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Thermafil Retreatment Using a New "System B" Technique or a Solvent

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The solid plastic carrier in the Thermafil obturation system must be removed to facilitate retreatment. The purpose of this study was to compare the efficacy and time required to retreat canals obturated with Thermafil with plastic carriers using a new technique based on the System B HeatSource or a solvent. Fifty-two extracted human mandibular premolars with single canals were instrumented and then obturated with Thermafil with plastic carriers. After 2 wk storage at 22°C and 100% humidity, they were randomly divided into 2 groups of 26 teeth each. Group 1 teeth were retreated using chloroform and hand files, whereas teeth in group 2 were retreated with a new technique using the System B HeatSource. The end point of retreatment was defined as complete removal of the plastic carrier. The time required for retreatment was recorded. Then, the apical 5 mm segment of each root was sectioned horizontally at 1 mm intervals and each section digitally imaged. The total area of the canal and the area of the canal occupied by gutta-percha and sealer were measured using NIH image software. Data were analyzed using an unpaired *t* test. The mean time for retrieval of the plastic carrier was significantly less for the System B technique (1.8 min) than for the solvent technique (3.6 min) ($p < 0.001$). The difference between the two groups in the amount of filling material (carrier, gutta-percha, and sealer) removed was not significant ($p > 0.05$).

Thermafil is an endodontic obturation material consisting of warmed α-phase gutta-percha that is carried into position using a solid central core. The retrievability of the solid core is, however, a concern for clinicians (1). A nonsoluble core can be an obstacle during retreatment of obturated root canals, affecting not only the ease of retreatment, but also the prognosis (2).

A variety of methods for retreating failed endodontically treated teeth obturated with Thermafil has been proposed (1, 3–7). Wilcox and Juhlin (3) showed that more gutta-percha remained in the canal after retreatment of Thermafil-obturated canals than after retreatment of canals obturated with laterally condensed gutta-percha. After evaluating Thermafil retreatment with and without a solvent, Wilcox (4) concluded that the adequacy of Thermafil retreatment may be related more to how easily the carrier can be removed than to the technique of gutta-percha removal. However, these studies dealt with the metal carriers originally manufactured for the Thermafil system. More recently Ibarrola et al. (1) evaluated the removal of Thermafil plastic carriers using solvents. They found that chloroform was the most effective solvent with an average removal time for the carrier of 2.5 min. Also using solvents, Bertrand et al. (7) reported the average time period needed to remove a plastic carrier was 6.5 to 7 min. Imura et al. (6) found no significant difference in remaining gutta-percha and sealer after retreatment of canals obturated with laterally condensed gutta-percha or Thermafil with plastic carriers. They found that the plastic carrier was easily removed from the canals. Historically, chloroform has been the most widely used and time-efficient solvent readily available (1, 8).

The purpose of this study was to compare the efficacy and time required to retreat Thermafil with plastic carriers using a new technique based on the System B HeatSource (Analytic Technology, Redmond, WA) or a standard solvent technique.

MATERIALS AND METHODS

Fifty-two extracted human mandibular premolars with single canals were selected for this study. Straight-line access preparations were made with a #1557 cross-cut fissure bur. Working length was determined for all teeth by subtracting 1 mm from the length of a file just visible at the apical foramen. Canal shaping and flaring were accomplished with .04 Profile Series 29 nickel-titanium (NiTi) rotary files (Tulsa Dental Products, Tulsa, OK) followed by apical instrumentation with a #35 NiTi hand file (Brasseler, Savannah, GA). All instrumentation was done using RC Prep (Premier Dental Products Co., Norristown, PA) as a lubricant and sterile water as an irrigant.

A #30 Thermafil size verifier was used to confirm the taper and passive fit of the carrier. If necessary, teeth were reinstrumented until a passive fit of the #30 size verifier was achieved. All teeth were obturated according to the manufacturer's instructions using #30 Thermafil (Tulsa Dental Products) obturators and Thermaseal (Tulsa Dental Products). After obturation, a cotton pellet and Cavit

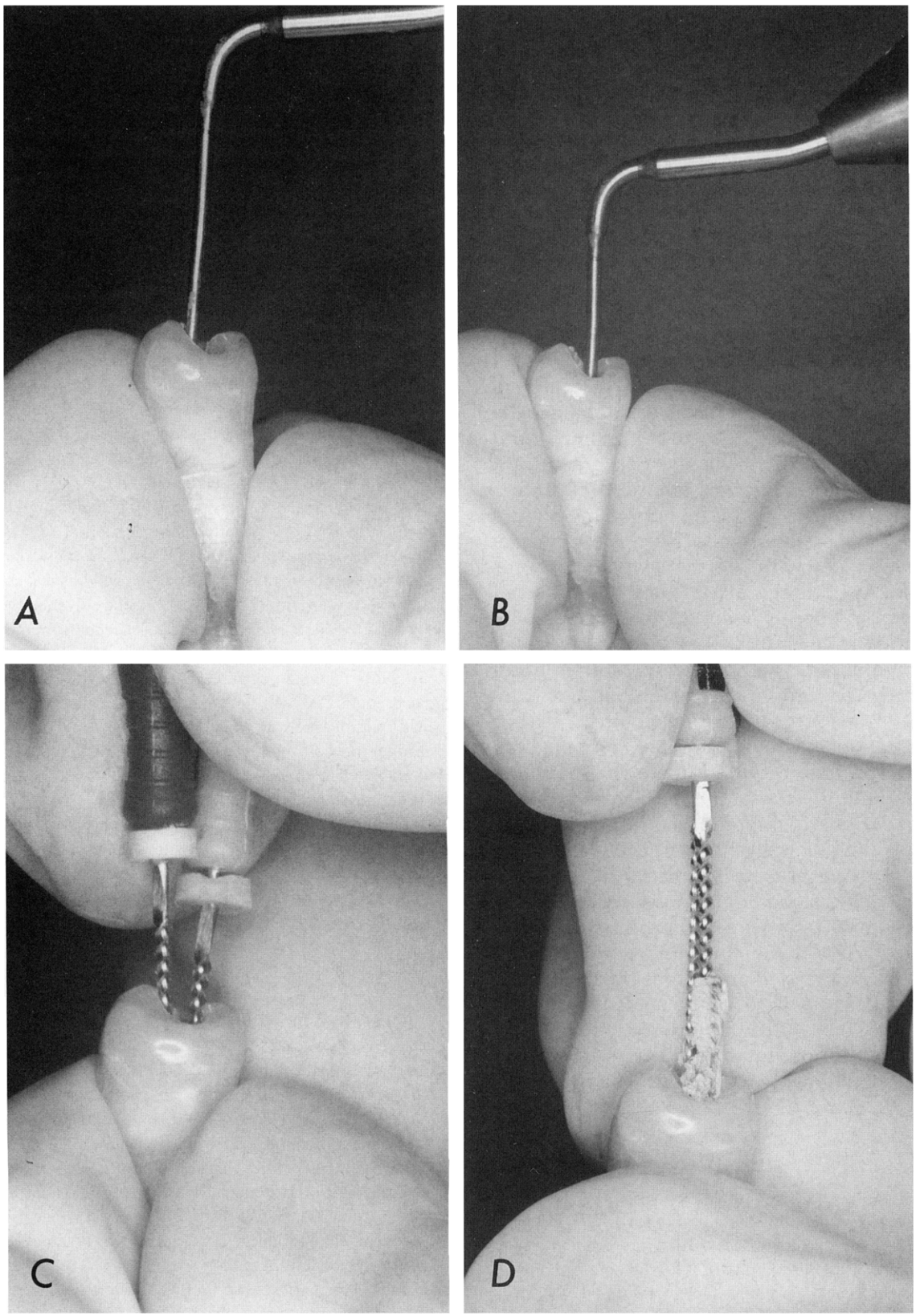

FIG 1. System B HeatSource method of Thermafil removal. (*A*) The System B HeatSource plugger is placed buccal and lingual to the plastic carrier. (*B*) The plugger is inserted to a depth of 10 to 15 mm for 5 to 8 s. (*C*) While the gutta-percha is still thermoplasticized, #50 and #55 NiTi hand files are placed alongside the carrier on the buccal and lingual. (*D*) After firm apical pressure and clockwise rotation to engage the plastic carrier, the files and carrier (*arrow*) are removed together.

temporary were placed, and the teeth stored at 22°C in 100% humidity for a minimum of 14 days.

Then, the teeth were randomly divided into 2 groups of 26 teeth each. In group 1, the carriers were retrieved using chloroform and hand files as recommended by the manufacturer. After a heated plugger was used to create a well for the solvent by removing ~2 mm of coronal gutta-percha, #30 to #50 NiTi hand files were used in a plunging motion to remove gutta-percha both buccal and lingual to the carrier. The solvent was replenished as needed until the files penetrated to within 5 mm of the working length. Two files were placed alongside the carrier, one on the buccal and one on the lingual. After both files were firmly seated with apical pressure and rotated clockwise to engage the plastic carrier, the files and carrier were removed as a single unit. The end point for the "retreatment" was defined as the moment when the carrier was removed from the canal.

In group 2, the Thermafil carriers were retrieved using a System B HeatSource fitted with a medium-fine plugger activated to a temperature of 225°C. The plugger was placed buccally (Fig. 1*A*) and then lingually to the plastic carrier to a depth of 10 to 15 mm (Fig. 1*B*) for 5 to 8 s. This melted the gutta-percha and softened the plastic carrier. While the gutta-percha was still thermoplasticized, #50 or #55 Flex-R hand files (Union Broach, York, PA) were placed alongside the carrier on the buccal and on the lingual (Fig. 1*C*). Both files were firmly seated with apical pressure and rotated clockwise to engage the plastic carrier. Then, the files and carrier were removed as a single unit (Fig. 1*D*). When a carrier was not retrieved on the first try, the System B HeatSource plugger was reintroduced into the canal and the retrieval procedures repeated as previously described. The time required to retrieve a plastic carrier was recorded for all teeth.

The teeth were embedded in epoxy resin blocks (E.T.I., Fields Landing, CA) and sectioned horizontally with a disc-type precision saw (Isomet, Buehler Ltd., Lakebluff, IL). Sections were made in the apical 5 mm of the root at 1 mm intervals.

After sectioning, each of the five horizontal segments was digitally imaged (NIH imaging software, version 1.5) at ×40 magnification (Meiji stereomicroscope, Tokyo, Japan). In each of the horizontal segments the cross-sectional area of gutta-percha and sealer left in the canal was measured as was the entire canal space (Fig. 2). The difference between these two measurements was the area of the canal debrided of filling material for each 1 mm segment. After converting the area measurements to percentages, the percentages of each of the five segments were averaged resulting in an overall value for debridement of carrier, gutta-percha, and sealer in the apical 5 mm of each tooth. Data were analyzed using an unpaired t test. The confidence level was set at $p \leq 0.05$.

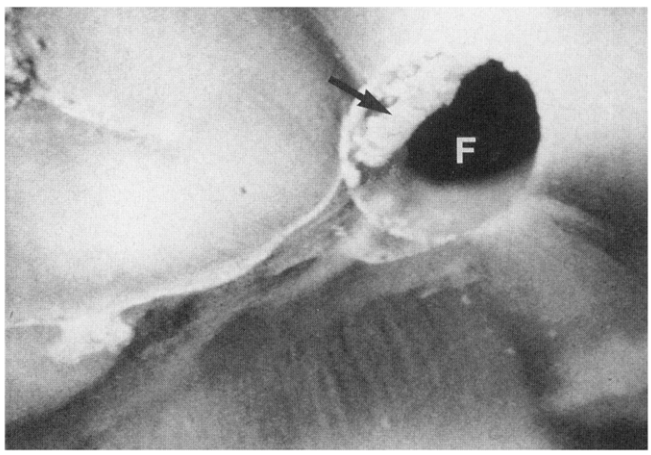

FIG 2. Example of a 1 mm root segment after removal of a Thermafil plastic carrier from the canal using the System B HeatSource. Note the debris-free portion of the canal segment (*F*) and the gutta-percha and sealer (*arrow*) remaining in the canal after carrier removal. (Original magnification ×40.)

RESULTS

The mean time for retrieval of the plastic carrier was significantly less for the System B technique (1.8 min) than for the solvent technique (3.6 min) ($p < 0.001$). The difference between the System B technique and the solvent technique in the amount of filling material (carrier, gutta-percha, and sealer) removed from the canals, 30% and 38% respectfully, was not significant ($p = 0.053$).

DISCUSSION

Endodontic treatment enjoys a high degree of success; however, some endodontically treated teeth fail regardless of the technique or obturation material used. According to Lovdahl (9), three modes of therapy exist to manage endodontic treatment failures: nonsurgical retreatment, periradicular surgery, and extraction. Mandel and Friedman (10) state that the nonsurgical approach is the treatment of choice when access to the root canal is feasible. This is consistent with one of Grossman's (11) criteria for an ideal root canal filling material, which states that the material should be easily removed from the canal.

Originally, techniques for the retreatment of Thermafil-coated stainless-steel carriers involved heat applied directly to the carrier, solvent used in conjunction with hand files, or both. However, since the advent of plastic carriers, only solvents used with hand files are recommended.

The literature shows chloroform to be the most time-efficient solvent readily available, but concerns about its potential toxicity exist (12). In addition, Wilcox et al. (13) found heat to be more effective than chloroform for retreating canals where AH26 was used as the sealer. AH26, a resin-based sealer, is the type of sealer recommended by the manufacturer for use with the Thermafil technique. The objectives of our study were to determine the efficacy and time requirements of a new technique based on the System B HeatSource, compared with a traditional method of retreatment using a solvent. Using an extracted tooth model, the Thermafil plastic carrier was more rapidly removed from the canal with the new System B technique.

During a pilot study in which the System B temperature was set as high as 300°C, the carrier melted through leaving a 5 mm fragment in the apical portion of the canal. Hence, the clinician should be aware of the melting point of the plastic to avoid overheating the carrier and causing separation of the apical portion of the carrier.

The present study used #30 obturators. This is significant because #45 and larger carriers are made with a plastic that is soluble in chloroform, whereas the sizes smaller than #45 are not soluble in the solvent. However, carriers that are #40 or smaller seem to represent a large majority of the difficult retrieval situations experienced by endodontic practitioners.

Ibarrola et al. (1) were able to retrieve #45 carriers in 2 to 3 min using chloroform, which is similar to our results with the System

B HeatSource. However, their #45 carriers were soluble in chloroform. Our #30 plastic carriers were not soluble in the solvent.

Although the present study was done with original plastic carriers, the manufacturer has subsequently introduced a redesigned plastic carrier that is not soluble regardless of size. These new carriers are designed to facilitate retreatment. Although the new carriers were not included in our research, the System B method of Thermafil removal should be highly effective when canals obturated with Thermafil with the new plastic carriers have to be retreated.

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