preoperative apical periodontitis showed better outcomes when retreated in a single session than in multiple visits (31). It is important to emphasize that interventions such as treatment in 1 or 2 sessions should be compared in well-planned randomized controlled trials and not in cohort studies such as the Toronto study (31), and to the

best of the authors' knowledge, there is no study that compared healing outcomes in cases of retreatment performed in single or multiple visits. A recent clinical study assessed the outcome measures of single-visit root canal retreatments and showed that single-appointment root canal retreatments presented a favorable success rate (32). In this study, 90.9% of the teeth were healed, and 98.2% remained asymptomatic and functional after single-appointment retreatments. Regarding postoperative pain, a systematic review showed that there is no compelling evidence that single-visit and multiple-visit treatments for root canals differ in terms of postoperative pain or flare-ups (33). Specifically regarding endodontic retreatment, Yoldas et al (34) found that 2-visit endodontic retreatment with intracanal medication was found to be effective in reducing postoperative pain of previously symptomatic teeth and decreased the number of flare-ups in all retreatment cases. However, in the present study, even when performing single-appointment endodontic retreatment, low pain rates were observed. These results may be explained by the high transoperative care: Reciproc and Mtwo instruments were used in a slow in-and-out pecking motion associated with careful canal disinfection and file cleaning after 3 movements to prevent dentin chip accumulation; furthermore, a specific irrigation protocol was performed, reducing even more the possibility of debris accumulation and extrusion using a NaviTip needle, which avoids the positive pressure directly to the apex.

Conclusions

In conclusion, the incidence of postoperative pain and the intake of analgesic medication prescribed for all the postoperative time points were similar for the 2 types of retreatment protocols assessed in this study.

Acknowledgments

Supported in part by FAPERJ grant E-26/201.491/2014, E-26/010.001654/2016.

The authors deny any conflicts of interest related to this study.

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