Effect of eugenol-based root canal sealers on retention of prefabricated metal posts luted with resin cement

Khalil Al-Ali

Department of Prosthetic Dental Sciences, College of Dentistry, King Saud University, P.O. Box 60169, Riyadh 11545, Saudi Arabia

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Abstract Objective: This study evaluated the effect of two different eugenol-based root canal sealers on the retention of prefabricated metal posts luted with adhesive resin cement.

Materials and methods: Thirty prefabricated ParaPosts randomly divided among three groups of 10 each were luted into extracted single-rooted teeth with adhesive resin cement. Two of the groups had been obturated with Gutta-Percha and one of two eugenol-based root canal sealers (Endofil and Tubli-Seal), respectively. The third group was not obturated and served as the control. The forces required for dislodgment of posts from their prepared post spaces were recorded using a universal testing machine. Data were statistically analyzed using one-way ANOVA and Tukey's multiple range test was used to determine the mean differences.

Results: Endofil and Tubli-Seal groups demonstrated significantly reduced retention compared to the unobturated (control) group ($P < 0.05$).

Conclusion: Eugenol-based sealers significantly reduced the retention of prefabricated posts luted with adhesive resin cement.

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1. Introduction

During the past two decades several laboratory studies have investigated post retention (Sorensen and Martinoff, 1984; Borer et al., 2007; Colley et al., 1968; Turner, 1982; Chapman et al., 1985; Young et al., 1985; Radke et al., 1988; Olin et al., 1991; Al-Ali et al., 2003; Al-Ali, 2005; Tjan and Nemetz, 1992; Bergeron et al., 2001; Alfredo et al., 2006; Mayhew et al., 2000; Burns et al., 2000; Boone et al., 2001; Hagge et al., 2002a,b). The variables known to affect retention are post design (Sorensen and Martinoff, 1984; Borer et al., 2007; Colley et al., 1968), post length (Sorensen and Martinoff, 1984; Borer et al., 2007; Colley et al., 1968), post diameter (Colley et al., 1968), cement type (Turner, 1982; Chapman et al., 1985; Young et al., 1985; Radke et al., 1988), methods of cementation (Chapman et al., 1985), canal preparation (Olin et al., 1991), timing of core preparation after post cementation (Al-Ali et al., 2003; Al-Ali, 2005), and type of sealer used for canal obturation (Tjan and Nemetz, 1992; Bergeron et al., 2001; Alfredo et al., 2006; Mayhew et al., 2000; Burns et al., 2000; Boone et al., 2001; Hagge et al., 2002a,b).
The types of luting agents used for cementation of posts have been studied extensively (Turner, 1982; Chapman et al., 1985; Young et al., 1985; Radke et al., 1988; Tjan and Nemetz, 1992). However, no luting agent is consistently rated superior to another (Turner, 1982; Chapman et al., 1985; Young et al., 1985; Radke et al., 1988; Tjan and Nemetz, 1992).

Root canal filling materials or other sealer ingredients used in obturation may interfere with the cement used to lute posts into prepared canals and hence affect the results. Additionally, many of the sealers used for root canal obturation contain eugenol, which has been shown to inhibit the polymerization of resins in a number of studies (Millstein and Nathanson, 1983; Macchi et al., 1992; Schwartz et al., 1992).

There are mixed results regarding the effect of eugenol-based root canal sealers on the retention of posts luted with resin cements (Tjan and Nemetz, 1992; Bergeron et al., 2001; Alfredo et al., 2006; Mayhew et al., 2000; Burns et al., 2000; Boone et al., 2001; Hagge et al., 2002a,b). Some studies showed that eugenol-based sealer had significantly negative effect on post retention (Tjan and Nemetz, 1992; Bergeron et al., 2001; Alfredo et al., 2006). For example, Bergeron et al. (2001) showed that posts cemented in teeth obturated with Gutta–Percha and eugenol-free (AH26) sealer demonstrated significantly greater resistance to dislodgement, compared with teeth obturated with Gutta–Percha and eugenol-based (Roth’s 801 Elite) sealer.

On the other hand, some investigators found that the types of root canal sealers had no significant negative effect on post retention (Mayhew et al., 2000; Burns et al., 2000; Boone et al., 2001; Hagge et al., 2002a,b). Hagge et al. (2002b) evaluated the effect of five luting cements on the retention of prefabricated posts into root canals obturated with Gutta–Percha and zinc oxide/eugenol sealer. They found that posts luted with Panavia 21 cement into unobturated root canals had significantly higher retention than those luted with all other obturated groups (Hagge et al., 2002b). Among the obturated groups, posts luted with Panavia 21 cement showed higher retention than the group luted with zinc phosphate cement (Hagge et al., 2002b).

New resin luting agents and different types of eugenol-based root canal sealers are continuously introduced into the market. However, the effect of these materials on the retention of posts has not been thoroughly investigated. The aim of this study was to evaluate the retention of prefabricated stainless steel parallel posts luted with adhesive resin cement into extracted teeth that were obturated with Gutta–Percha using eugenol-based root canal sealers.

2. Materials and methods

Thirty extracted, intact, single-rooted human teeth were selected. The teeth were cleaned of calculus and stored in tap water at room temperature. The coronal portion of each tooth was sectioned with a carbide bur perpendicular to its long axis, approximately 2 mm above the facial cemento-enamel junction (CEJ).

The canals of the teeth were instrumented to a size 50 with K-files (L.D. Caulk Division, Dentsply International, Inc., Milford, DE, USA). Peeso reamers (Pulpdent Corporation, Watertown, MA, USA) were successively used from Nos. 1 to 5, at low speed, to a depth of 10 mm. Post spaces of standard dimensions were prepared using a No. 6 parallel-sided ParaPost twist drill (ParaPost Black P-42, Whaledent International, New York, NY, USA) at low speed. Post spaces were standardized, 1.5 mm in diameter and 10 mm in depth. Water irrigation was used throughout instrumentation. Radiographs were taken mesiodistally and buccolingually of all root specimens to ensure that at least 1 mm root dentin thickness remained after preparation (Fernandes and Dessai, 2001).

After preparation, the teeth were randomly divided into three equal groups (Table 1). Group 1 was not obturated and served as a control group. Groups 2 and 3 were obturated with laterally condensed Gutta–Percha (Kerr/Sybron Corp., Romulus, MI) and one of the zinc oxide eugenol root canal sealers either EndoFill (Promedica, Neumünster, Germany) or Tubli-Seal (Kerr Italia S.P.A., Salerno, Italy), respectively. A heated endodontic plugger (No. 911, Moyco Union Broach, Inc., York, PA, USA) was used to vertically condense the coronal Gutta–Percha and subsequently prepare a 3 mm deep space coronally for a provisional restoration. All obturated teeth were then temporized with Cavit (ESPE, Norristown, PA, USA) and stored in 100% relative humidity at room temperature for 7 days. For Groups 2 and 3, the Gutta–Percha was removed from the canals to a depth of 10 mm using a heated plugger. All post space preparations were irrigated with saline and measured to a uniform 10 mm depth. A #6 parallel-sided, vented prefabricated post (ParaPost EP 44-6-12, Whaledent, New York, NY, USA) was used for all cases, and all fitted passively when completely seated in their respective canals before luting. Throughout root canal therapy and post space preparations, teeth were held in a gauze sponge soaked in saline to maintain moistness.

All roots were notched with carbide bur. Specimens were then mounted with self-cure resin (Ortho Resin, Dentsply DeTrey, Konstanz, Germany), in a short length of PVC pipe, using a dental surveyor (J.M. Ney Co., Bloomfield, CT, USA) to orientate the post space to the vertical axis.

After canal irrigation with saline and drying with absorbent paper points, the posts were luted with an adhesive resin cement (3M Relyx Arc, 3M, St. Paul, MN, USA). The cement was mixed according to the manufacturer’s instructions. The ParaPosts were uniformly coated with the cement and inserted to the prepared depth of the canals with finger pressure, and excess cement was removed. The posts were left passively in the canals while the cement set. Teeth were stored in 100% relative humidity at room temperature for 24 h before testing.

| Table 1 | Means and standard deviations (SD) of forces (N) required to dislodging posts (n = 10). |
|---------|----------------------------------|---|---|
| Sealer   | Manufacturer                      | Mean | SD |
| None     | Unobturated (control)             | 342 | 49<sup>a</sup> |
| EndoFill | Promedica, Neumünster, Germany    | 53  | 22<sup>b</sup> |
| Tubli-Seal | Kerr Italia S.P.A., Salerno, Italy | 123 | 43<sup>c</sup> |

<sup>a</sup>Mean values designated with different superscripts are significantly different (P < 0.05).
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4. Discussion

The results showed that the type of root canal sealer has an influence on post retention. Prefabricated posts luted with resin cement (3M Relyx Arc) in teeth obturated with Gutta-Percha using eugenol-based sealers (Endofil and Tubli-Seal) revealed significantly less resistance to axial dislodgement. The results suggested that residual eugenol adversely affected the retention of posts luted with resin cement. This could possibly interfere with the setting of the luting resin cement (Millstein and Nathanson, 1983). Accordingly, it is not recommended to use resin cement to lute prefabricated posts in canals obturated with Gutta-Percha and eugenol-based sealers. When a eugenol-based sealer is used, it is likely that eugenol penetrates into the dentin walls (Hume, 1984). Root canal sealers have setting times ranging from several days to several weeks (Allan et al., 2001). The slow setting time of such sealers allows the diffusion of eugenol through dentin tubules and surrounding tooth structure (Tjan and Nemetz, 1992), which may retard the setting of resin cement used for the subsequent luting of the posts (Millstein and Nathanson, 1983; Macchi et al., 1992; Schwartz et al., 1992).

The results of the present study were generally in agreement with those of some other studies which reported eugenol-based sealer to have a significant negative effect on post retention luted with resin cement (Tjan and Nemetz, 1992; Bergeron et al., 2001; Alfredo et al., 2006). Posts luted with resin cement into root canals obturated with Endofil (eugenol-based) sealer exhibited a reduced retention compared to Tubli-Seal (eugenol-based) sealer. This could be attributed to the differences in manufacturing procedures and variation in percentage of each constituent. In addition, it has been demonstrated that the unobturated (control) group luted with resin cement had significantly higher post retentive values than eugenol-based groups (Alfredo et al., 2006; Hagge et al., 2002a,b). On the other hand, the findings of this study are in contrast to those of other studies which reported that the type of root canal sealer had no effect on post retention luted with resin cement (Burns et al., 2000; Boone et al., 2001). The use of different resin cements and different eugenol-based sealers could give different results.

In this study, to investigate the effect of sealers, post space preparations were performed before obturation. Gutta-Percha was removed using a heated instrument. In this way, over sizing of post space preparation was avoided which might remove the sealer-contaminated dentin from the canal walls and hence could have resulted in possibly uncontrolled effects on post retention.

Several studies have shown that post retention is significantly reduced with loosely fitting posts (Turner, 1982; Trabert et al., 1975; Stegaroiu et al., 1996), and with increased cement film thickness (Colley et al., 1968; Turner, 1982; Wiskott et al., 1999; Greenfeld et al., 1989). Therefore, in this study the use of large diameter posts (1.5 mm diameter) was to compensate for the variable taper evident in root canals and to ensure an intimate fit at the post-dentin interface. Thus, a uniformly cylindrical post space was obtained throughout its length. Moreover, the close adaptation of posts to the canal walls

Figure 1 Specimen mounted in the testing machine using self aligning custom-made assembly.
minimizes the cement thickness and hence increases the post retention.

5. Conclusions

Under the conditions of this in vitro investigation, the following conclusions can be made:

1. Eugenol-based sealers had a significant negative effect on the retention of prefabricated posts luted with adhesive resin cement.

2. Posts luted with resin cement into root canals obturated with Endofil (eugenol-based) sealer exhibited a reduced retention compared to Tubli-Seal.

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References


الهدف:

هذه الدراسة قمت تأثير نوعين من حشوئات الأقنية التي تحتوي على مادة الأوجينول على شدة تثبيت الوتد المعدني المسبق الصنع والملصق بمادة الأسمنت الراتنجي.

الطرق والمواد المستخدمة:

استخدم (30) وتدًا معدنيًا مسبق الصنع قسمت لثلاث مجموعات بطريقة عشوائية وكل مجموعة تحتوي على عشرة أرتاد تم الصاقها في جذور أسنان مقلوعة أحادية الأقنية باستخدام الأسمنت الراتنجي.

مجموعتين من الجذور تم حشي أقنيتها بأقماع الكوبتابيرقا مع أحد أسمنت الأقنية الحاوية على مادة الأوجينول (Tubliseal) والـ Endofil على الترتالي. المجموعة الثالثة تم حشي أقنيتها واستخدمت كشاهد للمقارنة. تم تسجيل القوة المطلوبة لنزع الوتد باستخدام آلة الاختبار. تم حساب النتائج إحصائياً باستخدام طريقة الأنوفا وطريقة توكي المتعددة الأبعاد لتقرير الاختلاف الرئيسي بالثبيت.

النتائج:

مجموعتي Tubliseal والـ Endofil (0.05) بالمقارنة مع مجموعة الشاهد (P<0.05) أظهرا انخفاض شديد في قوة التثبيت أظهر أن حشوئات الأقنية الحاوية على مادة الأوجينول تخفض بشكل كبير تثبيت الوتد المسبق الصنع والملصق بالأسمنت الراتنجي.