Comparison of Removal Times of Thermafil Plastic Obturators Using ProFile Rotary Instruments at Different Rotational Speeds in Moderately Curved Canals

Alexander Royzenblat, DDS, MS, and Gary G. Goodell, DDS, MS, MA

Abstract

The purpose of this study was to compare the time required for removal of small Thermafil plastic carriers in moderately curved MB roots of mandibular molars using the ProFile rotary system at 300 and 1,500 rpm. MB roots of 40 mandibular molars were instrumented and obturated with size 30 Thermafil plastic obturators. Teeth were divided into two groups. In group 1, sizes 55 to 25 ProFile 0.04-taper instruments were used in a crown-down manner at 300 rpm. In group 2, size 25 ProFile 0.04-taper instruments were used at 1,500 rpm. Time of carrier removal and the number of instrument separations were recorded. The Student's *t* test demonstrated a significant difference between groups: 4 minutes 12 seconds for group 1 and 1 minute 28 seconds for group 2 ($p < 0.001$). However, a trend for greater separation of instruments was found with the higher rpm group. *(J Endod 2007;33:256–258)*

Key Words

Obturators, ProFile, retreatment, rpm, Thermafil

From the Naval Postgraduate Dental School, National Naval Medical Center, Bethesda, Maryland.

Address requests for reprints to Dr. Gary G. Goodell, 12214 Hollow Tree Lane, Fairfax, VA 22030. E-mail address: gggoodell@aol.com.

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Root canal therapy has proved to be a predictable and successful procedure for maintaining teeth when the primary principles of cleaning, shaping, and filling the root canal system are followed (1, 2). The complexity of root canal anatomy and the limitations of instrumentation, however, make complete debridement of canals impossible (3). Therefore, the obturation of the canal space after chemomechanical preparation is extremely important (4). In an effort to accomplish this, many techniques of obturation have been proposed. One technique, described by Johnson (5), uses gutta-percha molded around an endodontic file, softened in a flame, and inserted into the root canal. The coronal portion of the file is then sectioned and removed, leaving the apical portion behind as part of the root filling. In 1989, this idea was developed into the first version of carrier-based root canal obturators, called Thermafil.

It sometimes becomes necessary to retreat the root canal system in an effort to clean and disinfect the canals. Removal of small Thermafil plastic obturators can present a challenge because the plastic core is not soluble in common solvents. However, it has been suggested that solvents may not be routinely required in Thermafil retreatments. Wilcox (6) found that the success of retreatment of Thermafil depends on whether the carrier can be removed from the canal. Bertrand et al. (7) showed that retreatment of Thermafil plastic carriers using dimethylformamide or chloroform as solvents while performing manual instrumentation with K files and H files alternately between the carrier and dentinal walls required an average time of 7 minutes in maxillary central incisors. In another study using single-rooted premolars (8), a System B Heat Source fitted with a medium-fine plugger and activated to a temperature of 225°C melted the gutta-percha and softened the plastic carrier. Size 50 or 55 Flex-R hand files were then placed alongside the carrier on the buccal and lingual surfaces, firmly seated with apical pressure, and rotated clockwise to engage the plastic carrier. The files and carrier were removed as a single unit. The mean retrieval time was significantly less for the System B technique (1.8 minutes) than for a solvent technique (3.6 minutes) also tested. Baratto Filho et al. (9) evaluated the removal of root canal filling materials with 0.04 ProFile rotary files in a crown-down technique at 300 rpm in single-rooted mandibular canines. Thermafil plastic carriers were retrieved successfully in an average of approximately 5 minutes. However, removal of the gutta-percha was not complete and required additional manual instrumentation. The manufacturer, Dentsply Tulsa Dental, recommends using a size 30 ProFile 0.04- or 0.06-taper rotary instrument at 2,000 rpm, placed into the canal between the carrier and canal wall and leaned into the carrier until resistance is met. The file is designed to draw the carrier coronally. Hedstrom files may be used to pull out the carrier if the previous steps are unsuccessful (10).

Previous studies on Thermafil retreatments have been performed on single rooted, relatively straight teeth, which may not accurately represent the challenge of retreating smaller, curved canals. Also, the rotational speed recommended by the manufacturer has not been evaluated. The purpose of this study was to compare the time required for removal of small plastic Thermafil carriers in moderately curved MB roots of mandibular molars using the ProFile rotary system at 300 and 1,500 rpm.

Materials and Methods

Forty extracted mature mandibular molar teeth with MB root curvatures between 12.9 and 40 degrees were selected for this study. The MB cusps were used as reference points. Straight-line access preparations were made with #557 (Henry Schein, Melville,

NY) and Endo Z burrs (Dentsply Maillefer, Johnson City, TN). Size 8 through 15 FlexoFiles (Dentsply Maillefer) were introduced into the MB canal orifices and advanced until visible at the foramina, and then digital radiographs were exposed. Working lengths were then determined by subtracting 1 mm. Canal shaping and flaring were accomplished in the coronal and middle thirds with ProFile GT files (Dentsply Tulsa Dental, Tulsa, OK) operating at 300 rpm, with frequent 6% sodium hypochlorite (NaOCl) irrigation throughout the procedure. The instruments were used in the following sequence to resistance: ProFile GT size 20, 0.10 taper; ProFile GT size 20, 0.08 taper; and ProFile GT size 20, 0.06 taper. The apical thirds were instrumented using 0.04-taper ProFile instruments (Dentsply Tulsa Dental) in a crown-down fashion to working length in the following order of sizes: 55, 50, 45, 40, 35, and 30. Size 30 Thermafil Verifiers (Dentsply Tulsa Dental) were used to confirm the taper and passive fit of the carriers.

The canal curvatures were calculated using a modified Schneider technique, and the teeth were alternately assigned by degree of curvature to two groups of 20 each, with a resulting mean curvature of 26 degrees for both groups.

Before obturation, canals were irrigated with 1 ml of 17 % EDTA (Henry Schein) followed by 3 ml of 6% NaOCl. Teeth were randomly selected for obturation from each group. Paper points were used to completely dry the canals before applying ThermaSeal Plus sealer (Dentsply Tulsa Dental). Using size 20 FlexoFiles, a very light coating of sealer was brushed onto the canal walls to the working lengths. After heating in a Therma Prep oven (Dentsply Tulsa Dental) for the prescribed time, #30 Thermafil obturators were inserted into the canals to working lengths without twisting or forcing. The obturators were cut at the canal orifices using an inverted cone bur in a high-speed handpiece. Cotton pellets were placed in the teeth; they were then temporized with Cavit–3M (Henry Schein) and stored for 2 weeks in a humidifier at 37°C at 100% humidity to allow for setting of the sealer.

Teeth were randomly selected using the RandomBots Simple computer program (RandomWare.com) for retreatment. One investigator performed all the procedures under a dental operating microscope.

In group 1, the carriers were retrieved using a technique similar to that used by Baratto Filho et al. (9). Size 55, 50, 45, 40, 35, 30, and 25 ProFile instruments were used sequentially at a speed of 300 rpm in a crown-down manner along one side of the carriers until reaching the previously established working lengths. The sequence was then repeated on the other side of the carriers. If the obturators were not removed during these steps, a size 25 Hedstrom file–Kerr (Sybron Endo, Orange, CA) was wedged against the carriers to pull them out coronally. If this was unsuccessful, two size 25 Hedstrom files on either side of the obturators were braided together to pull out the carriers. In group 2, the carriers were retrieved as recommended by the manufacturer, with modifications. A pilot study showed that a 0.04-taper ProFile with a size 25 tip running at 1,500 rpm placed along two sides of the carrier until reaching the earlier established working length, followed by braiding two Hedstrom files and pulling coronally worked most effectively. The instruments were placed into the canals between the carriers and canal walls and leaned into the carriers. The instruments were then used with light resistance until reaching the earlier established working lengths. The process was repeated on the other sides of the carriers. As in group 1, if the carriers did not come out with the rotary instruments, Hedstrom files were used to facilitate their removal. A new series of 0.04-taper ProFile instruments was used for each tooth. Total time for carrier removal in each canal was recorded. Student's *t* test was used for statistical analysis with the confidence level set at $p < 0.05$. The canals with separated instruments were excluded from this analysis, but were recorded and statistically analyzed for frequency of separation using Fisher's exact test.

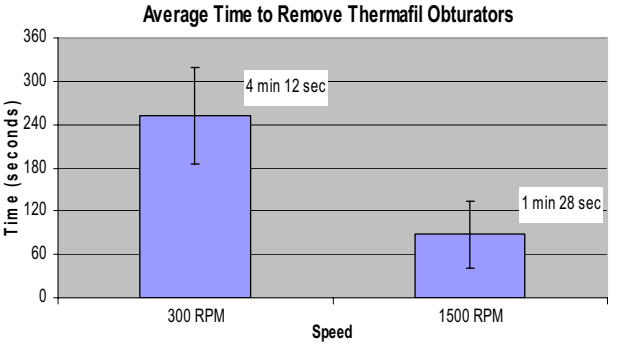

Figure 1. Carrier removal in group 2 (1,500 rpm) was significantly faster than in group 1 (300 rpm) ($p < 0.0001$).

Results

The average time required to remove the Thermafil plastic carriers for group 2 (1 minute 28 seconds) was significantly faster than for group 1 (4 minutes 12 seconds) ($p < 0.0001$) (Fig. 1). Four size 25 ProFile instruments separated in group 2 at canal degrees of curvature of 22.5, 28.7, 29.3, and 40. One size 40 ProFile instrument separated in group 1 at a canal degree of curvature of 33.8. Fisher's exact test did not show any significant difference between the two groups, but there was a trend for more separation at the greater rotational speed.

Discussion

It is important to note that original Thermafil carriers were used in this study. Recently, Dentsply Tulsa Dental has introduced the Thermafil Plus system, which uses a vented carrier for easier removal. Instructions for removal of these new carriers are available (11). In numerous research studies, Thermafil performs as well as or better than other obturation techniques in vitro (12). Clinically, however, no obturation technique is completely impervious to microleakage, and canals are not always instrumented and/or obturated correctly. Therefore, when endodontic treatment failure or new disease occurs, conservative retreatment, apical surgery, or extraction are necessary, and the first treatment of choice when access to the root canal is feasible should be retreatment (13).

When retreatment is indicated, removal of all the obturating material is desired so canal patency can be obtained. In an effort to facilitate this removal, the use of rotary instruments has been suggested, which may result in the reduction of time required and more effective cleaning of the apical third (14). However, some disadvantages to the use of rotary instruments are separation of instruments, canal ledging, transportation, and perforation.

Thermafil plastic carriers are designed to be placed into the canal with gutta-percha and remain as part of the obturating material. Other methods proposed to remove the carriers include hand instruments (6, 15), solvents (7, 16), and heat (8). A recent study using 0.04-taper Profile rotary instruments at 300 rpm in a crown-down manner showed that the removal of the carrier was successful in all the specimens, taking about 5 minutes each to remove (9).

The manufacturer recommends using a higher speed (2,000 rpm) to remove the carriers. However, no studies have shown that a higher speed is a safe and/or effective removal technique. In the present study, MB canals of mandibular molars with a moderate degree of curvature were selected in an attempt to simulate clinical conditions because most of the research on Thermafil retreatment has been done on single-rooted straight canals. Size 30 Thermafil obturators were selected for this study because they empirically seem to be the most difficult to remove from small canals.

In the 300-rpm group, a size 40 Profile instrument separated in a canal with 33.8 degrees of curvature. In the 1,500-rpm group, four size 25 Profile instruments separated in canals with a mean curvature of 30.1 degrees. The mean curvatures of the two groups were similar, suggesting that the speed used may be the factor in the difference in separation rates.

Greater file separation with high speed has been suggested in several in vitro instrumentation studies (17, 18).

Further studies with larger sample sizes are needed to determine if there is a significant difference in the file separation rate between these two speeds. It may be desirable to test other speeds as well, such as 600 or 800 rpm. In conclusion, this study showed that using a rotational speed of 1,500 rpm resulted in significantly faster removal of plastic Thermafil carriers than 300 rpm.

However, a nonsignificant higher incidence of instrument fracture was noted with the greater rotational speed. Therefore, until definitive instrument separation rates can be established for these speeds, and because the time of removal difference is small, it may be clinically prudent to use 300 rpm when removing Thermafil carriers.

Disclaimer

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