Summary

This study compared the effects of Hero 642 and Profile Ni-Ti canal instruments, to which a file is attached, on the original canal curvature.

This study was performed on the mesiobuccal canals of 20 extracted human mandibular first and second molar teeth. The teeth were embedded in clear acrylic resin and separated into two test groups. Pre- and postoperative radiographs of the teeth were made using a special apparatus. The radiographs were digitized and transferred to a computer. Using the program Free Hand, the pre- and postoperative angular and linear values of each tooth were determined, and then the curved canals were evaluated using AutoCAD R12.

In the teeth prepared using the Profile system, no statistically significant difference was found between the pre- and postoperative canal access angle (CAA), Schneider angle, or AC distance (p > 0.05). However, in the samples prepared with the Hero 642, the postoperative CAA decreased significantly (p < 0.01). Furthermore, there was also a significant decrease in the postoperative AC distance.

Key words: nickel-titanium rotary instruments, canal curvature, canal access angle (CAA)

Introduction

The goals of root canal preparation in endodontic treatment are to remove all pulp tissue, microorganisms, and affected dentin tissue and to clean and shape the root canal space. During canal preparation, the original canal curve and apical foramen should be protected without being transported [1].

When the root canal is curved, difficulty occurs during biomechanical preparation. Weine [2] reported that the case became more complex and complications were more likely during canal preparation if the canal curvature exceeded 30°. Recent studies revealed irregular preparation forms (such as ledges, zips, and elbows), apical foramen, and transportation of the canal, especially in narrow, curved canals [3,4,5].

In recent years, nickel-titanium (Ni-Ti) alloys have been used to make endodontic instruments because of their elasticity [6,7]. Moreover, Ni-Ti files fit the original canal anatomy better, reducing the risk of canal transportation during preparation [8,9].

The production of Ni-Ti instruments has increased the expectation of developing canal forms and reducing aberrations that impede the filling of canals [6]. Several studies suggest that the use of Ni-Ti files attached to rotary devices allows faster canal preparation and reduces patient and physician fatigue compared with the use of manual Ni-Ti instruments [10,11,12,13,14].

Hornberger et al. [15] investigated transportation in curved canals shaped using Flex-R (stainless steel), Onyx-R (Ni-Ti), Lightspeed, and Profile .04 instruments. In
preparations made using Ni-Ti rotary devices, transportation in the apical region and internal curvature decreased significantly. In a study of extracted maxillary molar teeth, Frick et al. [16] concluded that Ni-Ti rotary devices resulted in very little or no transportation in the apical one-third of the root canal.

The present study is a statistical comparison of the effects in terms of angularity of Hero 642 and Profile Ni-Ti canal instruments with attached files on the canal curve in curved root canal preparations.

**Materials and Methods**

Twenty-one and second molar teeth were studied. Teeth with incomplete apex formation, external root resorption, and canals too narrow and obstructed for entrance were excluded from the study. The mesiobuccal canals of the mandibular molar teeth were studied. When choosing samples, teeth of similar height were selected, with curves between 25° and 40° according to the Schneider method; there was no secondary curve, and care was taken to select teeth that allowed an ISO # 15 canal file to reach the foramen apicale. In order to standardize the conditions for the radiographs, a special apparatus was prepared and placed within the molds in which the teeth were embedded. The radiographs were transferred to a computer using a scanner (Scanner: Agfa-Duascan, Germany).

**Instrumentation procedure**

The working length of each canal was determined by placing an ISO # 15 Nitiflex K-File (Dentsply, Maillefer, Ballaigues, Switzerland) up to the apical foramen, and then pulling it back 1 mm from this point. The canal was prepared using the crown-down technique according to the manufacturer's instructions. The different instruments (tapers 0.02, 0.04 and 0.06) were fixed on a Micro-Mega handpiece (Micro-Mega, Besanon, France) with a regular speed head. Each instrument was used once, and irrigation was performed with 2 ml of 5.25 % Na OCL (Chem-Bright, Brighton, MI) after each instrument size. The canals were prepared by the same operator, who was experienced in the technique.

After the preparation procedure had been completed, contrast material was again placed within the mesiobuccal canal and postoperative radiographs were made. These radiographs were again scanned and transferred to a computer.

**Analysis of the canal preparation**

The canal orifice (A) and apex (B) points were connected with a line. The angle formed by the intersection between this line (AB) and one drawn parallel to the long axis of the canal from the coronal part (AC), (used in the Schneider method) is defined by Günday et al. as the CAA (Figure 1), [17]. Using the program Free Hand (Macromedia, Inc. San Francisco, USA), the pre- and postoperative angular and linear values of each tooth were drawn, and the CAA and AC dis-
tance were measured, along with the Schneider angle, using AutoCAD R12 (Auto-
desk, Inc. San Rafael, USA) (Figure 1).

Statistical analysis

Statistical analyses were performed using SPSS for Windows 10.0. The pre- and post-
operative values of the groups were com-
pared using the Wilcoxon rank test.

Results

Our findings are summarized in Table 1. There were no significant differences in the pre-
and postoperative CAA, Schneider angle, or AC distance in the samples pre-
pared using Profile (p > 0.05). In contrast, the samples prepared using Hero 642 exhib-
ited a significant (p < 0.01) postoperative decrease in CAA and a significant (p < 0.01) postoperative increase in AC distance.

Discussion

When shaping curved root canals, it is
essential to protect the original canal curve
and to prevent flattening that may impair
canal integrity, especially at the apex [18]
and in the internal part of the canal curve
[3].

This study examined the changes in
root canal shape during the preparation of
curved canals using Profile and Hero 642
rotary Ni-Ti canal instruments. A reduction
in the canal curve during the preparation of
root canals indicates flattening of the origi-
nal canal shape. The literature includes few
studies that evaluate the alteration of the
angle of the root canal curve. Esposito and
Cunningham [19] compared the efficacy of
stainless steel K-Flex and Ni-Ti canal files,
used manually, in protecting the original
canal. They found that Ni-Ti files shaped the
original canal appropriately in all cases. The
alterations to the canal curve produced using
stainless steel and Ni-Ti files were similar to
those produced using small-caliber files. However, they suggested that the results
were better with Ni-Ti files of number 30
and above.

In this study, we used the crown-down
technique with both the Profile and Hero
642 systems. With some canal widening
techniques, beginning the preparation in the
coronal region facilitates the entrance of the
canal device and provides more comfortable
working conditions [20,21]. In addition,
some complications that may occur in the
root canal are prevented, and canal trans-
portation is decreased. Cunningham and
Senia [22] investigated the effect of coronal
flaring on the Schneider angle and reported
that coronal flaring decreased this angle sig-
nificantly.

We found no statistically significant
differences in the CAA, Schneider angle, or
AC distance pre- and postoperatively in
canals prepared using the Profile system,
indicating that the Profile system preserves
the original shape of the root canal. In their
study of curved canals, Bryant et al. [23]
reported that the Profile system made very
few alterations to the working length of the
root canal, although they did not evaluate
angles.

After canal preparation with the Hero
642 system, we found that the CAA
decreased and AC distance increased signif-
ically, while the Schneider angle did not
change. This means that there was signifi-
cant flattening of the root canal configura-
tion. Moreover, our results indicated that
determining the Schneider angle alone is not
sufficient; it is necessary to determine the
CAA and AC distance of the prepared root
canal. Thompson and Dummer [24], who
investigated the effects of the Hero 642 sys-
tem on curved root canals, reported that
there was significant canal transportation at
the root canal entrance, root edge, and cur-
vature apex, but they did not evaluate the
canal angle. Their findings are in accor-
dance with our results. They also suggested
that the Hero 642 system resulted in a significant alteration of canal shape [14]. Likewise, Karagöz-Küçükay et al. showed that final canal curvatures and working lengths by preparation with Hero 642 were significantly reduced compared with those of original values [25].

Under the conditions tested, the Profile system appeared to protect the original shape of the root canal better than did the Hero 642 system. To evaluate changes in the root canal curve after root canal preparation, the CAA and AC distance must be evaluated as well as the Schneider angle.

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References