



Comparing the Efficiency of Single versus Dual Ultrasonic Devices for Metallic Post Removal in Endodontic Retreatment: A Clinical Study

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Introduction: Ultrasonic vibration for metallic post removal seems to be a unanimous choice between endodontists and general practitioners for providing the best results and having the highest safety. This study compared the time required by ultrasonic vibration for removing metallic post (MP) when 1 or 2 ultrasonics devices are used. **Materials and Methods:** One hundred and fifteen teeth with MPs from 105 patients, indicated for nonsurgical endodontic retreatment were divided into 2 groups according to the number of ultrasonic devices used (G1-1 device) and (G2-2 devices). In G1, the MP was worn with a transmetal bur, alongside the wear of the cement line (around 2 mm deep). Then, an ultrasonic tip attached to an ultrasonic unit, with a power of 100% was activated at the level of the post, with constant water spray at a level of 1 mm above the axial surface of the tooth. The position of the tip was changed between buccal and lingual surfaces every 10 seconds until the MP was removed. In G2 the same procedures were performed as described in G1, but two ultrasonic tips were activated simultaneously at buccal and lingual surfaces until the MP was removed. The vibration time necessary for removing each MP was recorded using a chronometer. **Results:** The mean time was 131.10±29.68 seconds (mean±standard error of the mean) for MP removal using one ultrasonic device, and 24.86±6.88 seconds for two devices. The time required for MP removal using two ultrasonic devices was significantly less than when using one ultrasonic device ($P<0.001$). **Conclusion:** The technique with 2 ultrasonic devices proved to be more efficient than the one using only 1 ultrasonic device.

Keywords: Endodontics; Metallic Post Removal; Post and Core Technique; Retreatment; Ultrasonic Vibrations

Introduction

Root canal retreatment presents a unique and complicated clinical challenge due to the necessity of removing prior obturation materials, overcoming procedural errors, reducing bacterial contamination and promoting apical healing when there is evidence of pathosis [1]. One of the most challenging aspects during the clinical procedures of the root canal retreatment is the post removal.

The procedure of post removal should not damage the tooth. Root fracture, periodontal heating, development of dentinal microcracks and excessive removal of sound dentin should always be avoided [2]. Therefore, the success of post removal is crucial for avoiding the indication for surgical retreatment.

Many techniques have already been described for metallic post (MP) removal and among them, ultrasonic vibration seems to be unanimously chosen by endodontists and general practitioners for providing the best results and having the highest safety [3-10].

The procedures of root canal retreatment tend to generate more dentinal defects in the remaining root canal structure [8, 11]. As mentioned above, the removal of a MP should induce minimal damage to the tooth and its surrounding tissues [8, 12]. The use of ultrasonic has been highlighted in MP removal with minimum dental tissue loss and other side effects on the root canal system [3-5, 8]. However, scientific evidence showed more dentinal defects in the long duration (7.7 min) of ultrasonic vibrations [13].

It is well known that the time required for dislodging a MP with an ultrasonic device is around 10 min [5, 9, 13]. Recently, a



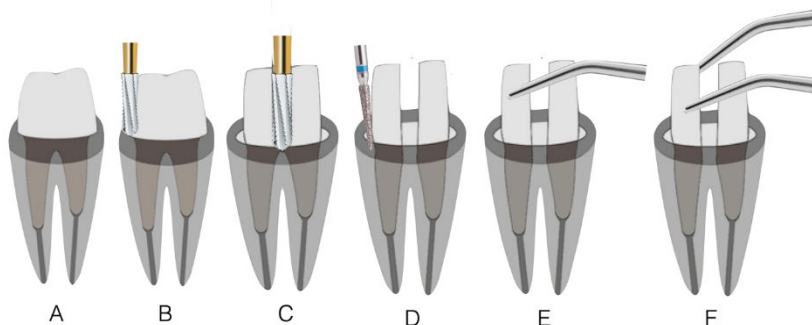


Figure 1. A) The MP removal technique with US in posterior teeth that had 2 posts; B) The reduction of the core with a trans-metal bur; C) The separation of core; D) The wear of cementation line between the core and dentin walls with a 2200 bur; E) The US tips E12, only one; F) Two tips at the same time

new protocol for removing MP has been proposed. Some specialists have mentioned advantages of simultaneously using two ultrasonic devices on MP surfaces through case reports. The main goal of this new technique in MP removal is reducing the total vibration time needed for the procedure.

The long vibration time of ultrasonic devices for MP removal can result in side effects on the root canal tissue remains, as well as dentinal defects and heating. A shorter time could make the procedure more comfortable and safer. Therefore, the purpose of this study was to compare the ultrasonic vibration time required for MP removal when 1 or 2 ultrasonic devices are used.

Materials and Methods

Informed written consent was obtained from each patient before the treatment, and a certification of the research was in accordance to the Helsinki Declaration of 1975 and granted by the Ethics Committee of the Federal University of Mato Grosso do Sul (CAAE 69047617.1.0000.0021).

One hundred and fifteen teeth with MPs from 105 patients aged from 21 to 75 years and referred for nonsurgical endodontic retreatment were included in this study. The MP removal was performed in all teeth groups (48 anterior teeth, 32 premolar teeth and 19 molar teeth). Regarding the posterior teeth that had 2 posts, separation of the core was performed before the use of the ultrasonic device. Therefore, 2 MPs were removed from some posterior teeth (Figure 1).

The teeth were divided into two groups (G1—one ultrasonic device, and G2—two ultrasonic devices). Characteristics such as shape and length of the MPs were observed in a periapical radiograph and teeth with similar MPs were selected for comparison between the two techniques. Teeth with signs and symptoms that suggested or had already been detected with preoperative vertical root fractures and advanced periodontal disease were excluded.

Metallic post removal using vibration from 1 or 2 ultrasonic units

In both groups, prior to the use of ultrasonic, the MP was worn with a transmetal bur (Dentsply, Petropolis, RJ, Brazil) until the cement line between MP and dentin could be noticed (Figures 1, 2). Furthermore, the wear of the cement line was performed (around 2 mm deep) by a 2200 diamond bur (KG Sorensen, Cotia, SP, Brazil). In the sequence of G1, an E12 ultrasonic tip (Helse, Ind. E Com., Santa Rosa de Viterbo, SP, Brazil) attached to a Woodpecker ultrasonic unit (Guilin Woodpecker Medical Instrument Co., Guilin, China), set to a power of 100% was activated at the level of the post, using constant water spray at a level of 1 mm above the axial surface of the tooth. The position of the tip was changed between buccal and lingual faces every 10 sec until the MP was removed. In G2 the same procedures were performed as described in G1, but two E12 ultrasonic tips were simultaneously activated at buccal and lingual faces until the MP was removed (Figures 1, 2). The vibration time necessary for removing each MP was recorded using a chronometer (Procon I; Nautika, São Paulo, SP, Brazil).

A Mann-Whitney test compared the vibration time required for removing the MP between the groups as the data samples did not pass the Shapiro-Wilk normality test ($P < 0.05$). The statistical analysis was performed using the version 12.5 SigmaPlot statistical program (Jandel Scientific, San Rafael, CA, USA) with a significance level of 5%.

Results

In this clinical study, all selected MPs were removed successfully. In G1 and G2, the shortest time for MP removal was 03.23 and 01.55 sec and the longest was 780.2 and 290.94 sec, respectively. The average time for MP removal using one ultrasonic device (G1) was 131.11 ± 29.68 sec (mean \pm standard deviation). When two ultrasonic devices were activated, the average time was 24.86 ± 6.688 sec. Therefore, the results obtained from G2 were significantly better than G1 ($P < 0.001$) (Figure 3).

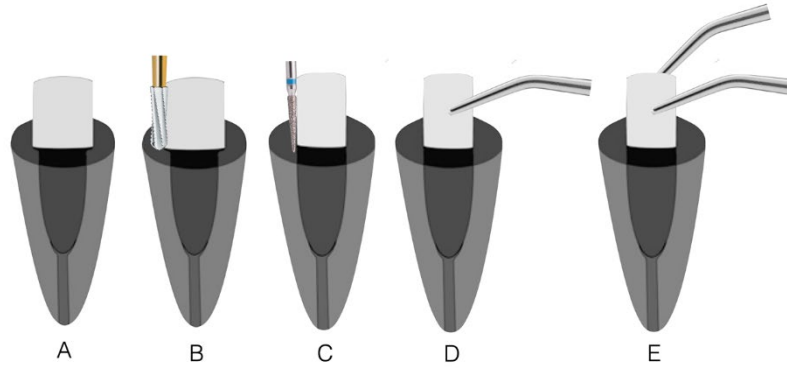


Figure 2. A) The MP removal technique with US; B) The reduction of the core with a trans-metal bur; C) The wear of cementation line between the core and dentin walls with a 2200 bur; D) The US tips E12, only one; E) Two tips at the same time

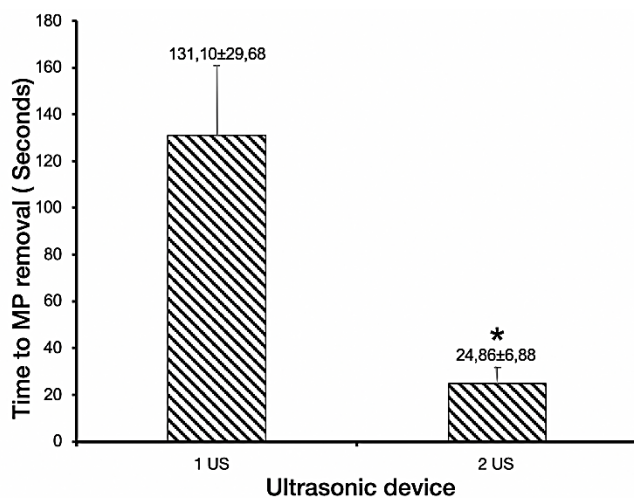


Figure 3. Graph shows the time for removal of the MP according to the number of US devices used. Each column represents the mean and the bar the standard error of the mean. * Significant difference in relation to the group where only one US device was used (Mann-Whitney test, $P < 0.001$)

Discussion

The available studies about the use of ultrasonic in relation to the required time for MP removal have been performed *in vitro* [4, 5, 9] or on cadavers [13]. *In vivo* studies result in more accurate findings about the use of ultrasonic vibration for MP removal [6].

Surveys [7, 8, 10] have reported contamination of the root canal caused by a coronal leakage, leading to cement dissolution as the main cause for MP removal. Hence, those studies suggest that in clinical conditions, the MP is removed with more ease than under *in vitro* condition. The average time of G1 is in accordance with Smith 2001 [6], which also performed MP removal by applying one ultrasonic device in clinical conditions.

There are many factors that may influence the required time for the post removal procedure. The resin-based cement luting agents make the removal difficult; while zinc phosphate or conventional

glass ionomer are easily removed with the ultrasonic technique [14]. The post design, parallel or conic, active or passive [15], and the length of the MP [4, 6] also influence its retention. Furthermore, the removal of the MP is typically more difficult in posterior teeth [8]. Thus, the factors described above possibly correlate with the intra-group variation of time exhibited in this study.

The vibration provided by the ultrasonic device spreads along the tip and is transferred to the MP in order to break the cement between the MP and dentin walls [7, 9]. This explains the shorter time of removal for G2. The ultrasonic vibration from two tips at the same time, in opposite directions broke the cement layer on both sides, simultaneously [5].

Some procedures applied prior to the ultrasonic vibration can facilitate the MP removal [10]. The reduction of the core for exposing the luting cement line between the MP and dentin is crucial because it allows for a small wearing of the cement line. This helps the spread of vibration from the ultrasonic tip to the intra canal part of the post, and consequently promotes a better and faster breakage of the luting cement until the MP loosens [7]. The reduction of the core and the wear of the cement line were performed in the same way for all samples.

For MP removal, the ultrasonic device is often used at maximum power, which generates heat, especially in prolonged periods of performance [10]. The ultrasonic vibration on the MP can transfer the heat to the root canal, and the risk of thermal injury to the surrounding periodontium and bone exists [16, 17]. Therefore, cooling with water [7, 10, 16-18] through a continuous flow of irrigation was done in all cases of this study. The use of ultrasonic with a continuous flow of water results in an up to 5 °C temperature decrease on the external root surface of the tooth [19]; therefore, it is the main preventive and obligatory measure against radicular heating in MP removal.

Among the factors that influence the success of nonsurgical retreatment, using techniques that avoid side effects is essential.

According to the literature reviewed, shorter times (in terms of sec) of ultrasonic vibration do not affect the integrity of the tooth and adjacent tissues. Moreover, the shorter time spent in this new technique provides a more comfortable procedure to the patient and the dentist. Therefore, based on the results of this study, the MP removal technique that uses two ultrasonic devices simultaneously is valid. Further research on this topic is required to decide whether performing MP removal by 2 ultrasonic devices is equal or superior when the cement line is not worn out prior to the vibration. That way, more sound dentin could be preserved in the root canal retreatment.

Conclusions

The technique of using two ultrasonic devices proved to be more efficient than using a single ultrasonic device. Ultimately, the advantages from the use of two ultrasonic devices at the same time make the procedure faster, safer, and consequently more comfortable for the patient.

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None.

Conflict of interest

None.

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Author contributions

Conception and design: Zafalon EJ, Pereira KFS, Santos Bastos HJ; Analysis and interpretation: Tomazinho LF, do Nascimento VR; Data collection: Pereira KFS, Junqueira-Verardo LB; Writing the article: Pereira KFS; Critical revision of the article: Pereira KFS, Santos Bastos HJ; Final Approval of the article: Pereira KFS, Zafalon EJ; Statistical analysis: LBJV; Overall responsibility: Junqueira-Verardo LB

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