

Comparison of Coronal Microleakage of Canals Filled with Gutta Percha and Resilon with a Glass Ionomer Coronal Barrier

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Abstract

Background and Aim: Coronal seal is as important as the quality of root canal therapy in treatment success. This study aimed to compare the coronal microleakage of canals filled with Resilon and gutta percha with a glass ionomer coronal barrier.

Materials and Methods: In this experimental study, the crowns of 64 single-rooted human premolar teeth were cut at the level of CEJ. Root canals were prepared using rotary ProTaper files. The teeth were randomly divided into 4 experimental groups (n=14) and 2 positive and negative control groups (n=8). Root canals of experimental group specimens were filled with gutta percha (groups 1 and 2) or Resilon (groups 3 and 4) using lateral condensation technique. The roots of negative control specimens were filled and all teeth surfaces were sealed with sticky wax. Root canals of positive controls were filled without the application of sealer. Glass ionomer coronal barrier was placed at the orifices in groups 2 and 4. Microleakage of *Streptococcus faecalis* was evaluated during 90 days. Data were analyzed using Chi square, Log-Rank and Tukey's tests.

Results: The degree of microleakage was less in groups with GI coronal barrier. However, this difference was not statistically significant ($p>0.05$). Time to microleakage in gutta percha+ coronal barrier and Resilon+ coronal barrier groups was significantly less than that in gutta percha and Resilon groups, respectively ($p=0.03$).

Conclusion: Within the limitations of this study, microleakage occurred in all groups but glass ionomer acted as an effective barrier.

Key Words: Bacterial microleakage, Resilon, Gutta percha, Coronal barrier

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Introduction

The main goal of root canal therapy (RCT) is elimination of microorganisms from the root canal system and its obturation in order to prevent microbial colonization. Gutta percha has the highest application for root canal filling and is the standard root canal filling material for comparison with other materials in terms of achieving a complete seal [1]. It possesses dimensional stability and biocompatibility. It is radiopaque and is plasticized if exposed to solvents or heat [1]. However, it cannot

bond to dentin and does not confer fracture resistance to tooth structure [2]. Resilon is a newly used synthetic, polymer-based root canal filling material that is used in combination with Epiphany sealer. Some studies on Resilon have indicated decreased microleakage [1] and increased resistance to fracture following its application in endodontically treated teeth in comparison with gutta percha [3-5]. However, some others showed that Resilon did not confer fracture resistance to teeth [6] and found no significant difference in bacterial microleakage

between Resilon and gutta percha [7]. In addition to apical and lateral seal of the root canal system, coronal seal is also required for a successful RCT regardless of the root canal filling material. Some researchers claim that RCT success more importantly depends on the quality of coronal restoration as the second line defense against microorganisms rather than the root canal filling material [6].

A wide range of materials such as glass ionomers, composite resins, Cavite, MTA and amalgam have been suggested and studied as coronal barrier against microleakage [8]. However, an ideal intra-orifice barrier has yet to be found [9]. This study aimed to compare coronal microleakage of canals filled with gutta percha and Resilon with a GI coronal barrier.

Materials and Methods

For this experimental study, 64 single-rooted human mandibular premolar teeth with straight roots were collected. The teeth were cleaned from periodontal tissue appendages and immersed in 5.25% sodium hypochlorite solution for 30min. the teeth were stored in normal saline solution until the experiments (maximum of one month). Teeth crowns were cut leaving 16 ± 1 mm of root length. The working length was determined using #15 k file (Mani, Japan) 0.5mm shorter than the apex. Root canals were prepared using the crown down technique and ProTaper rotary files (Dentsply, Tulsa Dental Specialties, Tulsa, OK) up to F4 MAF according to the manufacturer's instructions for the speed and torque of ProTaper files working with Endo IT electric motor (VDW, Germany); 2cc of 2.5% sodium hypochlorite solution was used for irrigation in between filings. Each rotary file was only used for preparation of 5 canals. After completion of instrumentation, canals were irrigated with 5ml of 5% sodium hypochlorite for smear layer removal followed by rinsing with 5 ml of 17% EDTA solution and a final irrigation with 5ml of normal saline solution. Canals were then dried. All teeth surfaces except for the coronal and apical 2mm were covered with 2 layers of nail varnish. The teeth were randomly divided into 4 experimental groups of 14 each and two positive and negative control groups of 4. Root canals were filled as follows: Root canals were filled with gutta percha cones (Ariadent, Iran) and AH26 sealer

(Dentsply, Germany) in groups 1 and 2 and Resilon cones and Epiphany sealer (SybronEndo, USA) in groups 3 and 4 using lateral condensation technique. In groups 3 and 4 (filled with Resilon/Epiphany) after completion of filling, the teeth were coronally light cured for 40s according to the manufacturer's instructions. In groups 2 and 4, after root canal obturation, 2 mm of the coronal gutta percha (group 2) or Resilon (group 4) was removed using a hot plagger and 2 mm of light-cured GI (Gold Label Fuji Dental, Japan) was placed at the coronal part of the root canals and light cured for 40s (Coltene, Switzerland). Four teeth were assigned to positive control group; of which, 2 were filled with Resilon without the Epiphany sealer and two teeth were filled with gutta percha without the AH26 sealer. Four teeth were assigned to the negative control group that underwent root canal filling and then their entire surfaces were covered with 2 layers of nail varnish. The coronal part and apices were sealed with sticky wax. All teeth were stored at 37°C and 100% moisture for three days [10]. For the assessment of microbial microleakage, a two-chamber bacterial microleakage model (Ependorf microtube and glass test tube) was used. The teeth were placed in one ml microtubes. The bottom of microtubes was cut by a scalpel in such way that the apical 2-3 mm of roots exited the microtubes. In the next step, Tryptic Soy Broth (TSB) culture medium (Merck, Germany) was poured into glass test tubes using sterile syringes in aseptic conditions under Class II biological safety cabinet. Then, the complex of tooth-microtube was assembled over it in such way that the apical 2-3 mm of roots were in the culture medium. A 0.5 McFarland suspension was prepared from the 24h culture of *Enterococcus faecalis* (ATCC=33186) in Brain Heart Infusion Agar (Liofilchem, Italy) and injected into the microtubes (coronal part of teeth). Specimens were then stored in an incubator at 37°C. The bacterial suspension was refreshed every 48h for 90 days. Specimens were evaluated daily in terms of turbidity of the TSB culture medium (color change from red to yellow due to acid production by the bacteria). In order to confirm that the *E. faecalis* bacteria were responsible for this color change, samples were taken from the medium inside the glass test tube, cultured in blood agar medium and gram-stained. Data were ana-

lyzed using Chi square, Log-Rank and Tukey's tests.

Results

Kolmogorov Smirnov test was used to assess the distribution of data; which showed that data had normal distribution ($p < 0.05$). Thus, parametric one-way ANOVA was applied for comparison of microleakage in the 4 groups ($p < 0.05$). In order to assess the survival of samples during the 90-day period Kaplan Meier survival analysis with the Log Rank test was applied ($p < 0.05$). The results of statistical analyses revealed significant differences between groups in time to microleakage. Time to microleakage in the 4 groups is shown in Table 1. In gutta percha specimens with coronal barrier and

Resilon samples with coronal barrier microleakage occurred significantly later than specimens with gutta percha and Resilon alone,, respectively ($p = 0.03$). No significant difference was found in this respect between the gutta percha and Resilon groups and groups with coronal barrier ($p > 0.05$). Evaluation of bacterial microleakage status in different groups after 90 days using Chi square test is shown in Diagram 1. The results of this test demonstrated the lowest microleakage in Resilon plus coronal barrier group followed by gutta percha plus coronal barrier. However, no significant difference was found in terms of frequency of microleakage between these groups and also other groups (without the coronal barrier) ($p = 0.24$).

Table 1. Statistical indices of time to microleakage (days) in teeth in the 4 experimental groups

Group	Number	Median	Minimum	Maximum	Mean
Gutta percha	14	13	12	*+90	14
GI+ gutta percha	14	63	4	+90	52/4
Resilon	14	24	6	+90	22/2
GI+ Resilon	14	70	70	+90	70

*+90 indicates no microleakage

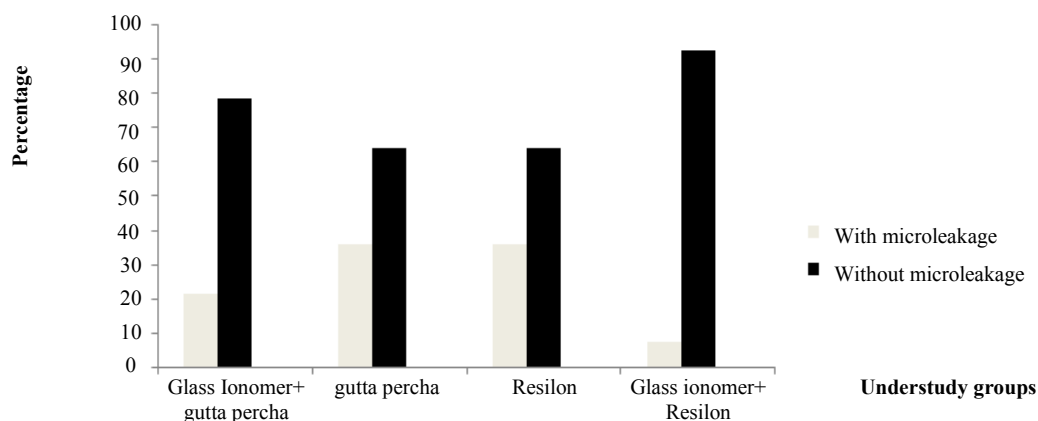


Diagram 1. Distribution of bacterial microleakage status (%) in different groups after 90 days

Discussion

Root canal filling materials should be able to prevent the entry of microorganisms and their toxins into the root canal system and peri-radicular tissues [11]. However, coronal seal is also important.

Immediate coronal seal clinically has many advantages for the patient; because in many circumstances, the filled canals may become exposed to saliva and a bacterial infection pursues in the canal [12]. The present study results demonstrated that

the degree of microleakage in the Resilon+ GI coronal barrier group was less than in other groups. The highest degree of microleakage was seen in groups without the coronal barrier. However, the difference in this respect between groups was not significant. Also, no significant difference was found in coronal microleakage of canals filled with gutta percha and Resilon alone. This finding is in accord with the results of Pitout et al, [13]. Tay et al. also reported that root canal filling with gutta percha or Resilon does not cause a fluid-tight apical seal [14]. Non-adhesion of gutta percha to dentinal canal walls or specific characteristics of the sealers used for preparation of root canal can increase the microleakage when using gutta percha as the main root canal filling material [2]. The results of a study by Shipper et al. indicated the presence of gaps between the gutta percha and AH26 sealer. These gaps enhance the microleakage [1]. Also, polymerization shrinkage of Epiphany sealer can be the possible cause of gap formation and subsequent coronal or apical microleakage in canals filled with Resilon [13]. Perdiagao et al, revealed two-dimensional detachments in the formed hybrid layer. They explained that despite the occurrence of hybridization in resin-based filling materials, achieving a perfect seal in the root canal system is practically difficult due to the complex anatomy and mechanical problems such as polymerization shrinkage [9]. Several other studies have also confirmed these results using dye penetration technique and bacterial microleakage models and found no significant difference between Resilon and gutta percha in this regard [7, 9, 15, 16]. In contrast to our results, Stratton et al. demonstrated that the microleakage in the Resilon system was significantly less than that of gutta percha [17]. The possible reason for this difference may be different experimental models. Stratton et al. used warm vertical condensation technique and the fluid filtration method for evaluation of microleakage [17]. They also evaluated apical microleakage of canals; whereas, we evaluated coronal microleakage. Many dentists strongly believe in achieving a complete seal by using gutta percha and a coronal barrier. Application of a coronal barrier may improve treatment prognosis [8]. It has been shown that canals filled with gutta percha and coronal barrier have lower microleakage than canals

filled with gutta percha alone [18, 19]. This finding confirms our obtained results. Immediate application of a coronal barrier can create an immediate seal after root canal therapy. Long-term prognosis not only depends on the quality of root canal filling but also on the coronal seal [20]. The results of the present study showed that Resilon and gutta percha alone were not capable of preventing bacterial microleakage and there was an obvious need for a coronal barrier. Application of coronal barrier in our study decreased coronal microleakage in both groups of gutta percha and especially Resilon. However, this difference was not significant.

Jack et al. evaluated the effect of coronal barrier on reducing the microleakage and indicated that the degree of microleakage in root canals filled with gutta percha+ GI coronal barrier was significantly less than that of Resilon group [21]. However, in contrast to our study, they did not use coronal barrier for groups filled with Resilon.

Roghanizad and Jones also reported that replacement of 3mm of coronal gutta percha at the canal orifice with several restorative materials as coronal barrier had a significant effect on reducing microleakage which is in agreement with the present study results. In contrast to our study, they used dye penetration technique; which has lower accuracy than the bacterial microleakage model used in our study [8]. Pisano et al, also evaluated the coronal microleakage of canals filled with gutta percha and AH26 sealer plus coronal barrier of different materials (Cavite, Super EBA, IRM) in a 90-day period and concluded that canals filled with gutta percha plus coronal barrier had less microleakage than canals filled with gutta percha without the coronal barrier. Based on their study results, 15% of specimens in the Cavite group showed microleakage; which is almost similar to our study results (glass ionomer barrier). Super EBA and IRM had greater microleakage (35%) [22]. In our study, the lowest amount of microleakage (although not significant) was observed in canals filled with Resilon after the application of GI coronal barrier. It seems that in addition to creation of a physical barrier, glass ionomer forms a chemical bond to dentinal walls and Resilon that further decreases the microleakage. However, this issue is in need of further investigations.

Based on our study results, no significant difference existed between gutta percha and Resilon in terms of microleakage; which is in accord with the findings of Gomez et al [23]. But, application of coronal barrier increased the time to microleakage in both groups of Resilon and gutta percha; which confirms the findings of Slutzky-Goldberg [24].

Conclusion

Our study on the evaluation of coronal microleakage of canals filled with gutta percha and Resilon with and without GI coronal barrier found no significant difference in microleakage between the root canal filling materials with or without coronal barrier. However, application of GI coronal barrier caused a delay in occurrence of microleakage.

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