

# Canal Centring Ability of ProTaper and Mtwo Rotary Systems in Curved Canals

## SUMMARY

The purpose of this investigation was to compare centring ratio of ProTaper and Mtwo rotary systems. 60 mandibular molar teeth which had 25, 30 and 35 degree curvature in mesio-buccal root canal were used. Group 1 had 25°, Group 2 had 30°, and Group 3 had 35° curvatures. The roots were sectioned horizontally at 2 mm away from the apex. The apical region was then observed under a stereo-microscope. In each group, teeth were instrumented using ProTaper and Mtwo systems. After canal preparation, digital images of apical part of canals were taken. These images were then superimposed by using Adobe Photoshop CS2 programme. The data were analyzed using ANOVA and Student's t-test.

No significant differences were found between each curvature degrees and rotary systems at the apical part of curved root canals ( $p < 0.05$ ).

**Keywords:** Root Canal, curved; Centring Ability; ProTaper; Mtwo

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**ORIGINAL PAPER (OP)**

**Balk J Dent Med, 2014; 18:89-92**

## Introduction

Canal-shaping is a critical aspect of endodontic treatment because it influences the outcome of the subsequent phases of canal irrigation, filling, and the overall success of the treatment itself<sup>1</sup>. One of the aims of endodontic treatment is to provide a continuously tapered preparation that maintains the canal anatomy, keeping the foramen as small as possible<sup>2-3</sup>, without any deviation from the original canal curvature<sup>2-4</sup>. This tapered canal shape allows effective irrigation and obturation<sup>5</sup>. During instrumentation, maintaining the original path of the canal in small-curved canals is often difficult. However, instrumentation of curved canals with stainless-steel files may cause some complications, such as canal transportation, zipping, ledging, root perforations or breaking files<sup>6-7</sup>. These complications are related to the use of stainless-steel files for bio-mechanical preparation of canals with complex root canal morphology. Stainless-steel files lose their elasticity to larger sizes.

Disadvantages of using traditional files cause requirement of files produced with different material. It was reported that files made from nickel-titanium alloy had 2-3 times bending and torsion elasticity compared

with stainless-steel<sup>8,9</sup>. The nickel-titanium files, which have ascendant properties such as super elasticity, bio-compatibility, high fatigue resistance, memory phenomenon (shape memory phenomenon) effects, are better than stainless-steel files for preparation of curved canals. Nickel-titanium rotary instruments reduce procedural errors and the time required to finish the root canal preparation<sup>10</sup>. Compared with stainless-steel files, nickel-titanium files have superiority in maintaining the original canal path and reducing the risk of transportation and perforation<sup>11</sup>. The super elasticity of the material allows the nickel-titanium rotary instruments to be used in continuous rotation, even in curved canals, to produce a desirable, tapered root canal form with low risk of transporting the original canal path<sup>12</sup>. There have been many reports on the effectiveness of these instruments while shaping teeth with curved root canals<sup>13</sup>. These *in vitro* studies confirm the ability of rotary Ni-Ti instrument to maintain the shape of even severely curved canals.

The purpose of this investigation was to compare the ability of 2 nickel-titanium rotary systems; ProTaper (Dentsply Maillefer, Switzerland) and Mtwo (Sweeden & Martina, Padova, Italy) in maintaining the original canal path at the apical part of the canal.

## Material and Methods

Mandibular first and second molars with varied degree of canal curvature were used in this study. The teeth with incompletely formed apices and had external resorption were eliminated. Surface debris, carries and old restorations were removed. After endodontic access preparation, a size 10 K file (Dentsply-Maillefer) was introduced into the mesio-buccal canal until the file tip was visible at the foramen. Then standardized radiographs were scanned with a computer (Scanner, Agfa Dugasca, Germany). The Canal curvature was determined by using the Schneider's method<sup>14</sup>. The 60 mandibular first molars that had 25°, 30° and 35° curvatures of mesio-buccal canals were chosen for this investigation. Each group comprised 20 teeth. Group 1 included 20 teeth with canal curvatures of 25°, Group 2 included 20 teeth with canal curvatures of 30° and Group 3 included 20 teeth with canal curvatures of 35°.

The mesio-buccal roots were sectioned horizontally, 2 mm away from the root apex. The teeth were mounted in resin blocks with transparent acrylic by leaving their apex visible, (Orthoplast; Vertex, Zeist, Netherlands). Pre and post-prepared apical foramen images were examined under a stereo microscope (Leica TM QWin, Leica Imaging Systems Ltd, Cambridge) and images were recorded. In each group, 10 teeth were prepared with ProTaper and the other 10 teeth were prepared with Mtwo according to the manufacturer's instructions. Canals were prepared using a set of ProTaper instruments, consisting of shaping files S1 and S2 and the finishing files F1 and F2 in crown-down manner. In all groups, irrigation was performed after each change of instrument with 2.0 ml of a 5.25% sodium hypochlorite solution, followed by 2.0 ml of a 17% EDTA and a final rinse with 2.0 ml saline. After preparing 5 canals, each set of ProTaper and Mtwo instruments was discarded and replaced with a new set. In Mtwo group the canals were instrumented with 10/0.4, 15/0.5, 20/0.6, and 25/0.6 files. Mtwo system required introduction of each instrument directly to working length, maintaining permanent rotation with slightly in-and-out movement. Images of post and pre- instrumented apices were superimposed using Adobe Photoshop CS2 program (Fig. 1).

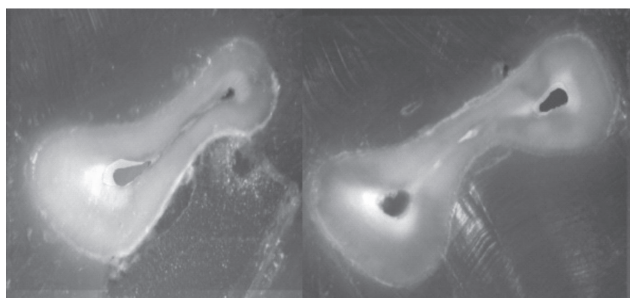


Figure 1. Superimposed computed images

The mean centring ratio was calculated by formula  $X1-X2/Y$ <sup>15</sup>, where X1 represented the maximum extend of canal movement in one direction, X2 was the movement in the opposite direction, and Y was the diameter of the final canal preparation. According to this formula, the centring ratio approached zero as X1 and X2 became closer. "Zero" was an indication of perfect canal centring and no canal transportation (Fig. 2).

Data were analysed with Student's t-test and ANOVA in SPSS 10.0 for Windows programme.

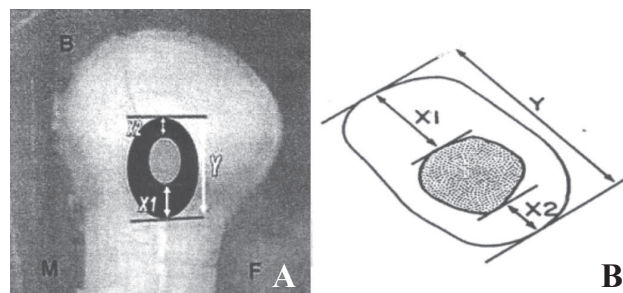


Figure 2. This photograph (A) and drawing (B) represent the centring ratio formula. The shaded area is the pre-instrumentation canal shape and the clear area represents the post instrumentation canal shape. X1 represents the maximum extent of canal movement in one direction and X2 is the movement in the opposite direction. Y is the diameter of final canal preparation

## Results

The results were presented in table 1. In the canals instrumented with Mtwo system in ratio of 24% and with Pro-taper system 22%, more material was removed on the outer wall then the inner wall in the apical part of the canal. In group 3, one of Mtwo files and two of ProTaper files were broken during the preparation. Although the centring ability ratio of ProTaper was found worse than that of the MTwo in Groups 2 and 3, no statistically significant difference was found between the systems and on canal curvatures ( $p < 0.05$ ).

Table 1. Mean values for centring ratio

	n	MTWO	PROTAPER	p
		Mean ± SD	Mean ± SD	
1. Grup (250 )	20	0.23 ± 0.10	0.24 ± 0.08	0.855
2. Grup (300)	20	0.21 ± 0.07	0.19 ± 0.12	0.747
3. Grup (350)	20	0.24 ± 0.09	0.21 ± 0.11	0.523
p		0.682	0.561	

## Discussion

One of the most important stages of root canal treatment is the bio-mechanical preparation of the root canals<sup>16-17</sup>.

During the shaping process of curved canals, the original canal curvature should be preserved, especially at the apex and inner side of the root curvature; straightening that might interfere with canal integrity has to be prevented<sup>18</sup>. Researches have shown that rotary nickel-titanium instruments prepare the root canal rapidly, and maintain the canal shape and working length with fewer aberrations compared with hand instrumentation<sup>19-21</sup>.

The aim of the present study was to compare the maintaining ability of ProTaper and Mtwo rotary systems in extracted human mandibular molars which had mesio-buccal root canals with different curvatures. Using extracted teeth in the present study provided conditions close to the clinical situation<sup>22</sup>. Because of the complex root anatomy and the variability in dentine hardness, the use of extracted teeth compromises standardization to a certain extent. Although rotary nickel-titanium instruments can maintain the canal shape better than other techniques, some researches have determined that they may cause canal transportation in curved canals, especially at the outer curve of the apical portion of the canal and the transportation would be more severe as the angle of the curvature increases<sup>23-26</sup>. This mainly depends on the restoring forces of the metal, which attempt to straighten a file in a curved canal toward the outer curvature and thus cause more material loss in this area. The results of this study are in agreement with these researches.

Root canal morphology and the degree of the curvature are determinative factors in endodontic root canal preparation<sup>27</sup>. Morphology of the curved root canal has a great importance to the outcome of root canal instrumentation, with several studies being conducted to describe the curvature<sup>28</sup>. The degrees of curvature were determined according to the Schneider's technique similar to other investigators. SEM, stereomicroscope, radiographic studies and CT were some of the techniques used in investigations in which extracted human teeth were used. Using the Adobe Photoshop CS2, photographs of the instrumented and un-instrumented canals could be superimposed. Changing the opacity of the layers allowed visualization of the movement of the instrumented canal at the apical side.

Alves et al, made a comparison among manual instruments and PathFile and Mtwo rotary instruments to create a glide path in the root canal preparation of curved canals<sup>10</sup>. They used mandibular molars with curvature angles between 25° and 35°. Computerized analysis was used to compare initial and final images of the central axis of the canals. Neither the manual stainless steel instruments nor the PathFile or Mtwo rotary instruments used to create a glide path had any influence on the occurrence of apical transportation or produced any canal aberration<sup>10</sup>. The results of that study are parallel to the present study.

The present study compared the maintaining ability of Mtwo and ProTaper Ni-Ti rotary instruments. Mtwo is characterized by constant taper increasing with the files. On the contrary, ProTaper instruments have multiple and progressively changing tapers along the length of their cutting blades<sup>29-30</sup>. Other features of the ProTaper instruments relate to their convex triangular cross-section. This feature reduces the contact area between the blade of the file and dentin, improving safety. It is used in crown-down manner. Mtwo is used with "single length technique"; all files used in working lengths. Mtwo instruments have S shaped cross-sections, which provide maximum space for removal of dentinal debris and minimum radial canal wall contact that enables right preparation. Working techniques and cross-sections of these systems are different from each other. On the basis of these differences, the present investigation has shown that there are no significant differences between the centring ratios of both systems. Both systems cause furthest apical transportation from mesial wall. Transportation ratio to distal wall was 24% in Mtwo groups and 22% in the ProTaper group.

## Conclusion

Although it was expected that transportation would be more severe as the angle of the curvature increases, no significant differences were found between each curvature degrees and rotary systems at the apical part of curved root canals.

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