Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 5, 2021, Pages. 2225 - 2229
Received 15 April 2021; Accepted 05 May 2021.

# Effect of Glide Path Preparation on Subsequent Centering Ability of Two Rotary Systems

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**ABSTRACT**

**Introduction:** The aim of this study was to compare the effect of root canal preflaring using manual file and PathFile on root canal shaping of ProTaper and Mtwo rotary systems.

**Materials and Methods:** One hundred curved Endo training blocks were selected and randomly based on type of preflaring and flaring instruments, divided in to four groups. Group 1: Preflaring with PathFile and flaring with ProTaper, Group 2: PathFile + Mtwo, group 3: manual K file + ProTaper and group 4: Manual K file + Mtwo. Preinstrumentation, preflaring and flaring images were superimposed to evaluate the increase of canal width. Intra and inter group comparisons were carried out by Man-Whitney and Kruskal-Wallis tests.

**Results:** In preflaring step, PathFile better than hand K files preserved canal centricity (P<0/05).In comparison of group 1 (PathFile+ProTaper) with 3 (hand K-file+ProTaper) and group 2 (PathFile+Mtwo) with 4 (hand K-file+Mtwo) in order to diversion of main path, there was no significant difference between them (P>0.05), but in comparison of four groups, preparation with ProTaper (group 1 and 3) significantly (P<0.05) increased the deviation of original canal shape than Mtwo (group 2 and 4).

**Conclusion:** Deviation of root canal is greater subsequent to use of ProTaper rotary files than Mtwo files without respect to the preflaring method.

**KEYWORDS**

Apical Transportation, Mtwo, PathFile, ProTaper, Root Canal Treatment.

## Introduction

Root canal cleaning and shaping are important phases in endodontic therapy. The objectives of instrumentation include debridment of the entire root canal system, formation of continuously tapering funnel shape canal, and maintenance of the original shape of root canal system (1).

It is known that nickel-titanium (NiTi) alloy has unique properties, including low elastic modulus. These properties make it the material of choice for instruments used in root canal treatment (2). NiTi files have two or three times the elastic flexibility of stainless steel files (3).

Coronal enlargement and preliminary manual preflaring to create glide path have been shown to be fundamental for safer use of NiTi rotary instrumentation, especially in canal preparation with Mtwo (VDW, Munich, Germany), and ProTaper(Dentsply Maillefer, Ballaigues, Switzerland) systems (4), Because unlike most rotary NiTi systems which used based on crown-down technique, the ProTaper and Mtwo, reverts to the standardized technique and all instruments are taken to full working length from the beginning (5). Therefore there is a higher risk of torsional fracture and canal transportation as the whole length of these instruments is subjected to stress and severely curved apical canal sections are successively instrumented with all instruments (4).

Preflaring and creation of the glide path are usually done by hand with stainless steel instruments. Hand stainless steel instruments involve numerous disadvantages, due to their relative rigidity and their tip that in many cases are aggressive, so during this step the most dangerous errors can be made, that can cause the entire treatment to fail (ledges, foramen transportations, dentine plugs) (6).

To avoid these dangerous errors, the PathFile (Dentsply Maillefer, Ballaigues, Switzerland) NiTi pathfinding rotary system is manufactured to facilitate preflaring and creating the mechanical Glide Path.

The system consists of 3 instruments with ISO 13, 16, 19 tip sizes respectively and taper 0.02 that use immediately after a # 1o hand K- file (Dentsply Maillefer, Ballaigues, Switzerland) to full working length (7).

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The purpose of this study was to compare the deviation of main path in canal preflaring using manual file and PathFile in ProTaper and Mtwo systems.

## Materials and Methods

One hundred transparent resin simulated root canal blocks (Dentsply, Maillefer, Ballaigues, Switzerland) were used to assess instrumentation. The degree of curvature and taper was 45° and o.o2 respectively. They were randomly divided into two groups of 50 canals each. Four landmarks were made with a fissure bur in the resin block from side wall to near inner and outer curve of the canal without penetrating into canal. These landmarks ensured a precise matching of pre and postoperative images. Preoperative digital images of resin blocks in a fixed position were prepared using Sony DSC-W170 (Tokyo, Japan).

Masking the resin blocks ensured that the process was carried out with purely tactile sensation.

In one group, after use of #10 stainless steel at working length, mechanical canal preflaring was performed by 3 instruments of PathFile set according to manufacture instructions (3oo rpm) and with Endo IT (VDW, Munich, Germany) system at working length. In another group, manual preflaring was performed by new # 10-15-20 stainless steel K-file at working length. Each block was then photographed in the previous fixed position.

Then they were randomly divided into four groups of 25 canals each, based on type of preflaring and flaring instruments respectively: Group 1: PathFile and ProTaper, group 2: PathFile and Mtwo, group 3: hand K-file and ProTaper, group 4: hand K-file and Mtwo.

In the group 1 and 3, the selected curved root canal was instrumented using the ProTaper system with six instruments in the following sequence: SX at two thirds of the working length; S1, S2, F1, F2, F3 at the working length, employing a cyclical in-out motion. In the group 2 and 4, the Mtwo system was used in the selected curved canal, according to the manufacturer's instructions. The instrumentation sequence employed five files, as follows: 0.04 taper ISO 10, 0.05 taper ISO 15, 0.06 taper ISO 20, 0.06 taper ISO 25, 0.05 taper ISO 30. All five instruments were used to the full length of the canals with the same cyclical in-out motion.

Irrigation with tap water and canal recapitulation was performed after each file. Files were regularly wipes using wet gauze to remove resin debris. To reduce interoperator variables all preparation were conducted by the same operator. Each instrument was used for preparation of 5 canals.

The blocks were then photographed in the same fixed position. Superimposition of the preoperative and preflaring phase and superimposition of preoperative and flaring phase was done by landmarks placed in the sides of the resin blocks. The superimposed images were analyzed using the Adobe Photoshop CC 2019 software which magnified the canal images 10 times. The removed resins were calculated at 5 different points based on Calberson et al study (12): canal orifice (O); half way to the orifice in the straight section (HO); the beginning of the curve (BC); the apex of the curve (AC) and the end point (EP). The increase in canal width due to the instrumentation process was recorded on both the inner and outer sides of the original canal.

Intra and inter group comparisons were carried out by Man-Whitney and Kruskal-Wallis tests. A level of $P<0.05$ was considered significant.

## Results

In preflaring step, more materials was removed by hand K-file on the outer wall at EP point ($P=0.035$) and on the inner wall at BC point ($P=0.041$). PathFile better than hand K- files preserved canal centricity ($P<0.05$).

Tables 1 and 2 show, respectively, the mean inner curve width and mean outer curve width at points O to EP of the canals after root canal shaping. In comparison of group 1 with 3 and group 2 with 4 in order to diversion of main path, there was no significant difference between them ($P> 0.05$).

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**Table 1.** Mean inner width measurements (mm) of canals in experimental groups

| Groups | O | HO | BC | AC | EP |
|---|---|---|---|---|---|
| PathFile & ProTaper | 0.26 ± 0.04 | 0.31 ± 0.06 | 0.45 ± 0.03 | 0.17 ± 0.07 | 0.06 ± 0.009 |
| PathFile & Mtwo | 0.31 ± 0.03 | 0.30 ± 0.04 | 0.28 ± 0.07 | 0.18 ± 0.04 | 0.07 ± 0.006 |
| K-File & ProTaper | 0.26 ± 0.05 | 0.29 ± 0.07 | 0.46 ± 0.05 | 0.23 ± 0.03 | 0.08 ± 0.007 |
| K-File & Mtwo | 0.32 ± 0.02 | 0.29 ± 0.05 | 0.29 ± 0.04 | 0.22 ± 0.06 | 0.07 ± 0.005 |

**Table 2.** Mean outer width measurements (mm) of canals in experimental groups

| Groups | O | HO | BC | AC | EP |
|---|---|---|---|---|---|
| PathFile & ProTaper | 0.48 ± 0.02 | 0.32 ± 0.03 | 0.13 ± 0.04 | 0.21 ± 0.05 | 0.19 ± 0.013 |
| PathFile & Mtwo | 0.30 ± 0.04 | 0.27 ± 0.05 | 0.17 ± 0.08 | 0.22 ± 0.08 | 0.13 ± 0.009 |
| K-File & ProTaper | 0.49 ± 0.07 | 0.32 ± 0.03 | 0.11 ± 0.06 | 0.21 ± 0.06 | 0.20 ± 0.018 |
| K-File & Mtwo | 0.29 ± 0.06 | 0.30 ± 0.04 | 0.17 ± 0.06 | 0.20 ± 0.07 | 0.14 ± 0.008 |

In group 1 and 3, ProTaper changed canal centricity in points O, BC, EP ($P<0.05$) and in group 2 and 4, Mtwo changed original canal shape in points BC and EP ($P<0.05$). In comparison of four groups, ProTaper (group 1 and 3) significantly increased the deviation of main path than Mtwo (group 2 and 4) ($P<0.05$).

## Discussion

Nowadays root canal preparation using NiTi rotary files without any procedural errors, such as apical transportation, ledges and deviation of main path, is one of the most important steps in root canal treatment (8). Glide path preparation before root canal enlargement, is recommended (9). The purpose of this study was to assess the diversion of main path in canal preflaring using manual file and NiTi rotary PathFile in ProTaper and Mtwo rotary systems.

This study described the shaping abilities of the instruments under strictly controlled laboratory conditions, using clear resin blocks. Use of simulated canals in resin blocks does not reflect the action of the instruments in root canals of real teeth because of differences in the surface texture, hardness and cross section. However, resin blocks allow a direct comparison of the shaping ability of different instruments (10).

The model used in this study was described by Calberson et al., allows an analysis of instrumentation in both the inside and outside walls of the canal at five points that is more accurate than comparing pre – and post – instrumentation file positions (11). The analysis of the canal width after preflaring revealed that in the K-file group significantly more outer and inner canal wall was removed at EP point and BC respectively than PathFile.

This is in agreement with Berruti et al (12), showed that PathFile demonstrated significantly less modification of curvature and fewer canal aberration. In addition to this one another study has shown K-files result more canal transportation than engine-driven preflaring systems (13). However Turker & Uzunoglu (5) showed that there was no significant difference between K-files and other rotary systems regarding to canal transportation.

In comparison of group 1 (PathFile + ProTaper) with 3 (K-file + ProTaper) and group 2 (PathFile + Mtwo) with 4 (K-file + Mtwo) in order to diversion of main path, there was not significantly difference between them. It means that difference between preflaring methods did not have any influence on maintenance of canal centricity in ProTaper or Mtwo groups. This is in agreement with Coelho et al (14) and Turker & Uzunoglu 5) which revealed no differences during subsequent shaping.

An explanation for this may be due to that, during root canal preparation by Mtwo and ProTaper, size, shape, taper, cross section and other physical and mechanical characteristics of NiTi rotary files are more important than the amount of the deviation of main canal path in preflaring step. Especially use of greater size and taper of rotary files, susceptible canals to aberration after flaring (15). But in one study preparation of glide path using K-files before root canal shaping by rotary files, resulted significantly more canal aberration (13).

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In comparison of four groups, ProTaper (group 1 and 3 ) significantly increased the deviation of main path than Mtwo ( $P<0.05$ ), means that Mtwo NiTi rotary instrument can prepare canals in curved roots with significantly less deviation than ProTaper instrument. ProTaper is thicker than other instruments at the same level, so it can result in more deviation and aberration of the original shape of the root canal (16). This finding is in agreement with the study of Kuzekanani et al (17), who showed that Mtwo resulted the least changes in canal shape than ProTaper. However in contrast with present study, Shivashankar et al (18), showed that Mtwo and ProTaper have similar behavior regarding to root canal transportation. In study of Bonaccorso et al, (19) more zip and ledge formation performed by Mtwo and ProTaper than our study, because they used files with greater size in more difficult S-shaped canals than our research.

In previous studies, using Mtwo and ProTaper files, instrument separation has been noted at modest frequency (10-20%), unlike the present study which no instrument separation occurred (16, 20). This may reflect the gentle technique used, and the lack of strong apical forces.

## Conclusion

Deviation of root canal is greater subsequent to use of ProTaper rotary files than Mtwo files without respect to the preflaring method.

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