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CLINICAL ARTICLES

Effectiveness of Manual and Rotary Instrumentation Techniques for Cleaning Flattened Root Canals

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The cleaning capacity of manual and rotary instrumentation techniques in mesial-distal flattened canals was studied by morphometric analysis. Twenty human mandibular incisors were divided into two groups of 10 teeth each: group 1, crown-down technique with rotary instrumentation using ProFile .04; group 2, crown-down technique with manual instrumentation using K-files. The teeth were evaluated with an optic microscope that was coupled to a computer to determine the percentage of root canal area with debris. The nonparametric Mann-Whitney *U* test showed a statistically significant difference at the level of 1% between the techniques. The manual technique was more efficient in cleaning mesial-distal flattened root canals than the rotary technique, although neither completely cleaned the root canal.

One of the major goals of chemomechanical preparation is to clean the root-canal system as thoroughly as possible by using endodontic files and irrigating solutions (1). Methods for cleaning and shaping the root canal have been reported over the last century; however, recent technological developments, such as a nickel-titanium (Ni-Ti) alloy (2) used in rotary file systems, have improved endodontic therapy. Most studies have reported that the canal shape was maintained by rotary Ni-Ti files (3–5), with the procedure being noticeably easier and faster (6) than hand preparation.

It has been shown that cleaning narrow, curved, and flattened root canals is not always easily accomplished, indicating that anatomic variations are also an important factor to be considered (7, 8). Thus, the purpose of this study was to evaluate the cleaning of the apical third of flattened root canals by rotary Ni-Ti file instrumentation (ProFile .04; Dentsply-Maillefer, Ballaigues, Switzerland).

MATERIALS AND METHODS

Twenty human mandibular central incisors with a mesiodistal-flattened root and a radiographically confirmed single root canal from laboratory stock were used in this study. The teeth were stored in 0.1% thymol solution and maintained at 9°C before use.

Conventional access was made and a #10 K-type file was introduced into each canal until it appeared at the apical foramen. The working length was established by subtracting 0.5 mm from this measurement. The teeth were randomly divided into two groups of 10 teeth each. Group 1 teeth were prepared by the crown-down technique, using rotary instrumentation with ProFile .04 Ni-Ti files as follows: after initial enlargement with a stainless steel #15 file, an ascending-sequential ProFile instrumentation (#15 to #40) was performed to the working length. Group 2 teeth were prepared by crown-down technique (9), using manual instrumentation with K-type files, until a #40 file reached the working length. Irrigation with 2 ml of distilled and deionized water was performed after each file for both groups and 10 ml of the same solution was used for final irrigation.

The apical third of each root was sectioned and removed for histological processing. Canals were immersed in 10% buffered formalin and stored for 12 h in the same solution until histological processing. The teeth were then washed, decalcified in 10% glycoacetic acid and embedded in paraffin. Serial transverse cross-sections (5 μm) were stained with hematoxylin and eosin. The cross-sections were examined with an optic microscope ($\times$40) that was coupled to a computer where the images were recorded. A grid was placed over these images to evaluate the total canal area and the area with debris. The percentage of debris in the root canal after chemomechanical preparation was calculated and the nonparametric Mann-Whitney *U* test was used for the statistical analysis.

RESULTS

There was 19.44 $\pm$ 2.01% canal area with debris in the root canals instrumented with rotary ProFile .04 (Fig. 1) and 7.18 $\pm$ 1.78% canal area with debris in the root canals instrumented manually (Fig. 2). Statistical analysis showed a significant difference between the groups at the 1% level.

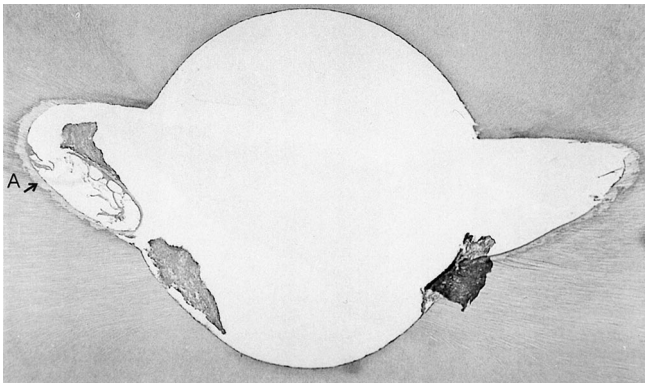

FIG. 1. Apical third of a flattened root canal showing areas with debris (*A*) after rotary ProFile .04 instrumentation (original magnification ×40).

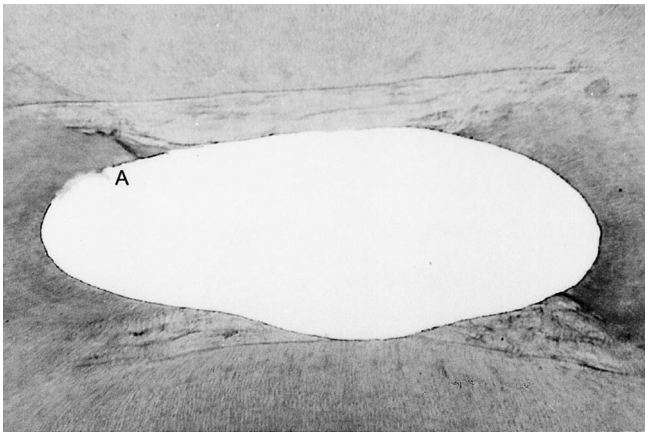

FIG. 2. Apical third of flattened root, showing areas with debris (*A*) after manual crown-down instrumentation (original magnification ×40).

DISCUSSION

Chemomechanical preparation is the key to successful endodontic treatment. Its objective is to clean the root canal and its ramifications as thoroughly as possible, creating ideal conditions for tissue regeneration and health.

This study did not evaluate the cleaning capacity of irrigating solutions, as in other reports (10). Research has concluded that chemomechanical preparation leaves organic and inorganic debris in the root canal (11–13). The results of this study are in agreement with others (14–16), showing that neither of the instrumentation techniques used completely cleaned the root canals.

Rotary instrumentation with Ni-Ti files has a limited area of action. Due to their superelasticity, it is known that they cannot be pressed against the root canal walls. Of course, the flattened root canal does not permit major enlargement without the risk of creating a lateral perforation. Thus, an effective irrigating solution is indispensable for dissolving organic tissues. A change of instrumentation techniques for flattened root canals should also be considered.

The results of this study confirm previous research (8), showing that the amount of debris in the root canals, after instrumentation, is related to internal anatomic characteristics. The manual crown-down technique was more effective in cleaning mesiodistal flattened root canals than the rotary technique (ProFile.04), although neither completely cleaned the root canal.

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