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Original Article

Apical sealing ability of resilon/epiphany system

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ABSTRACT

Background: Endodontic leakage research focus mainly on the quality of the apical seal of the root canal system and the newly introduced resilon/epiphany system claim to be superior to Gutta-percha in respect to obturation procedure. The aim of this study is to evaluate the root canal obturation completed by resilon/epiphany system.

Materials and Methods: A total of 42 teeth were selected and were divided into four groups. Two experimental groups consisted of 15 teeth each and positive control group consisted of eight teeth and negative control group consisted of four teeth. In the experimental groups, Group 1 was obturated with resilon/epiphany system and Group 2 was obturated with Gutta-percha and endofil sealer by lateral condensation technique. The teeth were then immersed in Methelene blue solution and were split longitudinally to access the amount of dye penetrated in the canal. The specimens were viewed under scanning electron microscope to evaluate the adhesion of the obturating material to the root canal walls. Data was subjected to statistical analysis by Analysis of Variance and Bonferroni multiple comparison test at 1% level of significance.

Results: The resilon/epiphany system showed better adaptation to the root canal walls, but the difference in dye penetration was not statistically significant when compared to specimens obturated with Gutta-percha and endofil sealer.

Conclusion: Although, there was no statistically significant difference between the groups, but resilon/epiphany system showed better adaptation to the root canal walls.

Key Words: Apical seal, endodontic leakage, Gutta-percha and endofil sealer, resilon/epiphany system

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INTRODUCTION

Successful root canal treatment depends on proper diagnosis, adequate cleaning, shaping and finally, 3-D obturation of the root canal system. The complete obturation of the root canal system and the creation of a fluid-tight seal have been proposed as a goal for successful endodontic treatment.[1] Failures have been attributed to penetration of substances from the apical tissues into the root canal. In addition, failure could be caused by irritants left in the canal that may seep out through an inadequate seal into the periapical tissues.[2]

The progress and maintenance of seal of root canal system is of paramount importance in the success of a root canal treatment.[3] Obturation of the root canal system is usually done by Gutta-percha and a sealer.[4] Until recently, Gutta-percha was the only material that came closest to fulfilling the criteria laid down by Grossman[5] for an ideal root canal filling material.

The main aim of a complete and perfect sealing of the root canal is to prevent leakage between the root filling and canal walls and also between the sealer and filler cones. The lack of adhesive property of

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Gutta-percha to the canal walls and to sealers makes it impossible to completely prevent microleakage.[6] This is considered to be one of the weakest links in root canal therapy.[7] This limitation of Gutta-percha may lead to the failure of a meticulously prepared root canal.

Microleakage between root canal filling materials and root canal walls adversely affect the results of root canal treatment.[6] Complete obturation of the root canal with an inert filling material and creation of an apical seal have been proposed as goals for successful endodontic treatment.[8]

Microorganisms can persist in lateral canals and dentinal tubules which may provide protection from the disinfecting actions of irrigant and medicaments. These microorganisms may play a role in persistent periapical disease.[9-11] A closer approximation between the root canal obturating material and the canal wall would limit or restrict the passage of microorganisms and their byproducts responsible for persistent periapical disease.[9-11] Keeping these points in mind, this *in vitro* study has been done to compare the apical microleakage of root canals obturated with resilon/epiphany system and Gutta-percha with endofil sealer. The prime purpose of this study was to evaluate the root canal obturations completed by the resilon/epiphany system in root canal obturation.

Specific objectives were:

a. To evaluate the level of dye penetration through the apical foramen in the samples.
b. To compare the degree of dye penetration in the obturations carried out by the different materials.
c. To analyze and compare the level of adhesion of the obturating materials to the canal walls.

MATERIALS AND METHODS

This is a prospective comparative *in vitro* study. 42 single canal extracted human mandibular and maxillary permanent anterior teeth were investigated as study specimen.

Inclusion criteria

1. Extracted permanent human mandibular and maxillary anterior teeth.
2. Teeth with fully formed apices.

Exclusion criteria

1. All deciduous teeth.
2. Teeth with resorptive defects, cracks, fracture, grossly decayed or developmental anomalies.
3. Teeth with narrow or severely curved roots.
4. Previously root canal treated teeth.

Teeth were preserved in 1% Sodium hypochlorite. Teeth were carefully cleaned by ultrasonic scaler. Cleaned teeth were then stored in the normal saline. The crowns of the teeth were sectioned at the cemento-enamel junction. Radicular pulp tissue was removed by barbed broach (MANI, INC. Japan). The canal lengths were determined by inserting a 15 K-file (MANI, INC. Japan) into each root canal until the tip of the apical foramen. The length of the reference point was measured when the tip of the file became visible at the apical foramen. The working length was determined and recorded by subtracting 1.0 mm from the measured actual root length. Then chemo-mechanical preparation by step back technique using K-files (MANI, INC. Japan) was carried out. Cleaning and shaping of each canal was performed to 40 K-file. Copious irrigation was done during instrumentation (5.2% sodium hypochlorite solution). Coronal third of the roots were flared using Gates Glidden burs (size 2 and 3, MANI, INC. Japan) using low speed handpiece. Final finishing of the canals was done using a 40 K-file. After the completion of instrumentation of the canal, a size 10 K-file was passed 1 mm through the apical foramen to ensure that the canal is patent. Then the samples were placed in normal saline.

Grouping of the tooth samples

Group 1: Laterally condensed Gutta-percha (Dentsply Maillefer, USA) and endofill sealer (endofill; Dentsply-Herpo, Petropolis, Brazil) (15 samples).

Group 2: Laterally condensed resilon points (Resilon Research LLC) and epiphany sealer (epiphany, Pentron Clinical Technologies, Wallingford, CT, USA) (15 samples).

Group 3: Gutta-percha without endofill sealer (3A) and resilon points without epiphany sealer (3B). This group was the positive control group (eight samples).

Group 4: Obturated with Gutta-percha and endofill. This group was the Negative control group (four samples).

Obturating procedure

The smear layer was removed with 10 ml of 17% ethylenediaminetetraacetic acid (EDTA) for 60 s, followed by 10 ml of 5.25% NaOCL. Finally, the root canals were flushed with 3 ml saline solution and then dried with paper points.

For Group 1, the master Gutta-percha point was selected to the working length. The endofill sealer was mixed on a clean glass slab and was introduced into the root canal by lentulo spiral (Dentsply Maillefer, USA) in order to smear the canal walls with the sealer and fitted into the root canal. Lateral condensation was then completed with the use of finger spreader and accessory points. A red hot instrument was use to remove the Gutta-percha points at the orifice level and the access was sealed with glass ionomer filling material (Ketac, 3M ESPE, Seefeld, Germany).

For Group 2, resilon primer was applied first into the root canal with an application brush and excess material was removed with paper points (Roeko, Langenau, Germany). The epiphany sealer was mixed and was introduced into the root canal by lentulo spiral in order to smear the canal walls with the material. Next, the resilon master cone was coated with epiphany sealer and was inserted into the root canal. Lateral condensation was then completed with the use of finger spreader (Dentsply Maillefer, USA) and accessory points (3M ESPE, Germany). The cone excess was cut-off with a heated instrument at the orifice level. The coronal access was light cured for 40 s with a standard light curing unit for an immediate seal. The coronal access was then sealed with glass ionomer filling material.

The negative control group consisted of four roots, which were filled with Gutta-percha and endofill sealer and then completely coated with two layers of nail varnish. For the positive control samples, four roots were obturated with resilon points without epiphany sealer. The roots were (Group 3) then coated with two layers of nail varnish except for the apical foramen. Upon completion of the filling process, all samples were stored in saline solution at 37°C for 48 h in order to allow the sealer to set completely.

The quality of adhesion was evaluated using the modified Ray and Seltzer criteria for evaluation.[12]

Identifying the apical leakage using dye penetration method

Each group was placed in a screw capped glass vial filled with distilled water stored in an incubator at 37°C for 48 h. The root surfaces were covered with two layers of nail varnish; except for the apical 2 mm. Samples were then placed into 2% methylene blue dye solution for 3 days at 37°C. The nail varnish was scraped away from the root surfaces with a scalpel. The samples were split longitudinally using a diamond disk. Linear apical leakage was measured from the apex to the coronal extent of the methylene blue dye penetration.

Procedure for measurement of linear dye leakage

The leakage was evaluated using a stereomicroscope (Olympus BX 50, Japan) (×20 magnification). Quantitative evaluation involved the measurement of linear apical leakage of the dye penetrated using a millimeter scale.

Estimation of adhesion of obturating materials to dentinal walls

The samples were then viewed under a scanning electron microscope (Hitachi S 3400N, Japan) at ×300 magnifications to see the adhesion of the filling material to the dentin walls in the apical region [Figure 1].

The quality of adhesion was evaluated using the modified Ray and Seltzer

Score 1 – Extremely good: Adhesion with smooth contact line at the sealer-dentin interface without any gaps [Figure 2].

Score 2 – Good adhesion: Slightly curved contact line on the sealer-dentin interface with few gaps between sealers and dentin walls [Figure 3].

Score 3 – Relatively good adhesion: Gaps were often found between sealers and dentin walls with unclear and curved contact line at the sealer-dentine interface [Figure 4].

Statistical analysis

All the relevant collected data were first compiled on a master chart. Data was processed and analyzed with the help of computer software Statistical Package for Social Sciences, version 16 (SPSS Inc., Chicago, IL, USA). The test statistics used to analyze the data were Analysis of Variance and the data were presented as mean ± standard deviation. The level of significance was set at 0.01 and $P < 0.01$ was considered to be significant. The significant data were tested for multiple comparisons by Bonferroni multiple comparison tests.

RESULTS

Table 1 shows the mean scores of adhesion of filling materials to dentinal walls in two experimental

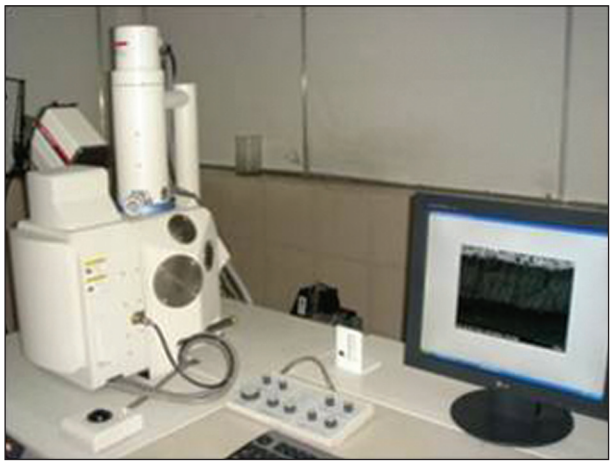

Figure 1: Estimation of adhesion of obturating materials to dentinal walls by a scanning electron microscope (Hitachi S 3400N, Japan)

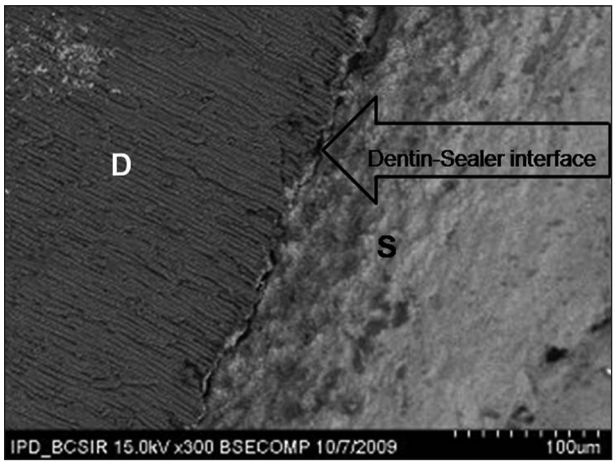

Figure 2: Photomicrographs of specimen of score 1

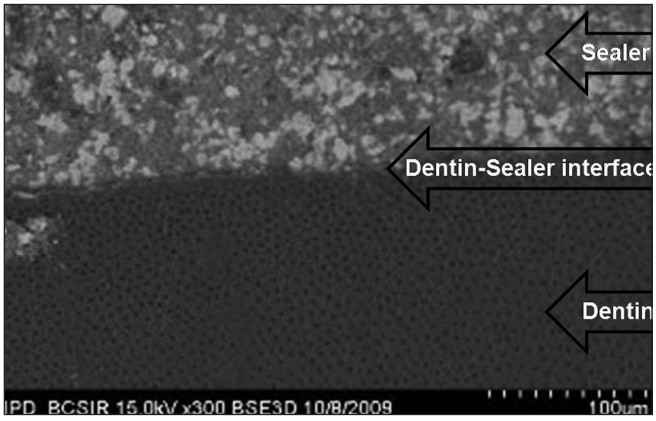

Figure 3: Photomicrographs of specimen of score 2

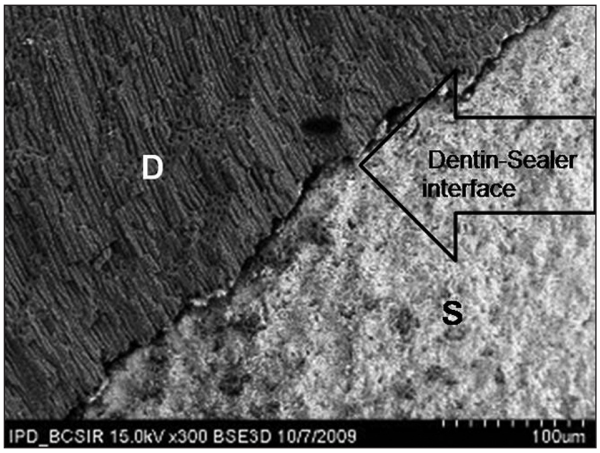

Figure 4: Photomicrographs of specimen of score 3

Table 1: Mean score of adhesion of experimental groups

Groups	Sample size	Range (mm)	Mean ± SD	*P* value
Group 1#	15	1-3	2.47±0.64	0.001*
Group 2^	15	1-3	1.53±0.74	

**t* value:3.686, df: 28; #Gutta-percha and endofill sealer; ^Resilon and Epiphany sealer; SD: Standard deviation

groups. There is a significant ($P < 0.001$) difference between the mean of the adhesion scores of Group 1 (Gutta percha and endofill sealer) and Group 2 (resilon and epiphany sealer).

Tables 2 and 3 show results among the experimental groups and their comparisons. Overall dye penetration was seen to be slightly higher in Group 1 (Gutta-percha and endofill sealer) than that of Group 2 (resilon and epiphany sealer). The negative samples did not show any dye penetration and the positive samples showed considerable leakage.

Dye penetration was seen in both experimental groups when viewed under the stereomicroscope. The difference in penetration of dye in samples obturated with resilon/epiphany system and Gutta-percha along with endofill sealer was not found to be statistically significant ($P = 1.000$) [Table 2].

When comparing the adaptation of the material to the root canal walls, the samples obturated with the resilon/epiphany system had better adaptation than samples obturated with Gutta-percha and endofill sealer [Table 3]. This difference was found to be statistically significant ($P = 0.001$).

DISCUSSION

This prospective comparative *in vitro* study was done to compare the apical microleakage of root canals obturated with resilon/epiphany system and Gutta-percha with endofil sealer. Adhesion of the obturating

Table 2: Mean dye penetration of different groups

Groups	Sample size	Range (mm)	Mean (±SD) apical leakage (mm)
Group 1	15	0-3	1.53±0.74
Group 2	15	0-2	1.47±0.64
Group 3A	4	12-13	12.25±0.50
Group 3B	4	10-13	12.0±1.41
Group 4	4	0	00±0.0

SD: Standard deviation; Group 1: Gutta-percha and endofill sealer; Group 2: Resilon and epiphany sealer; Group 3A: Positive control (resilon); Group 3B: Positive control (Gutta-percha); Group 4: Negative control

Table 3: Comparison of dye penetration among the five sample groups

Variable	Groups	Mean difference	*P* value
Dye penetration (mm)	Group 1 versus Group 2	0.67	1.000
	Group 1 versus Group 3A	−10.717	0.001*
	Group 1 versus Group 3B	−10.467	0.001*
	Group 1 versus Group 4	1.533	0.007*
	Group 2 versus Group 3A	−10.783	0.001*
	Group 2 versus Group 3B	−10.533	0.001*
	Group 2 versus Group 4	1.467	0.011*
	Group 3A versus Group 3B	0.250	1.000
	Group 3A versus Group 4	12.250	0.001*
	Group 3B versus Group 4	12.000	0.001*

*$P < 0.01$ is statistically significant; Group 1: Gutta-percha and endofill sealer; Group 2: Resilon and epiphany sealer; Group 3A: Positive control (resilon); Group 3B: Positive control (Gutta-percha); Group 4: Negative control

materials to the dentin walls was also evaluated in this study. The results of this study indicate that resilon/epiphany was alike, but not superior to gutta-percha/conventional endodontic sealers. These results does not confirm the hypothesis that resilon/epiphany sealed root canals are superior to conventional Gutta-percha/endodontic sealers.

Three-dimensional sealing of the root canal system is one of the main goals of endodontic treatment and is essential for prevention of canal re-infection and maintenance of healthy periapical tissues. Keeping this in mind, several endodontic obturating materials have been developed and evaluation of the sealing ability of these materials is considered extremely important.[13]

In the present study, results for penetration of dye in the samples showed that more dye penetration occurred in the samples that were obturated with Gutta-percha and endofil sealer than in samples that were obturated with resilon/epiphany system though it did not reach the significant level ($P = 1.000$). The results of experimental groups showed a significant difference when compared to the control groups. The negative samples did not show any dye penetration, whereas the positive samples showed considerable dye penetration. This further emphasizes the essential nature of sealers in root canal obturation. The results in this study strengthens the conclusion drawn from other researchers.[14-16] However, this result is not supported by other studies.[17,18]

Smear layer removal was done in this study by the alternating use of NaOCL and EDTA in order to improve the adaptation of the sealer to the canal wall. Cobankara *et al.*claimed that by removing the smear layer, the surface contact between the intracanal walls and the filling material is increased and apical seal may be improved.[19]

In the present study, adhesion of the obturating material to the dentinal walls was evaluated by viewing the samples under a scanning electron microscope. The scoring was done according to modified Ray and Seltzer criteria for evaluation.[12] Results showed very good adhesion to the dentinal walls with resilon/epiphany system. The sealer-dentine interface was not entirely gap free. A few areas could be seen where there were gaps between the epiphany sealer and dentine surface. Likewise, similar areas of gap free and gap containing areas were present in the samples which were obturated with Gutta-percha and endofill sealer. The results of this were similar to the results in a study by Tay *et al*.,[20] But Nunes *et al*.,[21] showed that epiphany sealer had poor adhesion to dentin when compared to AH26 sealer.[21]

In this study, it was seen that though the results of adhesion between the two experimental groups were significant, but the results for dye penetration was not statistically significant. However, caution must be exercised when comparing and evaluating tests of adhesion and leakage.

CONCLUSION

Based on the results obtained from this study, it can be concluded that, when comparing the extent of apical leakage in teeth obturated with resilon/epiphany system and Gutta-percha along with endofill sealer, there was no statistically significant difference between the groups. However, these groups showed considerably less leakage compared with the control groups. On the other hand, when adhesion to the root canal walls was evaluated among the groups, the teeth obturated with resilon/epiphany system showed better adaptation to the root canal walls.

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