Comparative Analysis of Microleakage and Seal for 2 Obturation Materials: Resilon/Epiphany and Gutta-Percha

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ABSTRACT

Objective: Microleakage continues to be a main reason for failure of root canal therapy, where the challenge has been to achieve an adequate seal between the internal tooth structure and the main obturation material, gutta-percha. The Resilon/Epiphany (R/E) system uses a new obturation material that bonds chemically with the internal tooth structure, thereby decreasing the possibility of microleakage. The purpose of this study was to compare dye leakage in root canals filled with R/E and those in which gutta-percha was used.

Methods and Materials: Pulpectomies were performed on 105 extracted human single-canal mandibular incisors. The teeth were then randomly divided into 2 groups: 1 was obturated with gutta-percha and the other with R/E. Obturation was performed using the lateral condensation technique. The teeth were then incubated for 10 days, 1 month or 3 months in a heated water bath solution with dye to simulate conditions in the human oral cavity. Teeth were sectioned and examined under dissecting and scanning electron microscopes to assess dye penetration, seal and bonding.

Results: Resilon as the main obturation material consistently resulted in less microleakage than gutta-percha at all 3 time intervals.

Conclusion: The R/E system provides a new material for root canal treatment. R/E creates a chemical bond with the internal tooth structure over the entire root area that is maintained over time, thus representing a better option than gutta-percha. Further studies on R/E will help validate its use and determine its long-term success rates in vivo.

MeSH Key Words: dental leakage/prevention & control; dental pulp cavity/microbiology; root canal filing materials; root canal obturation methods
dogs, in which vital roots were aseptically treated. After 4 weeks, access cavities were made and cotton pellets soaked in bacteria were placed in the cavities and sealed in the canal. This pellet placement was repeated every 2 weeks for 14 weeks. After the 14-week span, the animals were killed and the apices of the treated roots were evaluated. Of 22 roots treated with gutta-percha, 18 (82%) showed mild periapical inflammation compared with 4 (14%) of 21 roots treated with Resilon.

We set out to investigate dye leakage in root canals filled with R/E compared with gutta-percha. Previous studies have not looked at the longevity of the R/E system in the oral environment. We wanted to determine whether the R/E chemical bond and seal were preserved over time and how they compared with gutta-percha.

**Methods and Materials**

Randomly chosen single-rooted human mandibular incisors (105) were used in this study. The teeth had been previously extracted and stored in a 10% formalin solution until they were needed. The singularities of the canals were determined by analysis of mesial–distal view radiographs of each tooth. The teeth were then randomly divided into 7 groups, each consisting of 15 teeth. Pulpectomies were performed on 6 of the groups using rotary instrumentation consisting of RaCe (Brasseler USA, Savannah, Ga.), ProFiles (Dentsply, York, Pa.) and Gates Glidden drills using the step-back technique. Final smoothing of the canal was done with a #35 hedstrom file. A 2.5% NaOCl solution was used as an irrigant with the insertion of each instrument. EndoGel (Jordco Inc., Beaverton, Ore.) was also used as a lubricant with the RaCe and Profiles drills. Each specimen was prepared to a size 35 and an apical stop was confirmed with a master point.

Of the 6 groups, 3 were prepared for obturation with gutta-percha. Canals were rinsed with NaOCl and dried with absorbent paper points. The canals were then coated with Tubli-Seal (Kerr Corp., Orange, Calif.) with a #25 K file, and the master point was inserted into the canal.

**Figure 1**: The Epiphany primer, Epiphany sealer and Resilon points.

A study by Shipper and others investigated coronal leakage using Streptococcus mutans and Enterococcus faecalis in teeth filled with gutta-percha versus Resilon using both lateral and vertical condensation techniques for obturation. They amputated the coronal portions of 120 extracted single-canal teeth. The roots were randomly divided into 8 groups, depending on the obturation material and technique used. Resilon showed significantly less coronal microleakage: 10% to 16% of the specimens showed leakage, compared with gutta-percha where approximately 80% of the specimens leaked.

Another important study by Shipper and others looked at periapical inflammation after root canal treatment in
Accessory gutta-percha points were added using the lateral condensation method.

The other 3 groups were prepared for obturation using the R/E system. The canals were rinsed with distilled water, flushed with EDTA and dried with absorbent paper points. A dry paper point was soaked with Epiphany primer and used to coat the root canal walls. The Resilon core material master point was then coated in Epiphany sealer and inserted into the canal. Subsequent accessory points of Resilon core material were also coated with the sealer and added to the canal through lateral condensation. Once the obturation was completed the coronal surface was light cured for 40 seconds.

The coronal portion of all 6 groups was then restored using 37% phosphoric acid etchant for 15 seconds. Adper Singlebond Plus (3M ESPE, St. Paul, Minn.) was applied to the tooth structure and cured for 10 seconds, then Filtek Supreme (3M ESPE) composite resin was used in increments of 2 mm to fill and restore the cavity. Each increment was light cured for 40 seconds. The external root surface from the cementoenamel junction to 1 mm from the apex of teeth in all 6 groups and the control group was painted with 2 coats of nail polish (Sally Hansen, Del Laboratories Inc., Canada).

All teeth were incubated for 72 hours in saline at 37°C. Each group was then put into a separate Petri dish with saline solution and blue ink dye (Sanford Corporation, Oak Brook, Ill.) and placed in an incubator set at 37°C. The 3 groups of gutta-percha and the 3 groups of Resilon-filled teeth were kept in the incubator for 10 days, 1 month or 3 months. The control group remained in the incubator for the entire 3 months.

After incubation, the teeth were removed from the dye-containing solution. The root region of each tooth was sectioned twice using a flat-bed diamond cutter, resulting in 3 sections of root: the coronal third, middle third and apical third.

The cross-sectional surfaces of the root sections were examined under a dissecting microscope for evidence of dye penetration between the obturation material (gutta-percha and Tubiseal or R/E) and the internal root structure to confirm the presence or absence of microleakage. The control group was examined to confirm that dye penetration did not come from the areas that were painted with nail polish. Two randomly chosen cross-sectional samples from each of the 6 groups obturated with either gutta-percha or Resilon were also viewed under a scanning electron microscope (SEM). These samples were mounted on an aluminum stub, coated with gold atoms and examined using the JEOL 840A SEM to assess the interface between the obturation material and tooth structure at magnifications of 500 and 1,000 times.

Results

At all 3 incubation intervals, less leakage was apparent in the R/E obturated teeth sections than in the gutta-percha groups (Table 1). When the data were subjected to comparative regression analysis, Resilon was superior over all time intervals with an R value of 0.8928 compared with gutta-percha with an R value of 0.8161 (Fig. 2).

Two random samples from each group were observed under SEM. R/E samples showed a significantly superior seal for all 3 incubation periods compared with gutta-percha (Figs. 3 to 6). A complete seal was not observed in any of the gutta-percha samples.

Discussion

Studies of the R/E system have confirmed the superiority of this material. Bonding is clear between the obturation material and the tooth, showing promise for its future
endodontic studies, a bacterial leakage study would have had more significance. Thus, further studies to test such leakage must be conducted in animals.6

As shown in Table 1, gutta-percha formed a consistently poorer seal. This raises the question of the need for an alternative material for obturation. R/E is such a new material that may fill that need. With the R/E system, the use of primer before the Epiphany sealer prepares the tooth root surface through an etching process that creates finger-like dentinal projections. This allows for a lock and key type bond between the tooth and the sealer and core material. The data in Table 1 illustrate how R/E provided a more consistent seal along all regions of the root structure compared with gutta-percha. Furthermore, viewed through the SEM, this bond was observed to form a uniform transition from the tooth to R/E material even at a magnification of 1000× (Figs. 3 to 6). Gutta-percha, on the other hand, failed to produce a complete seal and there was evidence of a space at the tooth–filling interface in many of the gutta-percha samples.

It must be noted that this study was strictly in vitro and measured dye leakage with respect to the 2 materials; the results may not coincide with those achieved in a biological system.

In addition, there are some areas of concern with respect to the use of the R/E system. Sensitivity of the materials to technique must be further explored. Concerns lie in the operator's ability to place primer and sealer in the apical portions of root canals. There is also concern over the potential for biodegradability of R/E, as the filling material contains polycaprolactone.10

**Conclusion**

Problems associated with the inadequate seal formed by gutta-percha when used as an obturation material have been known for decades. Researchers and clinicians have tried numerous methods to alleviate this problem but with little success. The R/E system provides a new material for root canal treatment. Resilon not only creates a chemical bond with the internal tooth structure over the entire root area, but its seal is maintained over time to a greater degree than gutta-percha’s. This and other studies show that R/E has the potential to replace gutta-percha in this setting.
Further studies on R/E will help validate its use. Other needed research includes in vivo studies showing long-term success rates of this material, as well as comparisons of R/E with gutta-percha using different obturation techniques in long-term studies. Further research is also needed on the placement of primer and sealer in the apical portion of the canal.

**References**


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