

## Comparison of Retention of Titanium Para Post Luted with MTA and Four Common Dental Cements; an in-vitro Study

Rezaei-Soufi, L. \* Kasrei, SH. \*\* Khamverdi, Z. \*\*

\* Assistant professor, Member of dental research center, Operative dentistry department, Faculty of dentistry, Hamadan University of medical sciences, Hamadan, Iran.

\*\*Associate professor, Member of dental research center, Operative dentistry department, Faculty of dentistry, Hamadan University of medical sciences, Hamadan, Iran.

### ABSTRACT

**Statement of the problem:** When Root perforation occur in the middle third of the root, considerable canal length that would normally be available for post placement must be filled by the repair material, thus necessitating a considerably shorter post and leads to poorer retention.

**Purpose:** the aim of the study was to comparison of retention of Titanium Para Post luted with MTA and four cements.

**Materials and Methods:** One hundred recently extracted human sound mandibular premolars were selected and coronal portion of each tooth was removed. The roots were endodontically instrumented and assigned to 5 groups (n=20). In five groups, the specimens were obturated with gutta-percha/AH26 and the post was cemented into the roots with one of five luting agents: zinc phosphate Harvard (group ZP), glass-ionomer GC (group GI), resin cement Panavia F2.0 (group PF2), self-adhesive cement RelyX Unicem (group RU) and mineral trioxide aggregate White ProRoot (group MTA). In all specimens, parallel-sided titanium ParaPost was seated to a 10 mm deep post space prepared with the corresponding size drill. The debonding force (Newton) was measured using a universal testing machine and the failure mode was evaluated by a stereomicroscope. Statistical analysis was performed by ANOVA and Tukey's test ( $\alpha=0.05$ ).

**Results:** The mean and standard deviation of post retention was ZP (311.3±41.0), GI (289.2±35.5), and PF2 (285.0±29.5), RU (191.3±21.8) and MTA (185.0±24.4). The result of One-way ANOVA showed that there was a significant difference between groups retention value ( $p<0.05$ ). Tukey test showed that although there is no significant difference between the retention of posts luted with ZP, GI and PF2 they were significantly ( $p>0.05$ ) higher than of luted with MTA and RU.

**Conclusion:** The findings of this study showed the retention of posts luted with mineral trioxide aggregate were lower in compare with other common luting agents.

**Keywords:** Luting agent, MTA, Para posts, Retention

### INTRUDUCTION

Endodontically treated teeth require post

**Corresponding Author:** Z. Khamverdi Address: Dept. of Operative Dentistry, Faculty of Dentistry, Hamadan University of Medical Sciences, Hamadan, Iran. Phone: +989183122095 Email: [zahra.khamverdi@yahoo.com](mailto:zahra.khamverdi@yahoo.com)

when remaining tooth structure is insufficient to retain a core supporting final restorative crown.<sup>(1)</sup> Besides post loosening which is a common reason of failure in prosthodontic, Root perforation can occur as a result of a misdirected bur during access or post space preparation. Ingle <sup>(2)</sup> reported that

perforations are the second greatest cause of endodontic failures and make up 9.6% of all unsuccessful cases.

Mineral trioxide aggregate (MTA), which has been used in many surgical and nonsurgical applications, possesses the biocompatibility and sealing abilities requisite for a perforation material.<sup>(3)</sup> It can be used both as a nonabsorbable barrier and restorative material for repairing root perforations. Because it is hydrophilic and requires moisture to set, MTA is the barrier of choice when there is potential moisture contamination or when there are restrictions in technical access and visibility.<sup>(4)</sup>

When a perforation must be repaired in the middle third of the root, considerable canal length that would normally be available for post placement must be filled by the repair material, thus necessitating a considerably shorter post and poorer retention. A biocompatible material that could repair the perforation and lute the post simultaneously would allow deeper post placement and thus be highly desirable.<sup>(5)</sup>

Various luting agents, in an attempt to improve stability of post in root canal, have been introduced and many studies have evaluated the performance of the cements. However there is not a consistency on superiority of one particular cement to others in regarding post retention. Luting agents are necessary to cement post in post space. Currently luting agents such as glass-ionomer (GI), Panavia F2.0 (PF2) and zinc phosphate (ZP) have been revealed to provide desirable

retention of prefabricated post including Ti Para post.<sup>(6)</sup> No information is currently available on the retentive strength (the ability to resist post dislodgement in an axial direction) of MTA. The present study purposed to determine retention of a prefabricated titanium post cemented by some current cements; and hypothesized that MTA could provide sufficient post retentive strength whenever used as luting agent in endodontically treated teeth sealed by gutta percha or as a luting agent and sealer, simultaneously.

#### **MATERIALS AND METHODS**

This in vitro study was conducted by using human mandibular premolars utmost 3-month passed from their extraction. One-hundred teeth with no caries, straight free-fracture roots were selected through visual and radiographic assessments. Any calculus and soft tissues were removed by scalers. The teeth were immersed in 10% formalin (Shahid Ghazi Co., Tabriz, Iran) for 2 days, and subsequently in physiologic saline until time of experiments. Each tooth was horizontally sectioned using a carbide bur 878-016M (SSWhite Inc., Lakewood, USA) in a high speed handpiece with water coolant, to obtain a remaining root 15 mm length.

In all roots, working lengths were determined by inserting #10 K-file (Dentsply Maillefer, Ballaigues, Switzerland) inside the root canal until the tip was visible at the apical foramen, and subtracting 1 mm from actual canal length. Instrumentation was performed at the working length up to a #50 K-file. The canals

were irrigated with 2 mL of 1% sodium hypochlorite (Probem, Catanduva, Brazil) between instruments and with 10 mL of distilled water finally.

Roots were obturated to the working length with gutta-percha/AH26 sealer (Dentsply Maillefer, Ballaigue, Switzerland) using the lateral condensation technique. Lateral compaction was performed using a #30 finger spreader (Dentsply-Maillefer). Specimens were stored in distilled water for 24 h at 37°C and 100% humidity in an incubator.

After the period, the roots were restored with parallel-sided titanium ParaPost (Coltène/Whaledent, New York) of size 2 with 15 mm length and 1 mm diameter. The gutta-percha was removed with an endodontic heat carrier leaving a 4-mm gutta-percha plug in the apex of the canal. The post space was primitively prepared by using Gates-Glidden drills #3 (Dentsply-Maillefer) used on low speed handpiece followed by the corresponding size drills provided by the manufacturer to a depth of 10 mm. The specimens were assigned to 5 groups (n=20) according to cement type and post cementation was carried out as recommended by each manufacturer. Group ZP- zinc phosphate cement (Harvard, Richter and Hoffmann, Berlin, Germany) was prepared and a lentulo spiral was used to place mixed cement into the post space which not received conditioning, previously.

Group GI- The root canal dentin was etched with polyacrylic acid of the glass ionomer

system (GC Dental Industrial Corp, Tokyo, Japan) for 20 seconds, rinsed with distilled water and dried with paper points. The glass ionomer cement was prepared and the mixture was placed into the root canal with a lentulo spiral.

Group PF2- The post space was treated with ED primer (Kuraray, Japan) mixture using a microbrush for 30 s and gently air-dried. Excess ED primer was removed with paper points. Panavia F2.0 (Kuraray, Japan) pasts A and B were prepared and applied to the post within 3 minutes after mixing.

Group RU: RelyX Unicem (3M ESPE, Germany) cement, dispensed from capsule, was mixed and applied onto the post surface. Specimens in this group did not receive any dentin conditioning.

Group MTA: White ProRoot MTA (Dentsply Tulsa Dental, USA) was mixed and a lentulo spiral was used to place in into the root canal without any dentin treatment.

In all groups, the posts were coated with cement, were fitted under finger pressure and submitted to a 2-kg fixed load for 10 minutes, followed by removing cement excess by an explorer. All specimens were stored in wet gauze at room temperature for a 24-h period to allow cements to set.

The roots were embedded in autopolymerizing acrylic resin cylinders (Marlic Med Co., Tehran, Iran) and then stored in a 100% relative humidity environment at room temperature for one week. The same investigator performed all procedures including instrumentation,

obturation, cementation as well as root mounting in acrylic resin. A mechanical surveyor was used to obtain parallelism between post long axis and tensile force direction. The specimens were subjected to increasing axial tensile force applied by a universal testing machine (Instron, Corporation, Canton and Mass) with a 45 kg load cell and a crosshead speed of 5 mm/min until post dislodged from the root. The separation force in Newton was considered as post retention. Data was analyzed with one-way ANOVA followed by Tukey's test ( $\alpha=0.05$ ).

## RESULTS

**Table 1: Mean maximum, minimum and standard deviation (SD) post retention of experimental group in Newton (N).**

Group	Number	Mean (N)	SD	Minimum	Maximum
ZP	20	311.3	41.0	248.1	390.8
GI	20	289.2	35.5	231.1	343.4
PF2	20	285.0	29.5	240.0	348.1
RU	20	191.3	21.8	148.0	222.5
MTA	20	185.0	24.4	146.7	224.1

**Table 2: the results of Tukey test**

groups	Mean difference(N)	P value
ZP white GI	22.1	0.675
ZP white PF2	26.3	0.613
ZP white RU	120(*)	0.000
ZP white MTA	126.3(*)	0.000
GI white PF2	4.2	0.963
GI white RU	97.9(*)	0.021
GI white MTA	104.2(*)	0.000
PF2 white RU	93.7(*)	0.036
PF2 white MTA	100(*)	0.000
MTA white RU	6.3	0.872

\*Statistically significant difference

## DISCUSSION

The aim of this study was to compare retentive capability of several common used luting agents as well as MTA for cementation of a parallel sided titanium post. In this study, all procedures were performed by a single operator, and each cement was precisely applied according to manufacture's instruction. This study was conducted by using a titanium post system promising short chair time related to its prefabrication and increasing retention associated to parallel-sided design. The post could be fitted in roots that stress in root ends is not a crisis.

All factors regarding the posts were kept constant and only the type of root canal filling material and the post luting agent were varied. Gutta-percha as the most frequent sealing material was selected for obstruction in five groups. Since studies have approved gutta-percha sealing ability for clinical purposes. Studies showed that MTA provided an apical seal comparable to gutta percha and resilon.<sup>(7)</sup>

The post space was first instrumented by Gates-Glidden drills as recommended before using specific drills of prefabricated post system, then by ParaPost drills to provide a well fitness of post inside the root.<sup>(8)</sup>

The study showed comparable retentive strength of ZP, GI and PF2. These results are consistent with those of Balbosh et al<sup>(9)</sup> who reported no significant differences in retentive strength among zinc phosphate,

glass ionomer and Panavia 21 EX in specimens prior to canal surface roughening. However, the authors observed RU provided retention comparable to aforementioned cements. This finding is in contradiction to our results that revealed retentive strength of RU significantly lower than those of ZP, GI and PF2. This incongruence may be associated to difference in surface properties of prepared dentin between two studies and its significant effect on RU retentive strength. As Balbosh et al demonstrated RU performance varied significantly according to canal surface status (roughened vs. un-roughened).

Several studies showed that posts cemented with Panavia adhesive resin cement were more retentive than those cemented with zinc phosphate.<sup>(10, 11)</sup> These controversial results maybe associated to technical sensitivity of resin cements.

The loads required for dislodgment of posts cemented with zinc phosphate and glass ionomer were significantly higher than that required for posts cemented with MTA, in samples obturated with gutta-percha, as demonstrated by Vargas and his colleagues.<sup>(5)</sup> Vargas stated there was not a well-known limit for appropriate magnitude of retentive strength, but Monticelli et al. demonstrated a lowest retention of 200 N required for clinical success. The range of all specimens in ZP, GI and PF2 were fulfilling this limit.

## CONCLUSION

The findings of this study showed the retention of posts luted with mineral trioxide aggregate were lower in compare with other common luting agents.

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