

ORIGINAL ARTICLE

COMPARISON OF CENTERING ABILITY AND TRANSPORTATION OF THE PROTAPER NEXT AND ONESHape FILE ROTARY SYSTEMS FOR PREPARING SIMULATED CURVED CANAL

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Background: To compare the effect of ProTaper Next and One Shape rotary files on canal transportation and centering abilities in resin block with simulated curved canal. **Methods:** An in-vitro experimental study was carried out in Dental clinics. Sixty resin blocks (30 per group) having simulated curved canals prepared with ProTaper Next and One Shape and then filled with red and blue Indian ink, respectively. Photographs of resin blocks obtained using standardized manner were then transferred to the Adobe Photoshop 7.0. Centering abilities and amount of transportation were then calculated at coronal, middle and apical portion of canal for both the groups. Independent sample t-test was used to compare the transportation and centering ability of both file systems. Level of significance was kept at p -value ≤ 0.01 . **Results:** One Shape file resulted in more canal transportation at all the levels (apical, middle and coronal part) as compared to ProTaper Next file, however, difference was not statistically significant (p -value > 0.01). Statistically significant difference was noted at the apical third between these two rotary files with One Shape file showing more centered preparation as opposed to ProTaper Next file (p -value < 0.01). **Conclusion:** One Shape file system had more centered canal preparations specifically at the apical region as compared to ProTaper Next. One Shape also lead to more canal transportation in comparison to ProTaper Next, however the difference was not statistically significant.

Keywords: ProTaper Next; One Shape; Canal transportation; centering ability

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INTRODUCTION

Removal of pulpal tissues and shaping of the canal is the critical step in the endodontic therapy.¹ However, in the presence of curvature the preparation of canal becomes challenging and if the canal anatomy is not respected then the risk of endodontic mishaps such as canal transportation, ledges, etc increases.² The NiTi endodontic instruments have been introduced because of their unique ability of shape memory and super flexibility that ultimately leads to reduction in the procedural error frequency.^{3,4} Other factors that act as determining factor for the root canal preparations include root preparation techniques and canal instruments. As the curvature increases, the file become more distorted leading to more stresses on canal wall.⁵

Since their advent, various changes have been made in the endodontic arsenal leading to introduction of newer file systems.^{6,7} ProTaper Next (Dentsply Maillefer™) and One Shape rotary files (Micro Mega®) were introduced in the quest to provide more predictable treatment with less chances of procedure errors.^{8,9} ProTaper Next rotary files are unique due to the presence of offset rectangular cross-sectional design. These are

manufactured using m-wire technology and are claimed to have enhanced flexibility and increased resistance to cyclic fatigue.^{10,11} One Shape file, on the other, is single file system that prepares root canals in continuous rotation. It is manufactured using conventional NiTi, with variable cross-sectional design along its length from tip to the shaft.⁸

Numerous methods have been carried out to assess the effectiveness of rotary endodontic instruments. These methods include sections of teeth, radiographic evaluation, scanning electron microscopy, micro computed tomography etc.^{12–14} Endodontic resin blocks with simulated canals have also been widely used to evaluate instrumentation of root canals.^{15–17} Gambill *et al.*⁴ had devised a unique method of assessing endodontic preparation. It included the evaluation of computed tomography for assessing centering abilities and transportation. This method turned out to be reliable and was used in multiple studies for evaluation of endodontic instruments.^{18–20}

Numerous studies have been conducted assessing the centering and shaping ability of different file systems. In some of the studies ProTaper Next had better centering ability whereas

in others studies One Shape rotary files turned to be comparable in maintaining the original shape of the canals.²⁰⁻²³ However, there was a lack of studies with head to head comparison of the ProTaper Next with One Shape rotary files in assessing the centering ability and canal transportation. Therefore, the present study was designed to assess and compare the effect of ProTaper Next and One Shape rotary files on canal transportation and centering abilities in resin block with simulated curved canal. The null hypothesis was that there is no difference in canal transportation and centering abilities of ProTaper Next and One Shape rotary files.

MATERIALS AND METHODS

An in-vitro experimental study (ERC# 3681-Sur-ERC-15) was carried out in Dental clinics in two months period to compare the effect of ProTaper Next (Dentsply Maillefer™) and One Shape rotary files (Micro Mega®) on canal transportation and centering abilities in resin block with simulated curved canal. Ethical approval was sorted from the institutional ethical review committee before starting the data collection procedure.

Sample size for the present study was calculated using WHO sample size calculator (sample size determination in Health studies, WHO). The study by El Naghy *et al.*¹⁹ was taken as reference. Keeping the difference in transportation after using ProTaper Next at 3mm mentioned in the study at the level of significance (α) at 1% and power of study ($1-\beta$) at 90%, the sample size turned out to be at least 30 observations.

Since we had two experimental groups, so we needed a total of 60 specimens. Sixty resin blocks having simulated curved canal (Endo Training-Bloc, Dentsply Maillefer, Ballaigues, Switzerland) were selected on the basis of inclusion and exclusion criteria. Non-probability consecutive sampling technique was employed for sample selection. The resin blocks which had canal curvature between 25–35 degrees were included whereas damaged resin blocks were excluded from the study and replaced with additional resin blocks. Schneider's method for measurement of canal curvature was used in the present study for comparison of canal curvature assessment.²⁴

A single investigator had performed all preparations and assigned a unique code to each resin block for ease of identification. An ISO # 8 size K file was inserted into the simulated canal of resin and working length was established at 1 mm short of apex (point at which file exits the resin block) on visual examination. Following identification of working

length, canal was negotiated till length and preparation was performed using ISO # 20 size K file. After initial preparation, irrigation of the canal was performed with water using irrigating syringe and later filled the simulated canals with green Indian ink. Preoperative photographs was taken for each block with reference measuring scale with Nikon D7000 DSLR camera. All images were taken from the same distance and constant light setting in a dark room for standardization. The settings were kept constant for both the groups so confounding was cancelled.

Resin blocks were coded with unique identifier and were then randomly assigned into equal groups for subsequent preparations using One Shape rotary instrument or Pro Taper Next rotary instrument. The canal preparations were carried out following the manufacturers' instructions. Group of ProTaper Next was prepared till X2 at the working length. Red and blue indian ink were then filled in the resin blocks prepared with One Shape and ProTaper Next respectively. Photographs were then taken as mentioned previously using standardized methodology.

Photographs of resin blocks obtained using standardized manner were then transferred to the Adobe Photoshop 7.0. Amount of resin removed from the both inner and outer wall were evaluated at coronal, middle and apical portions of simulated canals. Centering abilities and amount of transportation were then calculated at coronal, middle and apical portion of canal for both OneShape and ProTaper Next rotary files using methodology devised by Gambill *et al.*⁴ Data analysis was performed using SPSS version 22.0. Independent sample t-test was used to compare the transportation and centering ability of One Shape and ProTaper Next rotary files at coronal, middle and apical segments. Level of significance was kept at p -value <0.01.

RESULTS

The transportation, without any exception, was found to be always away from the curvature, i.e., towards the outer wall. One Shape file resulted in more canal transportation at all the levels (apical, middle and coronal part) as compared to ProTaper Next file, however, difference was not statistically significant (p -value >0.01). (Table-1)

There was no statistically significant difference in the centering abilities of One Shape and ProTaper Next rotary files at the coronal and middle third of simulated canal. However, statistically significant difference was noted at the apical third between these two rotary files with One Shape file showing more centered preparation as opposed to ProTaper Next file. (Table-2)

Table-1: Transportation in apical, middle and coronal part

File system	Apical part	Middle part	Coronal part
OneShape file	-0.83±1.17	-0.70±0.82	-0.66±0.63
ProTaper Next	-0.53±0.57	-0.43±0.35	-0.39±0.38
p-value	0.21	0.09	0.05

Mean values±SD. Independent sample t-test. *p*-value <0.01 is significant
 Transportation = inner curvature resin removed–outer curvature resin removed
 If T=0 means no transportation
 T>0 means transportation is towards inner curvature
 T<0 means transportation is towards outer curvature

Table-2: Centering ratio in apical, middle and coronal part

File system	Apical part	Middle part	Coronal part
OneShape file	0.55±0.26	0.60±0.2	0.58±0.24
ProTaper Next	0.33±0.28	0.54±0.15	0.53±0.20
p-value	0.002	0.19	0.45

Mean values±SD. Independent sample t-test. *p*-value <0.01 is significant
 Centering ratio= inner resin removed/outer resin removed (if outer > inner)
 Centering ratio= outer resin removed/inner resin removed (if inner>outer)
 C=1 means perfect centering ability
 C closer to 0 means worse centering ability

DISCUSSION

The present study compared the centering ability and canal transportation of ProTaper Next and One Shape rotary files and it has rejected the null hypothesis as ProTaper Next showed less centered preparations in simulated canals specifically in apical region. These findings are similar to the study conducted by Liu *et al.* who concluded ProTaper Next to create less centered preparations when compared to WaveOne and Twisted File Adaptive.²⁵ However results of numerous studies are contrary to this and reported ProTaper Next to prepare more centered preparations.^{20,23,26} Pasqualini *et al.* also studied centering ability of ProTaper Next BioRace systems and reported better preservice of canal shape in ProTaper Next group.²⁷ Reddy *et al.* compared the shaping ability of One Shape and Twisted files and reported latter to better maintain original the shape of the canal.²⁸ Uzunoglu *et al.* compared One Shape and ProTaper Next for canal shaping ability in mesial canals of mandibular molars and found out no statistically significant difference between the two.²⁹ This is in disagreement to the findings of the current study according to which One Shape appeared to be better than ProTaper Next especially in apical third of the simulated canals. In this study, ProTaper Next was comparable to One Shape in centered preparations in coronal and middle third. However, according to Wu *et al.* findings, ProTaper Next instrument maintained the canal shape better at all

the levels of canals when compared with ProTaper Universal and WaveOne.³⁰ Overall, it is evident from the results that none of the two systems, ProTaper Next and One Shape, had not resulted in ideal centered canal preparations, nevertheless One Shape was superior between the two systems mainly with regard to apical third preparations. Of The most probable reason for less than ideal centered preparations in this study could be due to offset rectangular cross-section design resulting in swaggering motion of ProTaper Next and hence off-centered canal preparations. Also, we used resin blocks and its physical property could have also affected the results. These endodontic resin blocks have the tendency to melt when excessive stresses are placed on its surface.

This study found One Shape file to cause more canal transportation than ProTaper Next file, although the difference was not statistically significant (*p*-value >0.01). Burklein *et al.* compared ProTaper Next, ProTaper Universal, BT Race and Mtwo instruments in curved canals and concluded that there is no statistically significant differences among the groups for canal transportation.³¹ In another study, Saber *et al.* also failed to demonstrate any significant difference in apical canal transportation among ProTaper Next, iRace and Hyflex CM instruments.³² Saberi *et al.* found no difference in canal transportation of One Shape file when compared to M-one and Reciproc files in mesial canals of mandibular molars assessed on CBCT scans.³³ In another study, Mittal *et al.* also concluded that both the One Shape and Reciproc files are similar with respect to canal transportation.²² Nevertheless, Agarwal *et al.* showed contrary results, as in their study Oneshape files showed superiority over Protaper instruments.²¹ The safety in preparation of curved root canals by One Shape file in this study could be due to its less aggressive nature resulting in more centered preparations.

We have used resin blocks in this study as they are easy to obtain, hence eliminating the need for natural teeth/roots for experimental studies.³⁴ The preparation in resin blocks had similar outcomes to that of natural teeth as reported in studies.^{35,36} Nonetheless, because of different physical properties, concerns are there for using them as an alternative to natural teeth.³⁷

The limitations of the study are its in-vitro design which could not replicate the intra-oral conditions, single center study and use of resin blocks with moderately curved canals. Hence the results of this study can only be generalized on moderately curved canals. The other limitation of the current study was the lack of use of Cone

Beam Computed Tomography (CBCT) for assessing the centering ability. Well-designed in-vivo, prospective studies preferably randomized controlled trials based on CBCT are required in future to find out rotary instruments with ideal centering ability.

CONCLUSION

One Shape appeared to create more centered canal preparations specifically at the apical region as compared to ProTaper Next. One Shape also led to more canal transportation in comparison to ProTaper Next, however the difference was not statistically significant.

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AUTHORS'S CONTRIBUTION

KZ: Concept, design, data collection, data interpretation, and manuscript writing. SBB: Concept, design, data collection, data analysis, data interpretation. RG: Data interpretation, critical appraisal, gave final approval for the publication. FRK: Data Analysis and critical appraisal.

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