Comparison Between Gutta-Percha and Resilon Removal Using Two Different Techniques in Endodontic Retreatment

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Abstract

This study compared the remaining filling material and working time when removing gutta-percha/AH 26 and Resilon/Epiphany from root filled extracted teeth. The root fillings were removed using chloroform and two different rotary systems (K3 and Liberator files). The amount of residual filling material on the canal walls was imaged and measured using image analyzer software. The group filled with Resilon/Epiphany and retreated with K3 files demonstrated the least residual filling material on the walls ($p < 0.05$). There was no statistically significant difference between the gutta-percha/AH26 and Resilon/Epiphany groups when the Liberator files were used ($p > 0.05$). In the groups filled with Resilon/Epiphany, the filling was removed faster than groups filled with gutta-percha/AH 26 ($p < 0.05$). K3 rotary system was faster than Liberator to remove both gutta-percha and Resilon ($p < 0.05$). Resilon/Epiphany was effectively removed with K3 or Liberator rotary files. *(J Endod 2006;32:362–364)*

Key Words

Endodontic retreatment, Resilon, rotary files

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0099-2399/$0 - see front matter

doi:10.1016/j.joen.2005.12.006

Nonsurgical endodontic retreatment, when indicated (1), requires regaining of access to the entire root canal system through complete removal of the pre-existent endodontic filling material. This enables a new attempt at disinfection of the root canal system by thorough chemomechanical reinstrumentation and disinfection of the root canals, which are prerequisites for a successful outcome (2).

Gutta-percha, in combination with a variety of sealers, is the most commonly used material for root canal filling. Recently, Resilon (Pentron Clinical Technologies, Wallingford, CT) a thermoplastic synthetic polymer-based root canal filling material was proposed as an alternative to gutta-percha. Based on polymers of polyester, Resilon contains bioactive glass and radiopaque fillers. It performs like gutta-percha and has the same handling properties (3). The sealer, Epiphany Root Canal Sealant (Pentron Clinical Technologies, Wallingford, CT) is a dual curable dental resin composite sealer with a total filler content in the sealer of about 70% by weight (4) to allow its removal in retreatment cases. Fillers include calcium hydroxide, barium sulfate, barium glass, and silica.

In clinical practice, chloroform is the most effective and the most widely used solvent for gutta-percha (5). However, there are no studies using this solvent to remove synthetic polymer based root canal filling material.

Nickel-titanium (NiTi) files have been used increasingly in root canal preparation because of their unique physical properties. Increased flexibility is considered advantageous in preparing root canals of challenging shapes (6, 7). The ability of rotary systems to remove filling material has been widely studied (8–10). These studies have shown a good ability of different rotary file systems to remove gutta-percha and sealer from the root canal walls. The purpose of this study was therefore to compare the effectiveness in retreating gutta-percha and Resilon-filled root canals using K3 and Liberator rotary files.

Materials and Methods

Specimen Preparation

Eighty extracted single rooted teeth with a single patent canal and curvature <30 degrees determined by Schneider's technique (11) were selected and stored in 10% formalin until use. The crowns were flattened using steel discs (Brasseler USA, Savannah, GA) and a final dimension of 15 mm was achieved for each tooth. Working lengths were determined at 14 mm. Root canal preparation was done by a step-back technique using 0.02 tapered NiTi files (12) to master apical file size #35. Throughout instrumentation, a total of 30 ml of 1.0% sodium hypochlorite solution was delivered from a 30-gauge needle. After instrumentation the root canals were rinsed with 5 ml of 17% EDTA. The teeth had the canal filled using two different techniques. The canal of 40 teeth was dried with paper points and filled gutta-percha (Hygienic, Coltene/Whaledent, Inc., Mahwah, NJ) and AH 26 sealer (Dentsply Detrey, Konstanz, Germany) using the lateral condensation technique. A master gutta-percha cone corresponding to the last file size at working length was selected and customized for tug-back by trimming the tip. The sealer was applied 1 mm short of the canal length with a paper point and then the master cone was coated with sealer and positioned into the canal. Medium fine accessory gutta-percha cones were then laterally condensed until they could not be introduced more than 5 mm into the canal. A heated instrument was used to sear the filling material

TABLE 1. Total area of residual filling material in mm^2 (mean ± SD)

	Mean	SD
Gutta-percha/AH 26-K3	1.10[b]	± 0.32
Gutta-percha/AH 26-Liberator	1.76[c]	± 0.47
Resilon/Epiphany-K3	0.89[a]	± 0.19
Resilon/Epiphany-Liberator	1.30[c]	± 0.52

Averages followed by the same letter are not significantly different ($p \geq 0.05$).

off at the orifice of the canal. Other 40 teeth had the canal dried with paper points and coated with the primer (Epiphany Primer Pentron Clinical Technologies, Wallingford, CT) using a soaked paper point. Excess of primer was removed with a dry paper point. Then, the sealant (Epiphany sealant Pentron Clinical Technologies) was dispensed onto a mixing pad and placed into the root canal with a master Resilon cone (Pentron Clinical Technologies), previously selected. The accessory cones of Resilon were introduced for filling the root canals by lateral condensation technique. Excess of the Resilon was removed with a warm vertical condenser and the root canal entrances were immediately light-cured for 40 s. After placing a temporary restoration of Cavit (Premier, Norristown, PA), each tooth was stored in a humidor at 37°C for 2 wk to allow the sealer to set completely.

Retreatment Techniques

All roots had 5 mm of filling material removed from the cervical part of the canal using Gates Glidden burs #2 and #3 to create a reservoir for the solvent. Before starting the experimental phase, a drop of 0.2-ml chloroform was introduced in each canal to soften the filling material. Subsequently, all samples were divided randomly into four groups:

Group 1: Gutta-percha and AH 26 sealer was removed with K3 files (sds Kerr Sybron Dental Specialties, Orange, CA). The working length was regained gradually in a pecking motion with a file #25 taper 0.04 and then the canal instrumented with files #30.04, #35.04, #40.04, and #45.04 with an electric motor handpiece (AEU-20, Dentsply Tulsa Dental, Co., Tulsa, OK) with a contra-angle 6:1 reduction (Dentsply Tulsa Dental Products) at 350 rpm.

Group 2: Gutta-percha and AH 26 sealer was removed with Liberator files (Miltex, Inc., New York, PA). The working length was regained gradually in a pecking motion with a file #25 taper 0.04 and then the canal instrumented with files #30.04, #35.04, #40.04, and #45.04 with an electric motor handpiece (AEU-20, Dentsply Tulsa Dental, Co.) with a contra-angle 6:1 reduction (Dentsply Tulsa Dental Products) at 1300 rpm.

Group 3: Resilon and Epiphany sealer was removed with K3 files using the same technique described in group 1.

Group 4: Resilon and Epiphany sealer was removed with Liberator using the same technique described in group 2.

Increments of 0.05 ml of chloroform were injected into the canals every change of files.

During the retreatment, root canals were constantly irrigated with 1% NaOCl. In all cases, the canals were instrumented to two sizes larger than the previous master apical file used. Therefore, all canals were enlarged to final file #45 taper 0.04. The criteria for completion of retreatment were the presence of clean filings, no evident filling material on the files or paper points and smooth canal walls. If these requirements were not met, the canals were further instrumented with the same file size, #45, until the criteria were fulfilled. After final instrumentation, all canals were copiously irrigated with 5.0 ml of 1.5% NaOCl and dried with paper points. The duration of retreatment, recorded to the nearest second with a stopwatch, was based solely on the net time used in the retreatment procedure itself, excluding the time for handling of instruments, changing of files, irrigation, etc. All procedures were performed by the same operator.

The teeth were grooved vertically with steel discs (Brasseler USA, Savannah, GA) on the buccal and lingual surfaces. They were then split longitudinally with a chisel and a mallet into halves. The samples were then coded and attached to a glass slide using epoxy resin. The amount of residual filling material on the canal walls was imaged with a Digital Camera (Sony Cybershot DSC-F717, Tokyo, Japan) and measured in mm^2 using an image analyzer software (Image Tool for Windows Version 3.00). Analyzing coded images the software operator couldn't recognize which group the specimens came from.

Statistical Analysis

The area of residual filling material measured in mm^2 and the time required for root canal filling removal were statistically evaluated using Fisher and Mann Whitney tests. The level of significance in all tests was set at $p < 0.05$.

Results

The area of residual filling material on canal walls in mm^2 is shown in Table 1 (mean ± SD). The group filled with Resilon/Epiphany and retreated with K3 files demonstrated the least residual filling material on the walls ($p < 0.05$). There was no statistically significant difference between the gutta-percha/AH26 and Resilon/Epiphany groups when the Liberator files were used for retreatment ($p > 0.05$). K3 files were more efficient than Liberator for both Resilon/Epiphany and gutta-percha/AH 26 removal ($p < 0.05$).

Time in minutes for the filling material removal is shown in Table 2 (mean ± SD). In the groups filled with Resilon/Epiphany the filling was removed faster than groups filled with gutta-percha/AH 26 ($p < 0.05$). K3 rotary system was faster than Liberator to remove both gutta-percha and Resilon ($p < 0.05$).

Discussion

Nonsurgical endodontic retreatment of previously filled root canals is the initial treatment of choice for the management of endodontic failures (13). Removing as much sealer and filling material as possible from inadequately prepared and filled root canal is critical to uncover remnants of necrotic tissue or bacteria that may be responsible for periapical inflammation and failure (8). Conventionally, removal of gutta-percha using hand files with or without solvent (14) can be a tedious and time-consuming process, especially when the root canal filling material is well condensed. In many cases, the combined use of different techniques may be the most efficient and time-saving method (14–16). Wilcox and Swift (1991) (17) stated that when the same technique was used for the original treatment and any subsequent retreatment, it was improbable that previously unprepared areas would be instrumented completely on the second occasion. Therefore, it is conceivable that different methods of preparation may be indicated in retreatment cases to improve the cleaning and, supposedly, the rate of success.

TABLE 2. Working time in minutes for the filling material removal (mean ± SD)

	Mean	SD
Gutta-percha/AH 26-K3	3.35[c]	± 0.21
Gutta-percha/AH 26-Liberator	3.50[d]	± 0.20
Resilon/Epiphany-K3	2.36[a]	± 0.08
Resilon/Epiphany-Liberator	2.41[b]	± 0.09

Averages followed by the same letter are not significantly different ($p \geq 0.05$).

Several Rotary systems associated with different techniques have been used to remove filling material during endodontic retreatment. These studies have shown that NiTi rotary instruments are efficient and safe to remove gutta-percha and sealer from the root canal walls (10, 18). There are many factors that may influence the separation of NiTi rotary files during the clinical procedure. Rotational speed is not generally considered to be an important one regarding NiTi rotary instruments separation during the endodontic treatment of canals, which had never been instrumented (19, 20). Some studies, however, have shown that rotational speed might influence instrument separation in curved canals (21–23). Nevertheless, for filling material removal Bramante and Betti (2000) (24) using Quantec Rotary Files at 1500 rpm demonstrated less occurrence of separation than at 350 rpm.

In our study, torque and speed used were adjusted according to the information provided by the manufacturers for all experimental groups. K3 files were instrumented at 350 rpm and Liberators files were used at 1300 rpm.

Unfortunately, in vitro studies do not fully reproduce in vivo conditions, and decoronation further reduces their clinical relevance. In our study, decoronation (25) assured standardization of specimens eliminating some variables, such as the anatomy of the coronal area and the access to the root canals allowing a more reliable comparison between retreatment techniques.

The application of Chloroform has been a topic of long debate for endodontic retreatment because it is classified as a carcinogenic substance (26). Its possible damage to periapical tissues and the systemic toxicity and health hazard risk to dental personnel through repeated chloroform vapor inhalation cannot be overlooked (27, 28). Although chloroform is known to be the most efficient gutta-percha solvent (5, 28, 29) it has been reported to be locally toxic in contact with periradicular tissues, to be hepatotoxic and nephrotoxic and has been classified as a carcinogen (27, 28). Despite of this undesirable property this solvent is the most used in clinics. This fact encouraged us for testing the chloroform ability to dissolve Resilon/Epiphany filling. In this study, chloroform was an effective solvent for both filling materials. None of the techniques evaluated removed all filling material from root canals, a finding that is consistent with previous reports (10, 16, 30).

Resilon, a thermoplastic synthetic polymer based root canal filling material, performs like gutta-percha and has the same handling properties. Based on polymers of polyester, Resilon contains bioactive glass, bismuth oxychloride, and barium sulfate. The sealant used is Epiphany that is a dual curable dental resin composite. This sealant when used with the Resilon filling material forms a bond to the dentin wall and the core material making the filling resistant to bacterial penetration (3). Thus, the Resilon core filling with Epiphany is considered as a single entity and in this report will be referred to as the Resilon Monoblock System (RMS). In literature there are no studies comparing the removal of gutta-percha and resin based filling materials. In the present study, Resilon/Epiphany was shown to be removable from the root canal during the endodontic retreatment using rotary files and chloroform. Compared to gutta-percha, Resilon showed better results either related with operating time or remaining filling material when the K3 rotary system was used. There was no statistical difference related to filling material left when the retreatment was performed with Liberator files. Nevertheless Resilon/Epiphany was removed faster than gutta-percha/AH26. In this study K3 rotary system cleaned the canals better than Liberator groups, probably because the filling material was engaged by the instrument flutes and removed in a coronal direction, which didn't happen with the Liberator groups because of its no-flutes design. Our findings are in agreement with other studies that have showed a good cleaning ability of K3 rotary system files during the endodontic retreatment (8, 10, 30).

Thus, this study showed that Resilon/Epiphany was effectively removed with K3 or Liberator rotary files.

Acknowledgments

This study was supported by: UNC-Endodontic Foundation and CAPES (BEX: 0173/05-3) (BEX: 0546/05-4).

The author Martin Trope is a paid consultant for Pentron Clinical Technologies LLC, Wallingford, CT.

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