Abstract

The usefulness of NaviTip FX, a brush-covered irrigation needle, in endodontic therapy has never been reported. Therefore, the purpose of this investigation was to evaluate the cleaning efficacy of this new brush-covered irrigation needle, the NaviTip FX. Thirty single-rooted teeth were randomly divided into two equal groups and instrumented using the crown-down technique with 0.04 taper ProFile. Following each file use, the canals were irrigated with 1 ml of 5.25% NaOCl using the NaviTip FX needle for group 1 or using the same needle without the brush for group 2. At the end of instrumentation, the roots were cut longitudinally and each half was divided into three equal parts. The specimens were then routinely prepared for scanning electron microscopic evaluation. The results showed that using the NaviTip FX produced cleaner coronal thirds of instrumented root canals compared to the control group. On the other hand, the middle and apical thirds were not statistically significantly different between the two groups. Further development of this irrigation technique to improve cleanliness of the apical and middle thirds is required before the NaviTip FX can be recommended for routine use during root canal therapy. (J Endod 2006;32:1181–1184)

Key Words

Brush-covered needle, cleaning, debris, irrigation

Careful removal of vital and necrotic remnants of pulp tissues, microorganisms, and microbial toxins from the root canal system is essential for endodontic success. This can be achieved through chemo-mechanical instrumentation (1–5). However, root canals are irregular and complicated systems that are difficult to clean (3, 6–8). Although during root canal therapy we rely primarily on instrumentation for canal debridement, irrigation is an important adjunct. Irrigation facilitates cleaning the root canal system by flushing debris as well as serving as a bactericidal agent, tissue solvent, and lubricant (5, 9). Debris was defined as dentin chips and residual vital and necrotic pulp tissue loosely attached to the root canal wall that in most cases is infected (10, 11). The presence of debris on prepared root canal surfaces prevents efficient removal of microorganisms, one of the major goals of thorough debridement of the root canal system (10, 11). Furthermore, after instrumentation, a smear layer is formed that is a surface film 1- to 2-μm thick that remains adherent to the root canal wall (12). This smear layer consists of dentin particles, pulp tissue, bacterial components, as well as retained irrigants, and it occludes the dentinal tubular openings (5, 9, 12). The chemomechanical action of sodium hypochlorite removes loosely attached debris or organic material, whereas chelating agents are required to remove the smear layer (5, 7, 9).

Numerous investigations have been performed to evaluate the effectiveness of instruments and instrumentation techniques (10, 11, 13–18), and irrigants and methods of irrigation (7, 19–23) in canal debridement. These studies have all demonstrated that debris remain in the root canal system after instrumentation and irrigation. To aid in root canal debris removal, a few attempts have been described that use cotton wrapped around an endodontic file or a broach (24), or the use of an Endobrush (9, 25). The former study indicated that a cotton wrapped around a file or broach was not able to clean the canal properly especially the irregularities, whereas, the later study demonstrated a better cleaning effect when the Endobrush was used with hand instrumentation compared with that of instrumentation alone.

Recently, a 30-gauge irrigation needle covered with a brush (NaviTip FX, Ultradent, UT) was introduced to the market (Fig. 1A). A review of the literature revealed that no studies have been reported on the use of this brush-covered needle (NaviTip FX) in endodontic therapy, therefore, the purpose of this investigation was to evaluate the efficacy of NaviTip FX in removing root canal debris during root canal preparation using scanning electron microscopy.

Materials and Methods

Thirty single-rooted teeth with completely formed apices were used in this study. The teeth were radiographed to confirm canal patency and complete root formation. Standard endodontic access cavity preparations were performed to the pulp chambers. After access cavity preparation, a #15 k-type file was inserted into the canal until the tip was just visible at the apical foramen. The length of the file was measured and 1 mm was subtracted from this length to establish working length.

The teeth were then randomly divided into two groups, group 1 and group 2. For group 1, the brush-covered 30-gauge needle NaviTip FX (Ultradent) was used to irrigate the canals with 5.25% NaOCl after each instrument use. For group 2, NaviTip needle (Ultradent) that is a 30-gauge needle (Fig. 1B) similar to the one used in group 1 but...
without the covering brush, was used for irrigation following each instrument use. The needle was advanced into the canal until it bound to the canal walls and then was retracted by 1 mm to allow easy back flow of the irrigating solution.

Preliminary coronal enlargement was achieved using Gates Glidden drills size #4, 3, and 2. Initial instrumentation was performed using K-files size #15, 20, and 25, to the working length. The canals were then prepared using 0.04 taper Profile nickel titanium rotary files (Maillefer Dentsply, Ballaigues, Switzerland) using a crown-down technique to a size #40 master apical file. The rotary files were used in a controlled slow-speed, high-torque motor, with a continuous speed of 250 rpm. After using each file, the canals were irrigated with 1 ml of 5.25 % NaOCl using the needle type designated for each group. At the end of instrumentation each canal was flushed with 1 ml of 5.25 % NaOCl.

Immediately after completion of root canal preparations, the samples were coded to allow for blinded evaluation of the samples. The scores were then compared and if a difference was found, the two evaluators jointly examined the sample with a different score, if they could not reach an agreement a third evaluator helped with the scoring. The two evaluators were able to do all the scoring and at no time was a third evaluator needed. The code was then broken and each sample was assigned to its experimental group. The results were statistically analyzed using the Mann-Whitney U-test at significance level p < 0.05.

**Results**

The mean score for apical, middle, and coronal thirds of group 1 and 2 are shown in Table 1. The canals irrigated using the brush-covered needle (NaviTip FX) showed lower average scores in all the three thirds compared to the NaviTip needle (Fig. 2). The coronal thirds of the root canals irrigated with the NaviTip FX needle had statistically significantly less debris than those irrigated with the NaviTip needle (p = 0.022). The difference in the apical and middle thirds, on the other hand, was not statistically significant (p = 0.076 and p = 0.097, respectively).

**Discussion**

One of the most important objectives during root canal instrumentation is the removal of pulp tissue and elimination of microorganisms and their toxins from the root canal system (1–5, 9). The ability to achieve this objective was evaluated in the present study by using a brush-covered irrigation needle, the NaviTip FX, during instrumentation with rotary instruments, Gates-Glidden and ProFile, and irrigation with NaOCl. The results demonstrated improved cleanliness of the coronal one third of instrumented root canal walls irrigated with the NaviTip FX needle compared to canal walls instrumented using the same technique and irrigated with the NaviTip (brushless) needle.

Similar findings indicating improved canal debridement with the use of brushes were reported by Keir and his co-workers (25) who used the EndoBrush, which is an endodontically sized spiral brush that consists of nylon bristles set in twisted wires with an attached handle that is

**Table 1.** Mean scores (± SEM) for canal wall debris using each needle type

<table>
<thead>
<tr>
<th>No. of Roots</th>
<th>Apical</th>
<th>Middle</th>
<th>Coronal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>15</td>
<td>3.3 ± 0.19</td>
<td>2.9 ± 0.24</td>
</tr>
<tr>
<td>(NaviTip FX)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 2</td>
<td>15</td>
<td>3.7 ± 0.15</td>
<td>3.4 ± 0.21</td>
</tr>
<tr>
<td>(NaviTip)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In the current investigation, the cleaning efficacy of the NaviTip FX was examined by means of a scanning electron microscopic evaluation of the coronal, middle, and apical thirds of the canals. This technique is reliable as was previously described by several investigators (7, 13, 15, 18, 20, 31). Those investigators demonstrated that scanning electron microscopes are useful in examining and evaluating instrumented root canal walls using different instrumentation and irrigation systems. There was a general agreement in their results that none of the instrumentation techniques or devices could completely clean the root canal system.

This study has shown, for the first time, that this new product, the NaviTip FX, was able to produce cleaner coronal one third of root canal walls by simply using it as the irrigating needle during root canal preparation. However, further development of the technique is required to demonstrate efficacy of the NaviTip FX in the apical and middle thirds before it can be recommended for routine use during root canal therapy.

References


Figure 2. Example for debris: (A) Score 1: Clean surface of a canal wall irrigated using the NaviTip FX needle showing only a few scattered debris (magnification 200×). (B) Score 4: Canal wall surface almost completely covered with debris in a specimen irrigated with NaviTip needle (magnification 200×).

similar to a hand file handle, and has a relatively constant diameter along the entire length. In their study, Keir and his co-workers actively brushed the root canals with a 90-degree rotary motion combined with 2- to 3-mm up and down motion for one minute at the conclusion of instrumentation. The results obtained in this study might have been improved if the brush-covered needle was mechanically activated in an active scrubbing action during the irrigation process to increase the efficiency of the brush.

This study has shown that using the NaviTip FX would produce cleaner coronal one third of instrumented root canal walls of single-rooted teeth, however, the efficacy of the NaviTip FX in teeth with more complex root system anatomy such as mesial roots of upper and lower first molars has to be evaluated. In addition, cleanliness of the root canal walls depends on the size of apical enlargement where larger apical preparations result in better canal debridement (27–29). In this study, the canals were prepared to a size #40 master apical file, which is acceptable clinically and have been shown to produce superior canal debridement than smaller size apical preparations (28). Although the size of the 30-gauge needle is equivalent to a size 30 file allowing it to reach the apical most part of the canal, the apical third was the least effectively cleaned part of the root canal as has been shown by many previous studies (18, 26, 30).