# Assessment of a Cavity to Optimize Ultrasonic Efficiency to Remove Intraradicular Posts

*Izabela Araujo Aguiar Graça, MD,* Emílio Carlos Sponchiado Júnior, PhD,* André Augusto Franco Marques, PhD,† Leandro de Moura Martins, PhD,* and Ângela Delfina Bittencourt Garrido, PhD**

## Abstract

**Introduction:** The study assessed an *in vitro* protocol for the removal of cast metal posts using ultrasonic vibration in multirooted teeth by drilling a cavity in the coronal portion of the post followed by ultrasound application in the cavity. **Method:** Forty endodontically treated molars received intraradicular cast posts and were divided into 4 groups according to the removal protocol: the control group, no cavity and no ultrasonic vibration; the ultrasonic group, no cavity and ultrasonic vibration in the coronal portion of the core; the cavity group, a cavity in the core and no ultrasonic vibration; and the cavity ultrasonic group, a cavity in the core and ultrasonic vibration inside the cavity. The traction test was performed on all samples using a universal testing machine (EMIC DL-2000; EMIC Equipamentos e Sistemas de Ensaio LTDA, São José dos Pinhais, PR, Brazil) at a speed of 1 mm/min, obtaining values in Newtons. The data were statistically analyzed using analysis of variance and the Tukey-Kramer test ($P < .05$). **Results:** The results showed statistically significant differences between the tested groups (control group = 322.74 N, ultrasonic group = 283.09 N, cavity group = 244.00 N, and cavity ultrasonic group = 237.69 N). The lowest mean strength was found in the group that received ultrasonic vibration inside the cavity. **Conclusions:** Preparing a cavity in the coronal core followed by ultrasonic vibration reduces the traction force required for removal. The removal protocol was effective for removing posts in multirooted teeth cemented with zinc phosphate. *(J Endod 2017;■:1–4)*

## Key Words

Intraradicular posts, multirooted teeth, tensile strength

### Significance

The study tests a new protocol for the removal of retainers from multirooted teeth. The research results open new perspectives for the safe removal of retainers from multirooted teeth, preventing accidents.

Intraradicular posts are indicated for prosthetic rehabilitation of teeth with excessive coronary destruction (1–3). The need for endodontic of prosthetics in patients with intraradicular posts is considered a difficult procedure because the removal must occur without wearing, drilling, or fracturing the remaining tooth structure, which is previously weakened because of caries, endodontic treatment, and preparation of the prosthetic space (4–6).

Techniques and devices have been proposed for the removal of intraradicular posts, such as extraction and traction methods, but the risk of root fracture is high, and wearing techniques may lead to root perforation and excessive dentinal wear around the post (5, 7–10). To overcome these complications, researchers began to recommend ultrasound alone or combined with other techniques for safer and more effective removal of posts (2, 5, 9, 11–13).

The removal protocol of metal posts in multirooted teeth involves sectioning the core to divide the coronal portion into different cores and treating them individually with ultrasound. During the sectioning of the core, the pulp floor may be compromised because of unsatisfactory wearing with the rotating instrument (14).

For this reason, Souza et al (14) proposed drilling a single slot without sectioning the core. However, this procedure is close to the floor of the pulp chamber, and, depending on tooth inclination, the passage might be made toward the entrance of the root canal, which may hinder removal, leading to a removal protocol of a fractured post.

To expand knowledge, improve resources, and offer more efficient and safer techniques for the removal of posts in multirooted teeth, the objective of the study was to assess a new protocol for the removal of cast metal posts from multirooted teeth cemented with zinc phosphate by drilling a cavity in the core and applying ultrasonic vibration.

## Materials and Methods

The sample for this study was based on the primary outcome of the experimental study (ie, tensile force for the removal of retainers). To obtain 80% power and a type I error (significance level) of 5% to detect a minimum difference of 15%, the total sample required was 40 mandibular molars and 10 teeth for each group.

Forty mandibular molars with fully formed roots (3 roots, 2 mesial and 1 distal) and the absence of calcifications and curvatures in the distal canal were donated by the Biobank of the School of Dentistry, Federal University of Amazonas, Manaus, Brazil

From the *Department of Endodontics and Restorative Dentistry, Federal University of Amazonas, Manaus, Brazil and †Department of Endodontics, School of Dentistry, State University of Amazonas, Manaus, Brazil.

Address requests for reprints to Dr Izabela Araujo Aguiar Graça, Federal University of Amazonas, Av Ayrão 1539, Manaus, Brazil. E-mail address: izabelaaguiar@hotmail.com

0099-2399/$ - see front matter



http://dx.doi.org/10.1016/j.joen.2017.03.028

(Certificate of Presentation for Ethical Consideration no. 49116815.0.0000.5020). To standardize the selected teeth, the mandibular third molars were excluded from the sample because of their complex anatomy, and mechanical-chemical preparation was performed with pre-established Reciproc files (VDW GmbH, Munich, Germany) with the purpose of standardizing the root canal diameters. The same standardization was performed for the prosthetic space using Largo drills (Dentsply Maillefer, Ballaigues, Switzerland). The teeth were sectioned at the cervical portion near the cementoenamel junction with a diamond disk under cooling. The root length of all samples was standardized at 13 mm, and measurement was confirmed with the aid of a digital caliper (Mitutoyo, Miyazaki, Japan).

The roots were centered in a silicone mold and covered with acrylic resin. Endodontic treatment was performed on the samples held in vise using Reciproc reciprocating files driven by the VDW.GOLD RECIPROC engine (VDW GmbH), obtaining an apical diameter corresponding to the R25 file in mesial canals and R40 in the distal canals and a working length of 12 mm. After every 3 nipping movements, the root canal was irrigated with 2 mL 2.5% sodium hypochlorite and a final irrigation with 17% EDTA for 5 minutes followed by 2.5% hypochlorite. Metal cannulae and absorbent paper cones (VDW GmbH) compatible with the diameter of the preparation and the working length were used for drying the root canals. Obturation of the root canals was performed with gutta-percha (VDW GmbH) and endodontic cement (AH Plus; Dentsply, Petrópolis, RJ, Brazil) using thermal plasticization of gutta-percha and a #55 GUTTA-CONDENSOR (Dentsply Maillefer, Ballaigues, Switzerland). The extraradicular excess of the gutta-percha cones was removed using a Paiva condenser (Duflex; SSWhite, Rio de Janeiro, RJ, Brazil), and the remainder was heated and vertically condensed. The roots were temporarily sealed with restorative cement (Coltosol-Vigodent, River de Janeiro, RJ, Brazil).

The samples were stored in an ECB oven (Odontobrás, Ribeirão Preto, SP, Brazil) at 37°C (±2°C) at 100% relative humidity for 24 hours. After this period, the samples were placed in a vise for the preparation of the prosthetic space using a low-rotation straight piece coupled to a liner so preparations were parallel to the long axis of the root. A size 3 Largo drill was used in 8 mm of the distal canal and a size 2 Largo drill in 4 mm of the mesial canals.

The samples were randomly divided into 4 groups ($n$ = 10): the control group, no cavity and no ultrasonic vibration; the ultrasonic group, no cavity and ultrasonic vibration in the coronal portion of the core; the cavity group, a cavity in the core and no ultrasonic vibration; and the cavity ultrasonic group, a cavity in the core and ultrasonic vibration inside the cavity (Fig. 1).

The intraradicular post was molded using chemically activated acrylic resin (Duralay; Reliance Dental Mfg Co, Alsip, IL) and prefabricated Pin-Jet posts (Angelus, Londrina, PR, Brazil). The measurement of the sculpture in casting wax of the coronal portion was 6 mm mesiodistal, 5 mm buccolingual, and 6 mm cervico-occlusal. These measurements were verified using a caliper to ensure standardization. The test specimens were placed in a universal testing machine during the traction tests, and blue wax (Polidental, São Paulo, SP, Brazil) was placed around the proximal sides of the coronal portion in a 4-mm radius semicircle.

The specimens were sent to a dental laboratory and cast in a copper-aluminum alloy (Duracast MS, São Paulo, SP). The intraradicular posts were cemented with zinc phosphate (LS; Vivadent, Rio de Janeiro, RJ, Brazil). On a thick glass plate, a ratio of 1.4 g was used (0.5 mL corresponding to 4 drops of liquid and 1 powder measure). The powder was divided into half; the halves were halved, and finally the one-quarter portions of the powder were divided into 2 portions, totaling 6 portions. With the aid of a #24 spatula based on the incremental technique, the smallest portion of the powder was added to the liquid and mixed for 30 seconds using the large surface area of the plate. The other increments were added slowly, with a mean total time of spatulation of 2 minutes. The samples were stored at 37°C at 100% relative humidity for 48 hours.

After 48 hours, with each sample in the vise, a cavity in the coronal portion of the post was made in the cavity and cavity ultrasonic groups in the buccolingual direction using a spherical bur (H1S 012 FG; Komet, Santo André, SP, Brazil) at high speed. The cavity was made in the center between the cervicoincisal and mesiodistal area, precisely 3 mm from the cervical area and 3 mm in the proximal direction (Fig. 2).

In the ultrasonic and cavity ultrasonic groups, ultrasonic vibration was performed in alternating movements as follows: ultrasonic group, no cavity and ultrasonic vibration was performed on the buccolingual (30 seconds) and mesiodistal surfaces (30 seconds), and cavity ultrasonic group, ultrasonic vibration was performed inside the cavity in the cervicoincisal (30 seconds) and mesiodistal (30 seconds) direction, totaling 1 minute of vibration for the 2 groups. An ENAC ultrasound machine (model EO-5; Osada Electric Co, Ltd, Tokyo, Japan) was used at full power under cooling. The tip used to remove the core in the ultrasonic group was ST-09 and ST-020 in the cavity ultrasonic group, which are compatible with the cavity diameter.

The traction test was performed in all samples using a universal testing machine (EMIC DL-2000; EMIC Equipamentos e Sistemas de Ensaio LTDA, São José dos Pinhais, PR, Brazil). An increasing traction force was applied on the core and an increasing speed of 1 mm/min until the post was completely removed from the root. The results of the maximum traction strength, obtained in Newtons, were recorded and statistically analyzed using analysis of variance and the Tukey-Kramer test ($P < .05$).

## Results

Analysis of variance revealed a significant difference ($P < .05$) between the groups tested. The Tukey test showed a statistically significant difference ($P < .05$) between the mean traction force required to

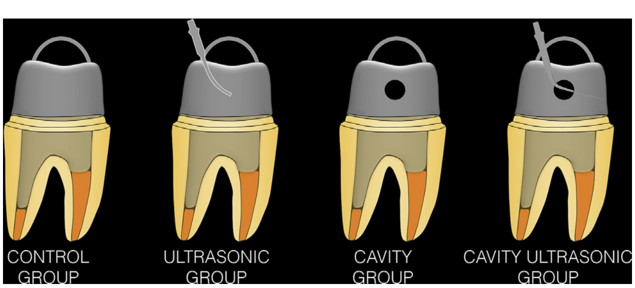


**Figure 1.** The division of groups according to the protocol used.

**Figure 2.** A cavity in the coronal portion of a post.