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Apical Leakage of Epiphany Root Canal Sealer Combined with Different Master Cones

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ABSTRACT

Objectives: The aim of this study was to assess the apical sealing ability of different core materials used with Epiphany™ sealer and to evaluate the effect of Resilon/Epiphany™ system on creating an apical mono-block seal.

Methods: Fifty-five extracted human teeth were used. Forty-five were selected and randomly divided into three groups and ten teeth were used as positive and negative control groups. In Group 1, roots were obturated using Resilon™ and Epiphany™, In Group 2, roots were obturated using tapered single-cone gutta-percha and Epiphany™ and in Group 3, roots were obturated using Thermafil obturators and Epiphany™ sealer. The apical leakage was measured using the dye penetration methodology. The teeth were cleared, and the linear extent of dye penetration was measured with a stereomicroscope. Data were analyzed by the one-way ANOVA and Tukey HSD tests.

Results: The teeth filled with Thermafil obturators and Epiphany™ sealer displayed the most apical leakage. The least apical leakage was shown with Resilon™ and Epiphany™. Groups 1 and 2 had significantly leaked less than Group 3.

Conclusions: Based on the data of this study, although Resilon™ and Epiphany™ sealer showed the least apical leakage, statistical analysis showed no difference between gutta-percha and Epiphany™. (Eur J Dent 2008;2:91-95)

Key words: Dye penetration; Apical leakage; Root-canal filling; Resilon™.

INTRODUCTION

The aim of root canal treatment is to achieve a hermetical apical and coronal seal following shaping and disinfection of the whole root canal system. In recent years, endodontic leakage studies focused on the quality of apical seal of canal system and showed that the present root filling materials and techniques failed to create an ideal seal.[1-3]

Although gutta-percha is a commonly used material, it is generally accepted that gutta-percha and endodontic sealers do not provide a fluid-tight seal.[4] Gutta-percha have an important disadvantage such as lack of bonding to canal dentin and sealers.[5] Such disadvantage of gutta-percha have led to a call for a new and improved product. Resilon™ (Epiphany™, Pentron

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Clinical Technologies, Wallingford, CT, USA), a thermoplastic synthetic polymer-based root canal filling material, has been introduced as an alternative to gutta-percha and traditional root canal sealers. Epiphany™ is a dual curable resin composite used as sealer combined with Resilon™ points. According to the manufacturer, Epiphany™ sealer bonds both to dentin and also to the root-canal filling material. This may be an important fact to eliminate microleakage since it is well-known that microleakage occurs not only through sealer-dentin but also through sealer and root canal filling material interfaces.[6,7]

Both cold lateral compaction and contemporary single cone techniques produce a mass of gutta-percha leaving space filled with sealer.[8] Thermoplasticized gutta-percha techniques were introduced in order to improve the three-dimensional filling of root canals.[9] In the past years, different studies indicated warm gutta-percha techniques as a successful alternative to replicate the irregularities of root canal system.[10,11] One of the pre-heated gutta-percha filling technique that is used with plastic carriers for the delivery of softened gutta-percha is Thermafil Plus Endodontic Obturators (Tulsa Dental Products, Tulsa, OK, USA). Radiographic evaluation of the material adaptation has shown that Thermafil obturators are better than lateral compaction.[12]

ProTaper (Dentsply Maillefer, Ballaigues, Switzerland), produces a well-tapered root canal form sufficient for obturation, and completes preparation in an acceptable time.[13] However the design of rotary instruments was not suitable for complete preparation of oval root canal walls because of the difference between instrument design and canal geometry.[14] Most posterior teeth have complex anatomy with curves, isthmuses, cul-de-sacs and fins.[15] The percentage of root canals that deviated from a round shape at 5 mm from the apex was 56% for distal root canals of mandibular molars.[16] Especially, in oval canals a circular cut using a rotary instrument left approximately 65% of the root canal unprepared at a level 5 mm from the apex.[17]

Microleakage tests are the most favourable *in vitro* methods to evaluate the sealing efficiency of a root canal fillings or sealers.[18] Various methods such as dye penetration test,[19] fluid filtration test,[20] radioactive isotopes,[21] bacterial penetration[3] and electrochemical leakage test are present.[22] The most common method is dye penetration due to its sensitivity, ease of use and convenience.[23]

The purpose of this study was to assess the apical sealing ability of three different solid core materials used with Epiphany™ as sealer in distal roots of lower mandibuler molars.

MATERIALS AND METHODS

Distal roots of fifty-five freshly extracted mandibular molar teeth were selected. The roots with open apices, cracks and resorptive defects were excluded. Soft tissue remnants were carefully cleaned with curettes and teeth were stored in saline solution prior to instrumentation. The crowns were sectioned and working lengths were established. ProTaper rotary nickel-titanium instruments were used for canal preperations of all specimens and final apical preparations were completed with ProTaper F4 (#40). The root canals were irrigated with 5.25% NaOCl after the use of each file. The smear layer was removed with 10 ml of 17% EDTA (Canal +, Septodont, France) for 60 seconds, followed by 10 ml of 5.25% NaOCl. Finally root canals were flashed with 3 ml saline solution and dried with paper points.

The specimens were randomly divided into three groups of fifteen samples each. 10 roots were divided into two groups of five samples each as positive and negative controls. The negative control group consisted of five roots which were filled with gutta-percha and sealer then completely coated with two layers of nail varnish. For the positive control samples, roots were coated with two layers of nail varnish except for the apical foramen and the coronal access.

A summary of groups is as follows:

Group 1: Epiphany™-Resilon™

Group 2: Epiphany™-.06 taper #40 ProTaper Universal gutta-percha

Group 3: Epiphany™-Thermafil

As a standart application in all groups, Resilon™ bonding material was firstly applied into the root canals with a brush. Different master cones were all coated with Epiphany™ sealer and were inserted into the canals. Next, light curing was carried for 40 seconds. Roots were filled with single cone technique in Group 1 and Group 2 for both groups as the sealer remains the same, different master cones were used.

In Group 3, following the placement of Thermafil obturators into the oven, Epiphany™ sealer was inserted into the canals, then pre-heated Thermafil obturators were inserted into the canals and light curing was carried for 40 seconds as in Groups 1 and 2. Following completion of the filling process roots were stored in saline solution for 48 hours. The surfaces of roots were coated with two layers of nail varnish, except apical 2 mm. Apical leakage was estimated using a dye penetration test. The specimens were placed into 2% methylene blue solution for three days. After the end of three days the specimens were washed with copious water and dried.

The teeth were sectioned longitudinally in a bucco-lingual direction through the center of the root. Linear apical leakage was measured from the apex to the coronal extent of the methylene blue dye penetration. The linear breakthrough of the dye was estimated using a stereomicroscope (Olympus BX 50, Japan).

The obtained results were submitted for statistical analysis using the analysis of one-way ANOVA and Tukey HSD tests.

RESULTS

The positive control specimens revealed full leakage throughout the length of the root canal, while the negative control roots showed no dye penetration. The mean of the depth of dye penetration for all groups is shown in Table 1.

Although Resilon™ core material and Epiphany™ sealer exhibited lower mean apical leakage value than the teeth filled with single cone gutta-percha using the sealer Epiphany™, statistical analysis showed no significant difference between Group 1 and Group 2 (P>.001). However the apical leakage of Group 1 and Group 2 were significantly less than Group 3 (P<.001). The specimens filled with thermoplasticized gutta- percha technique, Thermafil and Epiphany™ exhibited highest leakage results. The results showed that the mean leakage of Group 1 and Group 2 were statistically different from Group 3.

DISCUSSION

It is well-known that laboratory testing remains the only valuable preclinical screening test that can predict or indicate clinical performance.[24] Although limitations of dye-penetration tests have been discussed in some studies, they are commonly used because they are easy to accomplish and do not require sophisticated materials.[22,23,25] Besides the questionable results, Camps and Pashley[26] reported that dye-extraction and fluid-filtration techniques showed correlated results.

Longitudinal sectioning of roots and the linear measurement of dye penetration were used in the present study for the measurement of leakage. On the one hand, it is clear that this experimental model cannot mimic the *in vivo* situation. It enables the observation of dye penetration and whether or not that is associated with porosities in the gutta-percha, the presence of empty spaces, stripping of the gutta-percha from the solid core system or changes in the structure of thermoplasticized gutta-percha. Although different dye solutions are available, in this study methylene blue dye was used because it easily allows quantitative measurement of the extent of dye penetration by linear measurement techniques. It has a similar molecular size to bacterial by-products such as butyric acid which can leak out of infected root canals to irritate periapical tissues.[27]

For the prevention of apical leakage root canal fillings should provide a three-dimensional apical and coronal sealing.[28] Gutta-percha and sealer have been used for many years for root canal obturation. However new materials and techniques are now available which may increase the potential for successful outcomes by creating a better adaptation between root canal walls and the filling material to decrease leakage. Some studies have shown a relationship between apical leakage

Table 1. The mean depth of dye penetration.

Materials	Mean Leakage Values
Resilon™ and Epiphany™	0.76 ± 0.101
Tapered gutta-percha and Epiphany™	1.26 ± 0.125
Thermafil and Epiphany™	1.82 ± 0.162

and the bond strength of sealers.[29,30] The sealers have an inverse relationship for adhesion to gutta-percha and to dentin.[30] In contrast the attachment between the gutta-percha and the sealer AH26 and AH plus may allow a path for leakage. However, in the Epiphany™ root obturation system, Epiphany™ sealer's attachment to root canal walls and to the Resilon™ filling core material appears to be superior. The Resilon™ System may be attributed to the 'monoblock' provided by the adhesion of the filling material to the sealer, which also adheres and penetrates into the dentin walls of the root-canal system.[31] In a recent study, Raina et al[32] found that there was no differences between the apical sealings of gutta-percha/AH Plus and Resilon/Epiphany™ system and results concluded that both root canal fillings did not manage to create a monoblock root filling that does not leak, Paqué and Sirtes[33] investigated the apical long-term sealing ability of gutta-percha/AH Plus and Resilon/Epiphany™ using a fluid transportation model and reported that Resilon/Epiphany™ root fillings prevented fluid movement to the same degree as gutta-percha/AH Plus counterparts. The amount of solid filling core material and sealer in the root canal space are important facts for an adequte root canal filling. Gülşahı et al[34] compared the cross-sectional area of sealer plus voids of Epiphany™ sealer surrounding root fillings completed with Resilon™ cones and laterally compacted gutta-percha. No differences were found between the sealer plus void or void area of Resilon™ or gutta-percha groups at any level of sectioning.

Besides these varying results in a similar study to our paper, Shipper et al[31] investigated the bacterial leakage of roots filled using lateral and vertical condensation techniques with gutta-percha and AH 26 sealer, with gutta-percha and Epiphany™ sealer and filled with Resilon™ and Epiphany™ sealer. Their results are parallel to our results and showed that Resilon™ group was superior to gutta-percha groups. Verisimo et al[35] compared the apical leakage of canals filled with gutta-percha/AH-Plus and the Resilon/Epiphany™ System, when submitted to two filling techniques. Although there was no differences between the filling techniques, Resilon/Epiphany™ system leaked less than gutta-percha/AH-Plus.

In this study none of the root-canal filling materials and sealers exhibited complete apical sealing. Resilon™ and Epiphany™ sealer exhibited the least microleakage values and were found to be the best root-canal filling material and this finding may support the manufacturer thesis in which they stated that Resilon™ and Epiphany™ create a monoblock filling by bonding eachother. Also results showed that not only depending on the root canal filling material but also filling technique is more effective on creating a tight apical seal. Although single cone gutta-percha revealed higher mean apical leakage values than the group filled with Resilon™ fillings, statistical analysis showed no differences between single cone gutta-percha technique and Resilon™. Both groups leaked less than the group that was filled with Thermafil obturators and Epiphany™ sealer. These findings may depend on the adaptation of Thermafil obturators with the final shape of the canals prepared with ProTaper root canal instruments.

CONCLUSIONS

Data from *in vitro* studies cannot be directly adapted clinically. Further investigation should be conducted to determine if the new obturation material could replace gutta-percha as a root canal filling material. This study showed Resilon™ core material and Epiphany™ sealer had the least apical dye penetration than the other groups.

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