http://dx.doi.org/10.5272/jimab.2013194.426

ISSN: 1312-773X (Online)

Journal of IMAB - *Annual Proceeding (Scientific Papers)* 2013, vol. 19, issue 4

COMPARISON OF THE TIME REQUIRED FOR ULTRASONIC REMOVAL OF PREFABRICATED INTRARADICULAR POSTS

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ABSTRACT

Aim: To measure *in vitro* and compare the time necessary for ultrasonic removal of different prefabricated stainless steel and fiber posts, cemented with one and the same resin cement.

Methodology: Thirty extracted human teeth were randomly distributed into three groups (n=10) – passive stainless steel, screwed and fiber ones. All posts were fixed with resin cement and lately treated with piezoelectric scaler, without water spray cooling, until their final removal. The time for definitive post dislodgement was measured with a chronometer.

Results: Statistical analysis showed significant difference (p=0.001) between the mean time values for removal of tested posts. We found out considerable differences between measured time for passive stainless-steel and screwed posts (p=0.003) and passive stainless-steel and fiber posts (p=0.004) and insignificant for screwed stainless-steel and fiber posts (p=0.684).

Conclusion: The shortest time for removal of prefabricated intraradicular posts was for screwed posts, followed by fiber and passive stainless steel ones.

Keywords: post removal, prefabricated post, resin cement, ultrasound

INTRODUCTION

Often endodontic treatment is performed on teeth with extreme loss of tooth structure and sometimes intraradicular posts are needed to provide sufficient retention and resistance for the final restoration or crown [1].

When endodontic failure occurs, usually due to a presence of microorganisms within the root canal system, conservative orthograde retreatment is preferred to periradicular surgery. In cases with an existing posts or core, they must be removed prior to treatment. Sometimes this procedure is difficult and risky because of weakening of the root, perforations and fractures of the remaining root structure. It may be time consuming and depends on the post type, length, design, cementing agent, operator's skill and the chosen technique and instruments [2-5].

The removal of intraradicular posts can be accomplished by rotary instruments, special forceps, haemostatic tweezers, special devices (Masserann Kit, Eggler post remover, the Ganon post remover, the Ruddle post removal), ultrasonic vibration or a combination of these. Several authors have come to the conclusion that the use of ultrasound (alone or in combination with other techniques) makes the procedure safer, easier and quicker (Buoncristiani *et al.* 1994, Berbert *et al.* 1995, Dixon *et al.* 2002, Garrido *et al.* 2009, Brito *et al.* 2009) [6-10].

Ruddle [11] states that the success of post removal with ultrasound depends mainly on the employed technique and on the way the ultrasound tip is moved (around the post, following the cementation line in the interface metal/root canal wall). The most likely mechanism of action of ultrasonic vibration is disruption of the luting cement.

Currently four types of cementing agents are used to fix posts and to seal the irregularities between the post and the canal walls: zinc phosphate, zinc polycarboxylate, glass ionomer and resin cements [4, 12]. Resin cements provide the highest retention for posts but at the same time their removal from the root canals may be difficult[12-14]. Because of their viscoelastic nature they absorb energy and are expected to dampen ultrasonic vibrations[6]. The heat produced during application of ultrasound, without water spray cooling, can facilitate dislodgement of posts cemented with composite resin cements [12].

Importance of ultrasound for the removal of cast posts fixed with zinc phosphate and glass ionomer cements is the main object of observation in many studies [2, 5, 7, 10, 12]. Less attention is paid to its influence on prefabricated posts made from different materials, especially when cemented with resin cements.

Thus, the aim of this *in vitro* study was to measure and compare the time necessary for the ultrasonic removal of different prefabricated stainless steel and fiber posts, cemented with one and the same resin cement.

MATERIALS AND METHODS

Thirty extracted human teeth were selected according to the shape and length of the roots (single canal and straight root, approximately 13 mm). All teeth were without fractures and cracks in dentin. They were stored in water and kept moist during all procedures. All teeth were sectioned horizontally, close to the cemento-enamel junction, with carborundum disks under water spray cooling.

A working length was established with K-type file size 10, 15 or 20 (Dentslpy Maillefer, Ballaigues, Switzerland) to the apical foramen and subtracted with 1 mm. At the beginning the instrumentation was carried out with Path file (Dentslpy Maillefer, Ballaigues, Switzerland) up to the size 19.02 and then finished with single file technique with reciprocating mode of movement (*Wave One*, Dentslpy Maillefer, Ballaigues, Switzerland) up to the size 25.08 or 40.08. During cleaning and shaping 1.5% NaOCl and Glyde were used to irrigate the canals and to facilitate instrumentation.

Canals were dried with absorbent paper points and obturated with gutta-percha master cone (*WaveOne*, Dentslpy Maillefer, Ballaigues, Switzerland) and root canal sealer Topseal (Dentslpy Maillefer, Ballaigues, Switzerland).

The teeth were randomly distributed into three groups (n=10). The canals were prepared for post insertion to a depth of 10 mm as follows: with no. 4 and no. 5 Peeso drills for passive tapered prefabricated stainless-steel posts with grooves (Pivots, FKG Dentaire SA, Switzerland); with no. 2 drill for screwed prefabricated stainless-steel posts (Anthogyr, France) and with Parmax reamers PLR-5/2 for fiber (light transmitting) posts (Parmax, Sweden). Coronal parts of posts were 3 mm long. All posts were fixed with dual cure self-adhesive composite cement iCEM Self Adhesive (Heraeus, Germany), following the instructions of the producer.

A gap, 1 mm deep, was made with a diamond bur around the coronal part of the post, through the luting cement. All teeth were treated with piezoelectric scaler (Newtron® P5XS B. Led, Satelec, Acteon Equipment, France) with the power set to maximum, using Satelec ETPR vibrating tips for stainless-steel posts and Start-X TM no. 3 (Dentslpy Maillefer, Ballaigues, Switzerland) for fiber posts. Ultrasonic vibration, without water spray, was applied at the top of the post, circumferentially along the exposed height and at the dentin/luting cement border. Water cooling was used intermittently. The time for definitive post dislodgement was measured with a chronometer.

RESULTS

The mean time values for the removal of different prefabricated posts fixed with dual cure self-adhesive composite cement iCEM Self Adhesive are shown in Table 1.

Tabl. 1. Mean time values for the removal of prefabricated posts

Post type	Mean time (min)	Min. value	Max. value
Passive	12,175±6,89	3,50	27,40
Screwed	4,312±3,55	0,47	10,31
Fiber	4,863±2,64	1,30	9,30

The analyses showed statistically significant difference (p=0.001) between the mean time values for the removal of the tested posts (One-Way ANOVA test).

A parallel of the time necessary for the removal of different posts, in pairs, was made. There were considerable differences between the mean time values necessary for the dislodgement of passive stainless-steel and screwed posts (t-test, p=0.003) and passive stainless-steel and fiber posts (t-test, p=0.004). The results for the screwed stainless-steel and fiber posts were without significant difference (t-test, p=0.684).

DISCUSSION

The results obtained in this study showed that the shortest mean time for the complete removal of prefabricated posts, only with the help of ultrasound, was for screwed posts, followed by fiber and passive ones.

Up to now many studies [2, 7, 15-18] reveal the importance of ultrasound in the removal of different types of posts. Ultrasonic energy is usually used in combination with some other traction forces, especially at the beginning of the process, for fragmentation of the luting cement and reduction of the applied force. Independently of the type of the luting cement this treatment protocol leads to a shorter time for posts' dislodgement, as well [8].

Cast and prefabricated posts can be fixed in the root canal by means of various cements with different retention abilities. Garrido et al. [19] pointed out that zinc-phosphate cement is a friable material, with low resistance to traction and is easily fragmented under the influence of ultrasound. Just on the opposite, resin cements have a superior mean value of retention when compared with zinc phosphate and glass ionomer cements. [2, 20] However, Mendoza and Eakle [21] found out that glass ionomer cement gave the same or greater retention than the resin cement, despite the difference was insignificant. Bergeron et al. [22] and Hauman et al. [4] resumed that the type of the cement was not a statistically significant factor for post retention.

There are many studies [2, 4, 10, 12, 14, 19] investigating and comparing the removal of posts cemented with various cements, so we decided to study the influence of ultrasound on prefabricated posts fixed with one and the same resin cement. According to Buoncristiani et al. [6], Matsumura et al. [23], Gomes et al. [2] and Chandler et al. [24] there is no significant reduction of the force required for the removal of posts fixed with resin cement because it softens and alters the efficiency of ultrasonic vibration and so absorbs the energy transmitted to the posts. Philips [25] came to the conclusion that resin cements are not friable and do not produce micro fractures, as it is seen with glass ionomer and zinc phosphate cements.

Following the recommendation of Ruddle [11] a gap between the coronal part and the canal wall was made with the intention to increase the efficiency of ultrasound. This was important, especially for the fiber posts group, as the ultrasonic tip was moved only circumferentially around the coronal part, following this groove, without touching the canal dentine and the post. For the dislodgement procedure we relied on the rise of temperature under the influence of ultrasound, leading to disruption of the adhesive connection between fiber post and resin cement. Data for such adhesive failure can be found in the work of El-Mowafy and Milenkovic [26], as well. Our statement is in conformity with the results obtained by Garrido et al.[19] and Adarsha & Lata[12] who resumed that ultrasonic vibrations without water have indirect influence on resin cements by heat production. Resin cements are susceptible to temperature changes because of their high thermal expansion property.

Since excessive rise of temperature may expose the periodontal ligament and dental tissues to damage [27-31], ultrasound was used intermittently, followed by water spray cooling. In some of the samples parts of the fiber posts melted before the final removal of their apical parts but still the time necessary for their extraction was shorter than that for the passive serrated stainless-steel posts. As it is seen in the table with the time results the lowest maximum time value is registered in the fiber post group.

In the work of Bouncristiani et al. [6] is stated that the efficiency of ultrasound interferes with the module of elasticity of the metallic post. Rigid materials, such as stainless steel, are with high module of elasticity and increase efficiency of ultrasound and facilitate removal of metal posts. Following the application mode of ultrasound in the works of Dixon et al. [8], Alfredo et al. [5], Garrido et al. [9] and Adarsha & Lata [12], we expected that various movements of ultrasonic tip over and around the coronal part of the post should break more easily the junction between metal post and canal dentine. This was true for the screwed stainless steel posts but not for the passive ones. One possible explanation of these results can be found in the design of the post - we used passive serrated posts which are retentive and the combination with the resin cement makes them difficult to be removed. Evidence for that can be found in Table 1 where the mean, minimum and maximum time values for passive metal posts are the highest. We got the shortest time for screwed posts because they can be easily unscrewed under the influence of ultrasound, following the threading made when they were adjusted.

Our results pointed out that removal of prefabricated intararadicular posts fixed with resin cements required longer time when compared to removal of posts cemented with zinc phosphate and glass ionomer cements. They were in agreement with the conclusions of Brito-Junior et al. [10] who found out that cast posts cemented with zinc phosphate and glass ionomer sealers were removed in a short time interval (mean time up to 2 minutes) and that the type of luting agent had great influence on the time required for post removal.

CONCLUSION

The shortest time for the ultrasonic removal of prefabricated intraradicular posts fixed with resin cement was for screwed posts, followed by fiber and passive stainless steel ones.

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