Original Article

Comparison of Resilon and Gutta-Percha Filling Materials on Root Canal Fracture Resistance Following Restoring with Quartz Fiber Posts

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Abstract

Objective: Bacterial leakage and root fractures are the most important reasons of root canal treatment failure. Due to the lack of adhesion of gutta percha to the canal walls, Resilon has been introduced as a root-filling material able to bond to the root walls. Metal posts may predispose the tooth walls to oblique and vertical fracture which usually leads to tooth loss; whereas, fiber posts may reinforce the remaining tooth structure.
The purpose of this study was to compare the effect of Resilon and gutta-percha on the fracture resistance of root canal following restoring with quartz fiber posts.
Materials and Methods: Forty-four maxillary incisor root canals were chemo-mechanically prepared, then randomly divided into three groups: 1-Control group (n=20), 2-Experimental group (n=20) and a negative control group (n=4). Root filled teeth were restored with quartz fiber posts and composite resin cores. Four teeth with a conservative prepared access cavities and without any further post preparation were used as a negative control group. After simulating the clinical situation, specimens were loaded in the Universal Testing Machine for compressive strength test. All data were statistically analyzed by the T-test.
Results: The mean compressive strengths for group 1 was 535.8 ± 155.23 N and 645.93 ± 182.98N for group 2, which were statistically significant (p-value= 0.047).
Conclusion: Root canals filled with Resilon were significantly more resistant than that of gutta-percha, following restoration with quartz fiber posts.

Key Words: Resilon, Quartz Fiber Post, Root Fracture Resistance

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INTRODUCTION

Bacterial leakage and root fractures are the two most important causes for root canal treatment failure [1]. Gutta-percha and resin sealer *AH26* are commonly used for canal obturation, but they have drawbacks due to their lack of adhesion to the canal walls [2]. In fact, the root is not strengthened owing to the lack of chemical bonding of gutta-percha and sealer to the dentinal wall; therefore, the incidence of fracture may rise [1]. Resilon (Pentron, Wallingford, *CT, USA*) is a new resin material used for filling root canals that can be handled similar to gutta-percha. It may be laterally condensed, as well as heat softened and injected into the root canal system. It is used in conjunction with a dual cure, resin based sealer, Epiphany (Pentron), which bonds to the dentin walls and Resilon core [2-4]. Some studies have shown higher compressive strength in teeth that had been obturated with Resilon compared to that of filled with gutta-percha.[2,4] In addition, root-filled teeth are almost at higher risk of fracture because of the extensive destruction of tooth structure and post space preparations and placement. Metal posts are very rigid, but their modulus of elasticity differs greatly from that of dentin so they may predispose the tooth walls to oblique and vertical fracture usually leading to tooth loss[5]. Quartz fiber posts are superior to metal posts because of the high tensile strength and similar modulus of elasticity (*MOE*) to dentin. Using these posts, the root canal can be prepared more conservatively.

Fiber posts may reinforce the remaining tooth structure on account of their chemical bonding to dentin [6].

Besides, these posts will provide physico-chemical properties similar to dentin which will lead to proper stress distribution and reduced risk of root fracture [7-9].

Most of the studies have indicated higher compressive strength for fiber posts in comparison with metal posts [6,7,10,11]. It is noteworthy that fiber posts bond with the canal walls through the resin cement which itself may bond with resin-based filling materials such as Resilon. Hence, it is sensible to assume that Resilon may increase the fracture resistance of endodontically treated teeth.

Therefore, the purpose of the present study was to compare the effect of Resilon and gutta percha on the compressive strength of root after restoration with quartz-fiber posts.

MATERIALS AND METHODS

This study was performed on forty four human maxillary central incisors extracted due to periodontal disease. All samples were examined radiographically and then observed under the stereomicroscope (Nikon, *SMZ-1*) with 40 x magnification. Teeth without any internal or external resorption, root fracture, root caries, calcification in the canals and with a closed apex, the same buccolingual (5 to 7 mm) and mesiodiostal (3 to 5mm) diameters, a root length between 14 to 16 mm, an apical foramen diameter of 0.25 mm (equivalent to size 25 of endodontic k file) and a root curvature less than 20 degrees were selected. The buccolingual and mesiodistal diameters of the specimens were measured with a gauge with 0.1 mm accuracy at the cementoenamel junction (*CEJ).* The specimens were scrubbed thoroughly to remove debris and were kept for 24 hours in 1% sodium hypochlorite solution for surface disinfection.

All teeth (except the ones in the negative control group) were sectioned at the *CEJ* by a 0.2 mm-thick metal disk (*D&Z*, Switzerland) using a high-speed hand piece. After working length determination for each specimen, the ProTaper rotary system (Dentsply, Mailefer, Switzerland) was used with the crown-down technique according to the manufacturer`s instructions. Preparations were completed with the ProTaper file number F5 (apical diameter: 0.5 mm). *EDTA* 17% and sodium hypochlorite 5.25% were used consecutively, each for 1 minute, to remove the smear layer. Sterile water was used as the final rinse.

Next, the specimens were randomly divided into three groups: 1-Control group (n=20), 2-Experimental group (n=20) and a negative control group (n=4). In the control group (n=20), gutta-percha (Roeko Guttapercha Points *GT*, Coltene Whaledent, *USA*) and AH26 sealer (De Trey Dentsply, Switzerland) were used with the lateral condensation technique. Gutta-percha ISO taper cone size 50 was selected as the master cone according to F5 ProTaper file size and then lateral cones were used to fill the canal completely. In the experimental group (n=20), specimens were obturated with Resilon/Epiphany system. All materials were mixed and applied according to the manufacturer's instructions. Epiphany self-etching primer was applied with a micro brush inside the canals. Epiphany sealer was then mixed and applied to the canal walls using a paper point. Resilon master cone sized 50 was selected according to F5 ProTaper file and the lateral cones were condensed afterwards. The coronal 2 mm of the sealer was immediately light cured for 40 seconds using Coltolux 2.5 light cure device (380 mw/cm2) (Coltene, Germany). Complete setting of Epiphany sealer took up to 25 minutes. To evaluate the obturation quality, periapical radiographs were taken and specimens with improper obturation length and condensation quality were excluded. In the negative control group (n=4), the preparation was carried out with ProTaper the same as former groups, then two of the samples were filled with Resilon and the other two with gutta-percha by the lateral condensation technique. After radiographic evaluation, those with void and improper work lengths were excluded. Except for the negative control group, all specimens were restored with quartz fiber posts (D.T. White posts, *RTD*, *TM*, France) number 2 with 1 mm diameter and 14 mm length. All negative control cases had intact crowns and roots which were not subjected to any further post preparation and only the conservative prepared access cavities were restored just with light-cured Lumiglass composite (*RTD, TM*, France).

Post space preparation was performed with D.T. Universal Drill and D.T. Finishing Drills in a way that 3 to 5 mm of gutta-percha remained apically. Post spaces were then cleaned with normal saline and dried with paper points. The canal orifices were etched with 37% phosphoric acid for 15 seconds. Acid was rinsed and posts were cemented with Panavia F2.0 dual cure resin bonding cement (Kuraray, *USA*) according to the manufacturer's instructions. Then, the core was built up in each specimen using preformed polyester matrix filled with Lumiglass composite (*RTD*, *TM*, France) which was placed on the coronal portion of root by pressure and cured for 40 seconds from all aspects (buccal/lingual/mesial/distal). Specimens were mounted vertically in auto polymerized acrylic resin blocks and an artificial PDL was simulated around roots using polyether elastic material Impergum (*3M*, *ESPE*, *USA*). The specimens were then stored in 100% humidity at 37° C until fracture resistance testing. The specimens were loaded in Universal Testing Machine (Zwick-5113/Roell, Germany) for compressive strength test. The specimens were fixed in a jig and a gradually increasing compressive load was delivered at 130° to the long axis of the tooth in a lingual-labial direction just above the cingulum with a ball-shaped tip at the cross-head speed of 1mm/min. The peak load to fracture was recorded (Newton) and all data were analyzed statistically using T-test.

Finally, each specimen was studied under the stereomicroscope to evaluate the pattern of fracture.

RESULT

All specimens were tested for compressive strength. Kolmogorov-Smirnov test showed the normal distribution of data. Therefore, student T-test was used to compare mean fracture loads in the two groups. (Table 1).

The mean compressive strength in the negative control group with Resilon and gutta-percha were 760.12 ± 164.73N and 418.22 ± 318.13N, respectively. The mean compressive strength in the experimental group (Resilon) and the control group (gutta-percha) were 645.93 ± 182.98N and 535.8 ± 155.23N, respectively. This difference was statistically significant (p-value= 0.770) (Table 1). Of the 40 specimens of the case and control groups, 35 specimens were fractured in core material. In all cases, the roots were fractured horizontally at the cervical level, but only in one specimen the post was fractured.

DISCUSSION

Root canal treated teeth become weakened due to the loss of natural tooth structure during instrumentation and post preparation [8]. It has been suggested to reinforce these root canal walls using fiber posts. Since fiber posts do not adhere to gutta percha, Resilon might be a better choice for canal obturation. We assumed that Resilon system can adhere to dentinal walls of root canals and even fiber post, making it able to strengthen the root against fracture. In the present study, the canals filled with Resilon showed higher compressive strength than that of canals obturated with gutta percha and AH26 sealer.

Many studies have indicated higher fracture resistance for teeth filled with Resilon/Epiphany compared with similar teeth filled with gutta-percha [2, 4].

In a study by Teixeira et al. on compressive strength of endodontically treated teeth, canals filled with Resilon showed a significantly higher compressive strength compared with that of gutta-percha which is in agreement with our findings [12].

Monteiro et al. in an in vitro study regarding the resistance of roots filled with Resilon or gutta-percha against fracture found the same results [13].

On the other hand, in 2005 Stuart et al. evaluated the reinforcement of immature teeth with new resin obturating material and concluded that the mean compressive strength for gutta-percha was higher than Resilon [4]. The opposite results may be partially because of the differences between immature and mature roots such as thin dentinal walls of immature teeth.

The compressive strength of endodontically treated teeth which were reconstructed with different post systems showed that the mean fracture load was significantly highest in quartz fiber posts and the pattern of fracture in the groups reconstructed with quartz fiber and glass fiber posts were in the cervical portion of the roots [7].

In addition, another study evaluated the compressive strength of endodontically treated teeth which were reconstructed with three different prefabricated aesthetic post systems. It was stated that higher compressive strength was evident in aesthetic quartz fiber post group [8]. The innovative aspect of the present study was to compare the effectiveness of different root filling materials in vicinity of fiber post on fracture root resistance.

Table 1. Mean and SD of Compressive Strength (Newton) for Resilon and Gutta-Percha

Group	n	P value	Mean	SD	SD error
Resilon	20	0.76	645.93	182.98	40.91
Gutta-Percha	20	0.87	535.81	155.23	34.71
P-Value			**0.047**		

This difference was statistically significant (p-value= 0/047)

Unfortunately, no similar studies exist to compare our findings with. Only a new study is available regarding the influence of different sealers on the bonding interface of weakened roots reinforced with resin and fiber posts. The push-out test exhibited that the most frequent type of failure was adhesive. Overall, apical and middle regions of root canals presented a lower density of resin tags than the coronal region [14]. Accordingly, quartz fiber posts were used in the present study to enhance the fracture resistance of the specimens. In this research all fractures happened in the cervical third of the roots (1-2 mm from the canal orifice), as was expected because of the similarity of MOE (modulus of elasticity) of fiber posts to dentin. In the present study, we did not use full coverage crowns over the core material and the compressive load was applied directly on the core. In this way, the interfering factors such as the size, shape, thickness and material of the crowns were omitted from the study and more precise evaluation of the effect of Resilon and gutta-percha on compressive strength of roots became more promising [15,16]. One of the limitations of such in-vitro studies is to provide the complicated occlusion. However we were trying to simulate the situation by fixing the specimens in a jig where a gradually increasing compressive load was delivered at 130° to the long axis of the tooth in a lingual-labial direction just above the cingulum with a ball-shaped tip. Our favorable finding in the Resilon group may be attributed to the fact that the combination of resin filling material and adhesive resin sealers may provide the condition called "Monoblock" (dentin/adhesive sealer/obturating material/quartz fiber post), resulting in strengthening of the root walls [10,17]. In a recent study, it has been shown that monoblock created either by adhesive resin sealers or by different adhesive posts within the root canal can reduce the stresses that occur inside the tooth structure in endodontically treated teeth [18].

CONCLUSION

It can be concluded that the compressive strength of endodontically treated teeth which are obturated with Resilon and restored with quartz fiber posts is significantly higher than that of teeth obturated with gutta-percha and restored with quartz fiber posts.

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