Effectiveness of a Manual Glide Path on the Preparation of Curved Root Canals by Using Mtwo Rotary Instruments

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Abstract

Introduction: Nickel-titanium rotary instruments reduce procedural errors and the time required to finish root canal preparation. The goal of this study was to evaluate the effectiveness of a manual glide path on the preparation of curved root canals with Mtwo rotary system. **Methods**: Forty buccal root canals with angles of curvature between 25 to 76 degrees were randomly divided into 4 groups (n = 10); 2 groups were instrumented with Mtwo instruments to the full length, and in the other 2 groups a glide path with #08-15 K files was performed before instrumentation with Mtwo system. Digital double radiographic technique was used to determine apical transportation and the change in angle of curvature. Also working time was calculated. **Results**: No statistically significant differences in the angle of canal curvature, apical transportation, and the working time were found between groups with glide path and no glide path. No significant differences were found when comparing the results of 3 variables between degrees of curvature. **Conclusion**: The use of a manual glide path before Mtwo rotary system did not influence the apical transportation in curved root canals. *(J Endod 2009;35:699–702)*

Key Words

Glide path, Mtwo, NiTi rotary instrumentation

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Maintaining the original configuration of the root canal system without any iatrogenic events is essential in curved canals (1–3). Nickel-titanium (NiTi) instruments represent a new approach for the preparation of canals by using standardized taper (4–7) and produce well-centered preparations in curved canals in a shorter time as compared with manual instrumentation (8–11). NiTi files possess unique design properties in terms of cross-sectional shape, taper, the number and angle of flutes, and so forth. Most NiTi rotary systems use a crown-down technique and recommend a manual glide path with stainless steel hand files (12–15) to reduce the incidence of fracture and apical transportation (16, 17). However, it is not known whether crown-down method is still the preferred method for preparing root canals with NiTi rotary instruments (18).

Mtwo instruments (Sweden & Martina, Padova, Italy) have an S-shaped cross-sectional design, a noncutting safety tip, a positive rake angle with 2 cutting edges, and increasing pitch length from the tip to the shaft. This design prevents threading and binding in continuous rotation and reduces the transportation of debris toward the apex. The basic series of Mtwo instruments comprises 8 instruments with tapers ranging between 4% and 7% and sizes from 10–40 (Fig. 1).

The manufacturer proposes use of the so-called single-length technique to a full length of the root canal for the Mtwo system (11). In comparison with the crown-down procedure, Mtwo instruments allow more blades to be in contact with the canal at the same time, although this might result in a higher frictional resistance (19). Initial negotiation of root canal space is desirable by using hand files up to #15 in a watch-winding motion to assure the presence of a glide path (13) up to the foramen.

The aim of this study was to evaluate the effectiveness of a manual glide path on the preparation of curved root canals by using the Mtwo rotary system.

Materials and Methods

Specimen Preparation

Forty mandibular molars extracted for periodontal reasons were stored in a 2% timol solution until use. The crown and distal root of each tooth were removed at the level of the cementoenamel junction with a diamond disk in an Accutom 50 cutting machine (Struers, Ballerup, Denmark) to obtain a mesiobuccal root canal measuring 12 mm in length. The working length was determined by subtracting 1 mm from the length at which the file tip extruded apically.

A series of radiographs were taken following the methodology of Iqbal et al (18). Adobe Photoshop CS2 software (Adobe Systems Inc, San Jose, CA) was used to enhance the edges of the initial and final instrumentation radiographs. The angle of the canal curvature was determined according to the methodology of Pruett et al (20) by using a computerized digital image processing system (AutoCAD 2006; Autodesk Inc, San Rafael, CA). The roots whose angles of curvature ranged between 25 and 76 degrees were included in this study and were randomly divided into 2 groups of 20 each, 25–44 degrees and 45–76 degrees.

Root Canal Instrumentation

Four groups (n = 10) were established: group 25-44GP (glide path), 10 roots with moderate curvature (25–44 degrees) instrumented with a manual glide path followed by Mtwo system; group 25-44NGP (no glide path), 10 roots with moderate

Figure 1. Mtwo Ni-Ti rotary instruments (10/0.04, 15/0.05, 20/0.06, 25/0.06, 30/0.05, 35/0.04, 40/0.04, and 25/0.07).

curvature (25–44 degrees) instrumented with Mtwo system; group 45-76GP (glide path), 10 roots with severe curvature (45–76 degrees) instrumented with a manual glide path followed by Mtwo system; and group 45-76NGP (no glide path), 10 roots with severe curvature (45–76 degrees) instrumented with Mtwo system.

For all groups, Mtwo instruments were used to their full length in permanent rotation with a gentle in-and-out motion and a 4:1 reduction handpiece (WD-66 EM; W & H, Buermoos, Austria) powered by a torque limited electric motor (Endo IT motor; VDW GmbH, Munich, Germany), according to the manufacturer's instructions. The instrumentation sequence was the following: #10/04, #15/05, #20/06, #25/06, and #30/05.

In 25-44GP and 45-76GP groups, the specimens were prepared with #08, #10, and #15 stainless steel K-type hand files (Dentsply/Maillefer, Ballaigues, Switzerland) by using a balanced force technique at working length. After obtaining this glide path, the instrumentation sequence with Mtwo was the same.

The root canals were flushed with 20 mL of a 2.5% NaOCl solution by using a plastic syringe with a closed-end needle (Hawe Max-I-probe; Kerr-Hawe, Bioggio, Switzerland) inserted as deep as possible into the root canal without binding. Each set of files was rejected after 5 uses.

Assessment of Root Canal Preparation

The instrumented roots were repositioned on the radiographic jig at the previously established degree of rotation, and postoperative radiographs were taken with a size 30/05 Mtwo instrument inside the canals. The digital radiographs were downloaded in JPG format from the digital radiographic system and imported into Adobe Photoshop CS2. Then the images were transferred to AutoCAD 2006 to superimpose the central axis of files in the preoperative and postoperative radiographs, so as to measure the distance between these 2 central axes at working length (Fig. 2).

The evaluated parameters were change in angle of canal curvature, apical transportation, and working time. The number of fractures of the instruments was also logged.

Statistical Analysis

Mean and standard deviations were determined for each group, and a full-factorial regression model was used to assess the significance of the interaction between the 2 factors (curvature, glide path) and the 3 measured variables (change of the angle of canal curvature, apical transportation, and working time). The Shapiro-Wilk test was used to assess the distribution of the data. Given that the results for each group did not follow a normal distribution, the Mann-Whitney *U* test was used for pairwise comparisons. The level of statistical significance was set at $P < .05$. All statistical analyses were performed by using SPSS 15.0 software (SPSS Inc, Chicago, IL).

Results

Two teeth were lost as a result of a fracture of the #25/06 instrument in group 25-44GP and a fracture of the #25/06 instrument in group 45-76NGP; however, these teeth were replaced. Mean and standard deviation values are shown in Table 1. The full-factorial regression model did not show statistically significant interaction between the 2 factors in any of the variables. The results were very similar, and no significant differences were found for the change in angle of curvature, for the apical transportation, or for the working time when comparing glide path versus no glide path in the 2 groups of curvature. No significant differences in the comparison of the data between the angles of curvatures were found. Spearman bivariate correlation analysis gave no statistically significant relationship between the maintenance of canal curvature and apical transportation in the 4 groups.

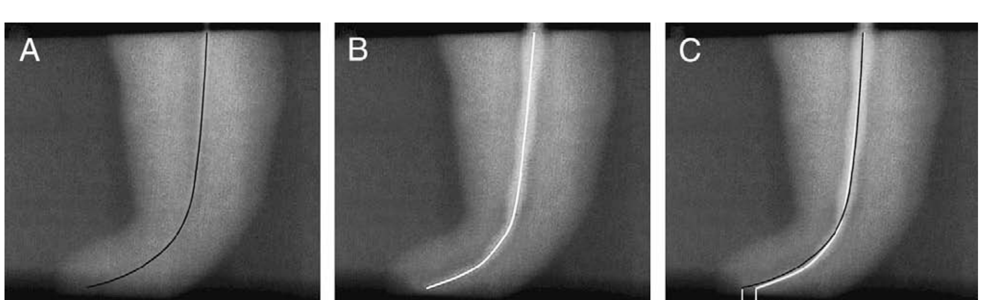

Figure 2. Method used for measuring the distance between 2 central axes at working length. (*A*) Initial digital image. (*B*) Postinstrumentation digital image. (*C*) Central axes superimposed.

TABLE 1. Means and Standard Deviations of the Variables at Different Curvature Degrees

	Curvature 25–44 degrees		Curvature 45–76 degrees		Comparison 25–44 degrees vs 45–76 degrees	
	GP	NGP	GP	NGP	GP	NGP
Changes in angle of curvature (degrees)	5.80 ± 9.74	4.44 ± 9.22	10.63 ± 24.59	10.00 ± 15.95	0.754	0.056
Apical transportation (mm)	0.16 ± 0.18	0.16 ± 0.27	0.13 ± 0.15	0.32 ± 0.08	0.754	0.110
Working time (sec)	586.60 ± 106.05	515.22 ± 99.14	670.25 ± 199.38	558.44 ± 126.64	0.594	0.427

GP, glide path; NGP, no glide path. Comparisons between groups (GP versus NGP) are not significant.

Discussion

Usually the clinical (mesiodistal) and proximal (buccolingual) views are used for evaluation of apical transportation. Actually, however, this method measures the projection of the transportation and not the real transportation, because teeth do not always display their maximum curvatures in the mesiodistal or buccolingual planes. In this study, the method used by Iqbal et al (18) was used to obtain the radiographic projection that most closely approximates the maximum real curvature of the root canal.

Blum et al (13) suggested a glide path with small flexible stainless steel hand files to create or verify that within any portion of a root canal there is sufficient space for rotary instruments to follow. Berutti et al (14) underlined the need for preflaring up to #20 K file for the Protaper instruments so as to ensure sufficient space for the S1 file, because its tip file measures 0.17 mm. They reported that the reduction in torsional stress increased the average instrument lifespan almost 6-fold, while reducing costs and the risk of instrument separation within the canal.

There is no consensus regarding the use of a manual glide path for the Mtwo system (10, 11, 21–24). In the present study, a glide path was prepared up to #15 K file to ensure sufficient space for the file to work and to avoid the risk of its locking. However, we have found no significant differences for the change in angle of curvature, for the apical transportation, or for the working time when comparing glide path versus no glide path in the 2 groups of curvature.

Usually the NiTi rotary systems use a crown-down technique. This technique reduces friction in the canal when the file cuts dentin, because only a part of the file works within the canal. The relatively minor friction decreases the incidence of apical transportation because the files go into the canal more freely (25). The Mtwo files are used at working length with a gentle in-and-out motion (11). This sequence causes the first files to encounter more friction in the canal; therefore, there is a greater chance of file fracture. However, it seems that the heightened flexibility, large space for debris removal, and the increasing distance between the cutting edges would have a positive influence. At any rate, the degree of influence of the instrumental design remains speculative. Furthermore, a comparison of torsional force with the single-length technique and crown-down techniques has not yet been sufficiently researched (21).

Plotino et al (22) concluded that Mtwo rotary instruments can be used safely in clinical conditions as many as 10 times in curved molar teeth, although the angle of curvature of the molar used was 10 degrees or greater. In the present study, Mtwo files were used up to 5 times because the angle of curvature was more variable (25–44 degrees and 45–76 degrees).

Veltri et al (23) analyzed the shaping ability of Mtwo and Hero Shaper (Micro-Mega, Besançon, France) systems in molar root canals with curvatures from 24–69 degrees. They concluded that these systems are effective in shaping curved canals, producing well-centered preparations without any aberrations. Xu et al (24) analyzed the geometric properties and the torsional stress of 6 different cross-sectional designs including Mtwo system. They concluded that Mtwo system was less stable in curved root canals than systems with convex and triple helix as a result of an asymmetrical cross-section design (S-type) and an unequal inertia in the geometric axes.

Shäfer et al (10, 11) compared the shaping and cleaning efficiency of Mtwo, K3 (Sybron Endo, Orange, CA), and RaCe systems, (FKG Dentaire, La-Chaux-de-Fonds, Switzerland) finding that the Mtwo system broke less often than K3 and RaCe and prepared curved canals rapidly while respecting the original curvature. In addition, a recent study of Schäfer and Oitzinger (26) showed that Mtwo presented a great cutting efficiency and produced better canal cleanliness than rotary instruments with radial lands.

In the present study, no significant differences were found when comparing the results of apical transportation between degrees of curvature (25–44 degrees versus 45–76 degrees). These results are in agreement with several studies (10, 11, 23, 26) that indicate good behavior for Mtwo system in curved canals, producing well-centered preparations.

When a NiTi file works in a curved canal, it has a tendency to recover its original form because of the property of pseudoelasticity. This situation causes a slight decrease in the angle of canal curvature. In the present study, straightening ranging from 6–10 degrees was registered. Other studies (11, 19) reported straightening ranging from 1–2.69 degrees in teeth with an angle of canal curvature between 25 and 35 degrees. Our results suggest that the straightening tendency increases in conjunction with severe curvature.

Tripi et al (27) compared the flexural fatigue of different NiTi instruments with a size of .25 and taper 6% and concluded that Mtwo and Hero might be selectively discarded to increase safety in complicated cases. In our study, two 25/.06 Mtwo files separated in 25-44GP and 45-76NGP groups. Most likely, the major metal volume of this file affords less flexibility and therefore decreases cyclic fatigue resistance in severe curvatures (28).

The use of a manual glide path before rotary instrumentation consumes more time, although in this study no significant differences involving time were found in groups with or without glide path. It is possible that a manual glide path before rotary instrumentation consumes more time at the beginning; on the other hand, it facilitates negotiation of the root canal, therefore enhancing the effectiveness of the rotary files and possibly consuming less time in the end. This potential end advantage needs further study.

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