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Original Article

The influence of ultrasound on removal of prefabricated metal post cemented with different resin cements

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ABSTRACT

Background: Ultrasonic vibrations are used to remove a cemented post from a root canal requiring endodontic retreatment. Various results have been reported from the studies that evaluated the effect of ultrasonic instruments in removing the posts cemented with resin cements. The aim of this study was to evaluate the effect of ultrasonic energy on the retention of prefabricated metal post cemented with Panavia or Maxcem Elite cements.

Materials and Methods: In this *in vitro* study, forty eight extracted single root premolars were decoronated with a diamond disc leaving a 13 mm long root and endodontically treated. The root canals were obturated by gutta-percha up to 5 mm with vertical condensation method and the 8 mm post-space was prepared to receive a no. 2 long Dentorama post. The roots were placed in an incubator for 48 h in 37°C and 100% humidity. After mounting the teeth in acrylic blocks, posts were cemented in the root canals using Panavia F2.0 in 24 specimens and Maxcem Elite in 24 others. For half of the specimens in each subgroup, an ultrasonic device was applied for 4 min. Universal testing machine was used to measure the force needed to remove the posts with a crosshead speed of 1 mm/min until the post came out of the canal. Kruskal-Wallis test was used for statistical analysis at 5% level of significance.

Results: The removal force was not significantly different among the groups ($P > 0.05$).

Conclusion: Ultrasonic energy did not decrease the retention of posts cemented with Panavia or Maxcem Elite cements. Furthermore, it seems that there is no significant difference between removal force of self-etch (Panavia) and the self-etch self-adhesive (Maxcem Elite) resin cements.

Key Words: Post removal, prefabricated metal post, resin cement, ultrasound

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INTRODUCTION

Endodontic retreatment of the teeth with intra-radicular posts is usually a difficult situation for clinicians, increasing the risk of perforations, fractures and weakness of the remaining structure of the teeth.[1,2] Removing such posts is performed with different methods and instruments including the Masserann technique, pivots-extracting forceps post excavator, post puller, Gonon extractor and other techniques using the rotary instruments or ultrasound.[3-5] Ultrasonic instruments have some advantages such as decreased prevalence of tooth fractures and perforations. These instruments especially are effective when zinc phosphate or glass ionomer cements are used.[5,6] The force needed to remove the cemented posts has shown to be related to the post type (cast or prefabricated), the post design (tapered or parallel, smooth, serrated or threaded), the post length and the type of cement used.[1,2,6-8]

Studies on the effect of ultrasound on removal of posts cemented with resin cements have shown conflicting results. While some studies showed

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that these vibrations had no effect on retention of posts,[2,5,8] Bergeron *et al*. demonstrated that using ultrasound increased the retention of stainless steel posts cemented with resin cement.[6] However, other studies expressed that application of ultrasound decreased the retention of cast posts cemented with resin cements.[3,9,10] All the above studies except one[10] used Panavia cement (Kuraray Medical, Japan), which is a self-etch resin cement. Considering inferior shear bond strength of self-adhesive resin cements to dentin,[11] it may be hypothesized that these cements may have different characteristics when exposed to ultrasonic vibrations. The purpose of this study was to assess the effect of ultrasonic vibrations from a piezoelectric device on retention of prefabricated metal posts cemented with self-etch and self-adhesive resin cements.

MATERIALS AND METHODS

In this *in vitro* study, forty eight extracted premolars were selected according to the form and length of the root (straight with single canal roots and approximately 13 mm in length and round cross-section). The teeth with root fracture or previous endodontic treatment were excluded from this study. The teeth were kept in 0.2% thymol solution before the experiment. The crowns were cut-off using a diamond disk under running water, leaving a 13 mm long root.

The root canals were instrumented with k-file (Mani, Japan) up to file #35 and flared using Gates-Glidden drills #1 to #4 (Mani, Japan). Apical 5 mm of the root canals were obturated with gutta-percha (Gapadent, China) and AH26 sealer (Dentsply, Germany) employing vertical condensation method. The roots were placed in an incubator (Behdad, Iran) for 48 h in 37°C and 100% humidity.[7] The remaining 8 mm of the canal space was prepared by Peeso reamers #2 and #3 (Mani, Japan) for placing a long Dentorama prefabricated post #2 (Svenska Dentorama AB, Sweden). The Peeso reamer #3 and long Dentorama prefabricated post #2 have the same diameter (1.1 mm).

The posts were examined to have an inactive fit in the canals by placing 8 mm inside the canal without having any mobility in the place. Specimens that did not have suitable fitness for a long Dentorama post #2 were eliminated. The roots were embedded in self-curing acrylic resin blocks (Marlic Medical Ind. Co, Iran). Canals were cleaned with 97% ethanol and dried with paper cones (Ariadent, Iran).

The specimens were randomly assigned to 4 groups; in groups 1 and 2 the posts were cemented in the canals using Panavia F 2.0 cement (Kuraray Medical, Japan) and in groups 3 and 4 using Maxcem Elite cement (Kerr, USA). Each cement was prepared according to its manufacturer's instruction. A black-banded lentulo spiral *(*FFDM-Pneumat, France) was used to introduce cement into the preparation and coat the walls of the canal. The posts were coated with cement and inserted in the canals to the prepared depth and held in place for 1 min to ensure complete seating according to manufacturer's instruction.

After initial setting of the cements, all specimens were placed in thermocycling machine (Vafaei, Iran) to simulate the thermal changes of the oral cavity (5-55°C, 500 cycles, 20 s dwell time and 10 s transfer time).

The posts in groups 2 and 4 received ultrasonic vibrations for 4 min using a piezoelectric unit with the blunt-ended tip (JE 27000, Juya Electronic, Iran) with maximum power and minimum water as coolant.[4,12] For transferring the vibrations to the specimens, the tip of the instrument was placed on buccal, lingual, mesial and distal aspects between the post and dentine (on cement surface), 30 s for each. Then, the tip of the instrument touched the post and rotated around it for 2 min.

The specimens were fixed in a custom made holder [Figure 1] and placed in a universal testing machine (Dartec, England). Tensile force was introduced to each post along the long axis of the root with a

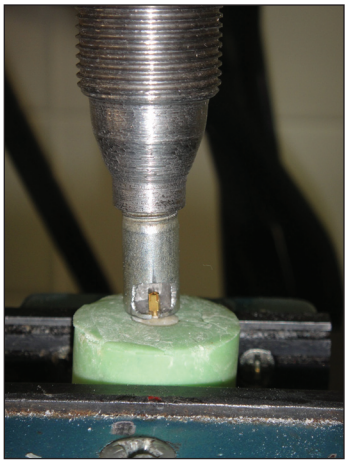

Figure 1: Custom made holder for tensile force testing

crosshead speed of 1 mm/min until the post came out of the canal. The maximum force was recorded for each sample in Newtons.

Statistical analysis was performed using SPSS software (version 11.5, SPSS Inc., USA). Kruskal-Wallis test was used to assess the differences between groups at a 5% level of significance.

RESULTS

A total of 8 specimens were missed during the traction test as their roots came out of the acrylic block before the posts dislodged, 4 specimens in group 1, 3 specimens in group 3 and 1 specimen in group 4. Means and standard deviations of dislodgement forces in each group are summarized in Table 1. Statistical analysis showed no significant difference between the 4 groups (P = 0.488); hence, neither cement type nor ultrasonic vibrations affected the dislodgement force significantly.

DISCUSSION

When a post is to be removed from the root canal, ultrasound may be used to make some fractures in cement until the post comes out with less extraction force. This study shows that ultrasound did not reduce the retention of the posts cemented with Panavia or Maxcem Elite resin cements. These findings are in agreement with previous reports on resistance of resin cements to ultrasonic vibrations.[6,11] This may be due to the viscoelastic nature of resin cements, which tends to soften the vibrations and absorb the energy transmitted to the post.[13]

There was a difference between our results and some other studies. In some studies, ultrasound application decreased the retention of the posts cemented with Panavia.[3,9] There was even a report of increased retention of posts cemented with Panavia.[8] This variety could be due to differences in method of the study: Type of the post (custom versus prefabricated), type, duration and method of using ultrasonic devices as well as using or not using water. In the Study, which showed increase in the retention of the Panavia cemented posts by ultrasound application great standard deviation was considered as a main cause of this increase.[8]

In the majority of studies, which used custom posts ultrasound decreased the retention of Panavia cemented posts[3,9] except the study by Gomes *et al*. which showed the neutral effect of ultrasound on retention of custom posts.[2]

Method of application of ultrasonic devices for removing posts varies in different studies. This variety is in duration of using ultrasound, location of the ultrasonic tip on the post, using water or not as a coolant, type of the tip of ultrasonic instrument and etc.[2,3,6,9]

About the time period of using ultrasound, there are different ideas in the studies.[1,6,9] Some issues have been proposed on how to use ultrasonic instruments including duration of time and water cooling.[2,3,6,9] Some authors have recommended 8-10 min of ultrasonic application to effectively dislodge cemented posts,[2,13] and Hauman *et al*. reported that 16 min is not enough for the posts cemented with resin cements.[8] In the current study, ultrasound was applied for 4 min similar to the studies of Garrido *et al*., Braga *et al*. and Smith.[3,9,14] Smith reported that the average time of ultrasound application needed to extract the post in clinical conditions is about 25% of the time at *in vitro* conditions.[14] He demonstrated that the leakage of restorative materials, cementation under unfavorable conditions and the forces induced to the posts soon after cementation are the main causes of this difference. In this study, thermocycling was used to mimic clinical conditions.

Regarding water cooling, it has been shown that ultrasonic vibrations with water coolant is less effective on post removal than without it.[3,12] This can be caused by the fact that resin cements are not friable and there is no tendency to micro fracture in the cement; unlike zinc phosphate cement, which is friable.[2] Furthermore, due to high viscoelastic characteristic of the resin cement, which are categorized as a plastic material, it tends to absorb energy from posts.[3] However, it cannot be assumed that application of ultrasound without water can decrease the retention of resin cemented posts since it can be caused by the generated heat by the

Table 1: Summery of post dislodgment forces in the test groups (*N*)

Cement type	Ultrasonic vibrations	Mean	Standard deviation
Panavia F 2.0	No (*n*=8)	271	91
	Yes (*n*=12)	229	73
Maxcem Elite	No (*n*=9)	188	94
	Yes (*n*=11)	235	53

ultrasonic device. Resins are very sensitive to thermal changes because of their high thermal expansion characteristic.[3]

Watanabe *et al*. found that attachment capacity of resin cements decreased gradually by thermal cycles.[15] Therefore, by increasing temperature, resins expand and lose their adhesive characteristic and as a result, their retention. In this study, we used minimum water cooling to simulate clinical situation where high temperatures should be avoided.

Our results showed no significant differences between removal forces of posts cemented with either Panavia (a self-etch resin) or Maxcem Elite (a self-etch self-adhesive resin) cements. Although it has been shown that self-etch self-adhesive resin cements have inferior bonding strength to dentin, it seems that this does not affect retention of posts in the root canal, where a well-fitting post is to be retained inside a cylindrical preparation. The geometry of this space is different from shear bond strength test environments. Further research seems necessary to confirm the effect of ultrasound on retention of different cements in clinical situations where the materials are subject to different thermal and loading conditions.

CONCLUSION

Within the limitations of the current study, the efficacy of ultrasound on reducing the retention of prefabricated metal posts cemented with Panavia or Maxcem Elite resin cements is in doubt.

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