ACTA SCIENTIFIC DENTAL SCIENCES (ISSN: 2581-4893)

Volume 4 Issue 4 April 2020

Research Article

# Assessment of the Shaping Abilities of 2Shape, Neolix and Pro Taper Next Rotary Systems: A Comparative *In vitro* study

**Yasmin Hamdy Hussien[1]*, Nehal Nabil Roshdy[2] and Angie Galal Ghoniem[3]**

[1]*Masters student, Faculty of Dentistry, Cairo University, Egypt*

[2]*Associate Professor of Endodontics, Faculty of Dentistry, Cairo University, Egypt*

[3]*Professor of Endodontics, Faculty of Dentistry, Cairo University, Egypt*

***Corresponding Author:** Yasmin Hamdy Hussien, Masters student, Faculty of Dentistry, Cairo University, Egypt.

**Received:** February 25, 2020

**Published:** March 19, 2020

© All rights are reserved by **Yasmin Hamdy Hussien*., et al.***

## Abstract

**Objective:** This study attempted to compare the shaping abilities of the 2Shape, Neolix and Pro Taper Next rotary NiTi systems in terms of canal transportation and centering ability by cone beam computed tomography.

**Methods:** Mesiobuccal canals of fifty-seven first mandibular molar teeth with an angle of curvature ranging from 20σ to 40σ according to Schneider's technique were randomly assigned into three groups according to the rotary system used (n = 19). Canals were scanned using cone beam computed tomography before and after preparation to evaluate canal transportation and centering ratio at 3, 6, and 9 mm from the apex.

**Results:** There was no statistically significant difference in amounts of mesiodistal canal transportation between the three groups at the apical, middle and coronal thirds. There was no statistically significant difference in the centric ratio between the three groups at the coronal and apical thirds. At the middle third, the 2Shape and ProTaper Next showed higher statistically significantly median centric ratio in the mesiodistal direction than Neolix group.

**Conclusions:** The three systems showed comparable performance regarding the degree of canal transportation and centering ability.

**Keywords:** Cone Beam Computed Tomography; Canal Transportation; Centering Ability; 2Shape; Pro Taper Next; Neolix

## Introduction

Success of endodontic treatment depends on proper cleaning and shaping of the root canal system through the phase of chemomechanical preparation. Mechanical instrumentation and chemical preparation are inseparable; whereas mechanical instrumentation allows for canal enlargement, which in turn enhances the effectiveness of chemical preparation provided by irrigants and antimicrobial agents. There by, efficient mechanical preparation is considered the cornerstone for successful endodontic treatment [1].

Creating a continuous tapered shape while preserving the original root canal geometry with regards to the narrow and curved canals represents a significant challenge for clinicians, due to increased risks of mishaps as canal transportation, ledge and perforation. Mechanical instrumentation using the traditional stainless steel hand instruments is now considered time consuming and associated with difficulty in achieving Schilder's mechanical objective [2] of maintaining the original canal geometry.

Since the 1990s, various rotary nickel-titanium (NiTi) instruments have been introduced for root canal instrumentation in an attempt to improve the performance of instruments in the canal. Efficiency of these files varies greatly according to the alloy type, cross-sectional design, taper variation, number of files and sequence of instruments. These newly developed Ni-Ti files possess a unique design property in terms of cross-section, reduced number of files and enhanced metallurgical properties. These innovations were intended to reduce the incidence of instrument separation and produce faster instrumentation with maximum amount of touched walls while preserving the original canal anatomy without deviations [3].

Recently various NiTi rotary systems with reduced number of files were introduced. Of these systems are the 2Shape (Micro-Mega, Besancon, France), Neolix (châtres-la-Forêt, France) and ProTaper Next (Dentsply Maillefer, Ballaigues, Switzerland) rotary systems. ProTaper Next rotary system was chosen as the comparator in the present study, as it has been successfully used over years, and can be considered as a reference for comparison.

Up till now, data regarding the shaping abilities in terms of canal transportation and centering ability regarding 2Shape and Neolix system is still lacking. This is why the following study was undertaken.

## Materials and Methods

### Sample size

Based on a previous study by Pasternak., *et al*. 2009 and using power 80% and 5% significance level we needed to study 19 in each group.

### Sample selection

A total of 57 human permanent mandibular first molars extracted due to periodontal or prosthodontic reasons were collected from the Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Cairo University. Inclusion criteria were the presence of two separate canals in the mesial root with independent apical foramina, mesiobuccal canal curvatures between 20° and 40°, complete root formation, no root caries, no calcification in the root canal, and no internal or external root resorption.

### Sample preparation

The teeth were decoronated using a low speed diamond saw (Dentsply Sirona, Ballaigues, Switzerland) under copious irrigation to obtain 16 mm uniform root lengths. Distal root of each sample was resected using a low speed diamond saw under copious irrigation. K-file (Mani Inc., tochigi-Kan, Japan) size #10 was inserted in the mesiobuccal canal of each root to check patency. K-file size #15 was confirmed to fit to the full working length. While K-file size #20 was placed to check that it couldn't reach the working length. The working length was adjusted to be 1mm shorter.

The roots were fixed by mounting them vertically halfway in transparent autopolymerizing acrylic resin (Acrostone, Dental and Medical Supplies, Cairo, Egypt) mixed according to the manufacturer's instructions in a plastic mould (10 cm x 12 cm). Vaseline (Unilever, Indea) was painted on the internal surface of the mould as a separating medium. The root apices were sealed with wax (Wilson, Sao Paulo, Brazil) to preserve the apical foramen from resin penetration. To ensure standardization of the specimens during tomographic scanning, each root was placed in the unset acrylic resin such that its long axis was parallel to the long axis of the mould and with the buccal surfaces of all roots facing at the same direction. In addition, an amalgam filling was inserted into the resin at the mesiobuccal line angle of the roots, to enable the orientation of the canal during scanning.

### Pre-instrumentation scanning

All roots were scanned using cone beam computed tomography (i-CAT FLX V-Series, United States) with voxel dimension of 0.125mm, 120 kVp, 37.07 mAs, and 26.9 sec acquisition time to detect canal shape before instrumentation.

### Root canal preparation

Samples were randomly divided into 3 equal groups (n = 19 canals per group) as follows:

- **Group I:** 2Shape group, where roots were mechanically prepared using TS1 (25/04) and TS2 (25/06) files to the full working length. Files were operated at 300 rpm/1.2 Ncm torque in continuous rotation motion.
- **Group II:** Neolix group, where roots were mechanically prepared using, Neoniti A1 (20/06) and A1 (25/06) files to the full working length. Files were operated at 500 rpm/1.5 Ncm torque values in continuous rotation motion.
- **Group III:** ProTaper Next group, where roots were mechanically prepared using, ProTaper Next X1 (17/04) and X2 (25/06) files to the full working length. Files were operated at 300 rpm/2 Ncm torque in continuous rotation motion.

Xsmart plus endodontic motor (Dentsply Sirona, Ballaigues, Switzerland) was employed for root canal preparation of all samples, following the manufacturer's instructions for each system. Each instrument was used to prepare only six canals and then discarded. Cleaning and shaping was performed in a crown-down technique, with a slow in and out pecking motion with an amplitude of about 3 mm. After three pecks, the flutes of the instruments were cleaned and reinserted, and the process was repeated until the full working length was reached. In all groups, the canals were irrigated with 3 ml of freshly prepared 2.6% sodium hypochlorite solution (Clorox, Cairo, Egypt) as an irrigant between each instrument using a 30-gauge max-i-Probe needle tips (Dentsply-Rinn, Elgin, IL, Switzerland) placed as apical as possible into the canal without binding. Apical patency was retained by using a #10 K-file between each rotary file. Then, 3 ml of distilled water were used followed by 1 ml of 17% EDTA (PREVEST Dent Pro, Indea) solution for 1 minute, and finally 3 ml of distilled water as a final flush of the root canals.

### Post-instrumentation scanning

The root canals were scanned after mechanical preparation using CBCT, similarly to the pre-instrumentation scanning protocol.

### Pre- and post-instrumentation measurement

For each specimen, three tomograms were chosen (Pre and post-instrumentation) according to the distance from the root apex, as follows: 3 mm from the root apex (Representing the apical third), 6 mm from the root apex (Representing the middle third) and 9 mm from the root apex (Representing the coronal third). All scans were assessed using a Software program (OnDemand 3D) (Cybermed, South Korea). In the axial plane, dentin thickness was measured mesially and distally, from the root canal boundary to the root surface boundary for each tomogram (Figure 1).

**Figure 1:** Showing the pre- and post- instrumentation measurements of the dentine thickness at 9 mm level (coronal third) in a selected specimen.

Pre and post-instrumentation scans were superimposed using the abovementioned software program to evaluate the degree of transportation as well as the centering ability of the tested instruments.

### Evaluation method

### Canal transportation

The degree of canal transportation was calculated according to the formula provided by Gambill., *et al.* (1996) [4]. The value used were the measurements of the shortest distance from the edge of the instrumented canal to the periphery of the root surface (mesially, distally), and comparing these measurements with the same measurements before canal instrumentation. The formula used for calculation of canal transportation (CT):

Mesiodistally = (M1-M2) -(D1-D2)

**Where:**

**M1:** Refers to the shortest distance from the mesial edge of the root to the mesial edge of the uninstrumented canal.

**M2:** Refers to the shortest distance from the mesial edge of the root to the mesial edge of the instrumented canal.

**D1:** Refers to the shortest distance from the distal edge of the root to the distal edge of the uninstrumented canal.

**D2:** Refers to the shortest distance from the distal edge of the root to the distal edge of the instrumented canal.

### Centering ability

Centering ability ratio was calculated using the same values obtained during the measurement of transportation according to the formula introduced by Gambill., *et al.* (1996) [4]:

Mesiodistally: (M1-M2)/(D1-D2) or (D1-D2)/(M1-M2)

The formula was selected in such a manner that the lowest of the results acquired through the difference should be the numerator. A result equal to 1.0 signified perfect centralization. When the value was closer to zero, it denoted that the instrument had a lower capacity to maintain itself in the central axis of the canal.

### The statistical analysis

Numerical data were explored for normality by checking the distribution of data and using tests of normality (Kolmogorov-Smirnov and Shapiro-Wilk tests). Non-parametric data were presented as median and range values while parametric data were presented as mean, standard deviation and 95% Confidence Interval values. For non-parametric data; Kruskal-Wallis test was used to compare between the three systems. Friedman's test was used to compare between the different root levels. Dunn's test was used for pair-wise comparisons. For parametric data; repeated measures ANOVA test was used to compare between the three systems as well as the three root levels. Bonferroni's post-hoc test was used for pair-wise comparisons. Chi-square test or Fisher's Exact test when applicable were used to compare between the systems. The significance level was set at P ≤ 0.05. Statistical analysis was performed with IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.

## Results

### Canal transportation

There was no statistically significant difference between amounts of mesiodistal transportation at the different root thirds of Group I: 2Shape (2S), Group: II Neolix (N) and Group III: ProTaper Next (PTN) (P-value = 0.126, 0.513 and 0.321 respectively). (Table 1).

There was no statistically significant difference between the three groups at the apical, middle and coronal thirds (P-value = 0.200, 0.060 and 0.702 respectively) (Table 2)

| Root level | Group I: 2S | | Group II: N | | Group III: PTN | |
|---|---|---|---|---|---|---|
| | Median | Range | Median | Range | Median | Range |
| Apical | 0.08 | 0.01 – 0.22 | 0.11 | 0.02 – 0.2 | 0.13 | 0 – 0.23 |
| Middle | 0.08 | 0.02 – 0.37 | 0.16 | 0.02 – 0.33 | 0.07 | 0.01 – 0.28 |
| Coronal | 0.15 | 0 – 0.2 | 0.13 | 0.01 – 0.21 | 0.08 | 0 – 0.38 |
| P-value | 0.126 | | 0.513 | | 0.321 | |

**Table 1:** The median, range values and results of Friedman's test for comparison between amounts of MD canal transportation (mm) at different root thirds within each group.

*: Significant at P ≤ 0.05

| Root level | Group I: 2S | | Group II: N | | Group III: PTN | | P-value |
|---|---|---|---|---|---|---|---|
| | Median | Range | Median | Range | Median | Range | |
| Apical | 0.08 | 0.01 – 0.22 | 0.11 | 0.02 – 0.2 | 0.13 | 0 – 0.23 | 0.200 |
| Middle | 0.08 | 0.02 – 0.37 | 0.16 | 0.02 – 0.33 | 0.07 | 0.01 – 0.28 | 0.060 |
| Coronal | 0.15 | 0 – 0.2 | 0.13 | 0.01 – 0.21 | 0.08 | 0 – 0.38 | 0.702 |

**Table 2:** The median, range values and results of Kruskal-Wallis test for comparison between amounts of MD canal transportation (mm) in the three groups.

*: Significant at P ≤ 0.05

### Centric Ratio (CR)

There was no statistically significant difference between CR in the mesiodistal direction at different root thirds in Group I: (2S), Group II: (N) and Group III: (PTN); (P-value = 0.255, 0.247 and 0.368 respectively) (Table 3)

There was no statistically significant difference between the three groups at the coronal third (P-value = 0.830).

There was a statistically significant difference between the three groups at the middle third (P-value = 0.003). Pair-wise comparisons between the groups revealed that there was no statistically significant difference between Group I: (2S) and Group III: (PTN); both showed higher statistically significantly median CR in the MD direction than Group II: (N).

At the apical third, there was no statistically significant difference between the three groups (P-value = 0.877). (Table 4),

| Root level | Group I: 2S | | Group II: N | | Group III: PTN | |
|---|---|---|---|---|---|---|
| | Median | Range | Median | Range | Median | Range |
| Apical | 0.56 | 0.15 – 0.67 | 0.5 | 0.17 – 0.85 | 0.57 | 0.08 – 1 |
| Middle | 0.63 | 0.05 – 0.93 | 0.27 | 0.06 – 0.69 | 0.67 | 0.44 – 0.94 |
| Coronal | 0.89 | 0.45 – 1 | 0.5 | 0.16 – 0.96 | 0.5 | 0.07 – 1 |
| P-value | 0.255 | | 0.2470 | | 0.368 | |

**Table 3:** The median, range values and results of Friedman's test for comparison between CR in MD direction at different root thirds within each group.

*: Significant at P ≤ 0.05

| Root level | Group I: 2S | | Group II: N | | Group III: PTN | | P-value |
|---|---|---|---|---|---|---|---|
| | Median | Range | Median | Range | Median | Range | |
| Apical | 0.56 | 0.15 – 0.67 | 0.5 | 0.17 – 0.85 | 0.57 | 0.08 – 1 | 0.877 |
| Middle | $0.63^{A}$ | 0.05 – 0.93 | $0.27^{B}$ | 0.06 – 0.69 | $0.67^{A}$ | 0.44 – 0.94 | 0.003* |
| Coronal | 0.89 | 0.45 – 1 | 0.5 | 0.16 – 0.96 | 0.5 | 0.07 – 1 | 0.830 |

**Table 4:** The median, range values and results of Kruskal-Wallis test for comparison between CR in MD direction within the three groups.

*: Significant at P ≤ 0.05, Different superscripts in the same row are statistically significantly different

## Discussion

Canal preparation is one of the major factors in determining the success of root canal therapy [5]. Complex root canal anatomy have always presented a challenge to successful endodontic therapy, through creating a continuous tapered form, while preserving the original canal anatomy [6].

The purpose of this study was to compare the shaping ability of new NiTi rotary instruments (2Shape, Neolix and ProTaper Next) in terms of canal transportation and centring ratio in the mesiobuccal root canals of mandibular molars. The study was designated to be a comparative *In vitro* study to ensure control of the variables and uniformity of the results. 2Shape rotary system (MicroMega, Besancon, France) has been introduced to the market as a new rotary system consisting of two shaping files which have been heat-treated representing the T-Wire technology [7]. While, Neoniti (Neolix, Châtres-la-Forêt, France) NiTi rotary system is manufactured by cutting a wire through electrical discharge machining process [8]. The manufacturer assumed that it has controlled memory and a rough surface, resulting in satisfactory shaping and no screwing effect. On the other hand, ProTaper Next rotary system was chosen as the comparator in the present study, as it has been successfully used over years, and can be considered as a reference for comparison [9,10]. The effectiveness of this system is related to the enhanced file flexibility, resistance to cyclic fatigue and cutting efficiency due to the M-wire technology [11,12].

Shaping ability was assessed in terms of two parameters; canal transportation and centering ability, since they significantly affect the final outcome of root canal therapy [13]. Where, canal transportation corresponds to the post- instrumentation deviation in the axis comparable to the original pre-instrumentation axis [14]. While, centring ability refers to the ability of the file axis to be inline with the canal axis. Thereby, avoiding canal zipping, ledging or perforation [15].

Extracted mandibular first molars were utilized in the study because testing file system in natural dentin represents a more realistic clinical condition in comparison to standardized artificial canals due to the different properties of the dentine texture, stiffness, hardness and the detailed anatomical features. The mesiobuccal root canals were selected as they are narrow and curved in two planes, which represent a challenge to instrumentation [11,16]. Specimens included in the present study possessed similar preoperative geometric parameters; length characteristic (16mm), initial apical diameter (k file #10) [17] and angle of curvature(20°- 40°). The angles of curvature of teeth included were measured using Schneider's method. It is a simple method that is most commonly used for measuring root canal curvature in literature [18].

The irrigant used during the chemo-mechanical preparation was 2.6% Sodium Hypochlorite (NaOCl) because it is the most commonly used concentration in routine endodontic practice. Clinically, this concentration was chosen to achieve a balance between the antibacterial activity and cytotoxicity [19]. A 30-gauge needle tip was introduced 1 - 2 mm short of the working length to allow deep introduction of the irrigant to the apical third [20]. 1 ml of 17% EDTA was used after instrumentation to simulate the clinical conditions [21]. To obtain comparable results, similar apical preparation diameter was established for all samples to size 25 and 0.06 taper represented as TS2 in the 2Shape group, A1 in the Neolix group and X2 in the ProTaper Next group [22].

Outcomes were assessed at three levels; 3, 6, and 9 mm from the root apex to represent the canal's apical, middle and coronal thirds [23]. Cone beam computed tomography (CBCT) was chosen as the evaluation method for its an accuracy, practicality, reliability, reproducibility and noninvasiveness that allows quantitative and qualitative three-dimensional evaluation of root canals [24]. The samples of each group were fixed in a resin mould. This resin inclusion method allows positioning of the samples inside the CBCT easier and more reproducible [25]. Being an effective method in measuring the canal transportation and centering ability the formula introduced by Gambill., *et al.* [4], was used to calculate the extent and direction of canal transportation, as well as centering ratio [26].

Concerning the results of the shaping ability in the present study, there was no statistically significant difference between the amount of mesiodistal transportation among the three groups at the apical, middle and coronal thirds ($P > 0.05$). This was in agreement with the findings of Brasil., *et al.* (2017) [27], Forghani., *et al.* (2017) [28] and Staffoli., *et al.* (2018) [29].

At the middle third; The 2Shape and ProTaper Next systems showed statistically significantly higher median centric ratio in the mesiodistal direction than Neolix system. The superiority of 2Shape and ProTaper Next files can be credited to its asymmetrical cross-section design. The snake like motion helps in preserving the original canal anatomy due to the offset rotation center, causing the file to engage and disengage along the canal wall, thus reducing the stresses between the file and the canal wall [30].

Generally, there are several instrument-related factors that affect the canal shaping ability including; instrument design (degree of taper, cross sectional designs, radial lands, cutting/ noncutting tip design), metallurgy of NiTi alloy of the instrument, movement kinematics and instrumentation technique (previous creation of glide path, coronal pre-flaring and size of apical preparation) [28]. Where, the absence of significant difference in most of the aspects of the shaping ability among the three groups could be attributed to numerous similarities between them including; modified noncutting tips, movement kinematics (rotation motion), instrumentation technique (crown-down technique) and size of apical preparation (size 25,0.06 taper).

## Conclusions

Within the limitations of this study, it could be concluded that the three systems showed comparable performance regarding the degree of canal transportation and centering ability.

## Conflict of Interest

The authors deny any conflicts of interest in this study.

## Bibliography

1. Hülsmann M., *et al*. "Mechanical preparation of root canals: shaping goals, techniques and means". *Endodontic Topics* 10.1 (2005): 30-76.
2. Schilder H. "Cleaning and shaping the root canal". *Dental Clinics of North America* 18 (1974): 269-296.
3. Burkhardt L., *et al*. "Comparison of the shaping ability of RaCe, FlexMaster, and ProFile nickel-titanium instruments in severely curved root canals". *Journal of Clinical and Experimental Dentistry* 8.5 (2016): e523-e528.
4. Gambill JM., *et al*. "Comparison of nickel-titanium and stainless steel hand-file instrumentation using computed tomography". *Journal of Endodontics* 22.7 (1996): 369-375.
5. Wu MK., *et al*. "Does the first file to bind correspond to the diameter of the canal in the apical region". *International Endodontic Journal* 35.3 (2002): 264-267.

6. Drukteinis S., *et al*. "Shaping ability of BioRace, Pro Taper NEXT and Genius nickel-titanium instruments in curved canals of mandibular molars: a Micro CT study". *International Endodontic Journal* 52.1 (2019): 86-93.

7. Uslu G., *et al*. "Cyclic fatigue resistance of 2Shape, Twisted File and EndoSequence Xpress nickel-titanium rotary files at intracanal temperature". *Journal of Dental Research, Dental Clinics, Dental Prospects* 12.4 (2018): 283.

8. Aminsobhani M., *et al*. "The effect of root canal preparation using single versus multiple endodontic rotary files on post-operative pain, a randomised clinical trial". *European Endodontic Journal* 2.1 (2017): 1.

9. Ruddle CJ., *et al*. "Fifth-generation technology in endodontic: The shaping movement". *Roots* 1 (2014): 22-28.

10. Bürklein S., *et al*. "Shaping ability of P ro T aper NEXT and BT-R a C e nickel–titanium instruments in severely curved root canals". *International Endodontic Journal* 48.8 (2015): 774-781.

11. Elnaghy AM and Elsaka SE. "Evaluation of root canal transportation, centering ratio, and remaining dentin thickness associated with ProTaper Next instruments with and without glide path". *Journal of Endodontics* 40.12 (2014): 2053-2056.

12. Liu Y., *et al*. "Comparison of shaping ability of five nickel-titanium rotary instruments in simulated curved canals. of. 5 (2017): 2.

13. Stern S., *et al*. "Changes in centring and shaping ability using three nickel–titanium instrumentation techniques analysed by micro-computed tomography (μCT)". *International Endodontic Journal* 45.6 (2012): 514-523.

14. Wu MK., *et al*. "Leakage along apical root fillings in curved root canals. Part I: effects of apical transportation on seal of root fillings". *Journal of Endodontics* 26.4 (2000): 210-216.

15. Vallaeys K., *et al*. "Comparative analysis of canal transportation and centring ability of three Ni–Ti rotary endodontic systems: Protaper®, MTwo® and Revo-S™, assessed by micro-computed tomography". *Odontology* 104.1 (2016): 83-88.

16. Silva EJ., *et al*. "Comparison of canal transportation in simulated curved canals prepared with ProTaper Universal and ProTaper Gold systems". *Restorative Dentistry and Endodontics* 41.1 (2016): 1-5.

17. Iqbal MK., *et al*. "Comparison of apical transportation between ProFile™ and ProTaper™ NiTi rotary instruments". *International Endodontic Journal* 37.6 (2004): 359-364.

18. Nagy CD., *et al*. "The effect of root canal morphology on canal shape following instrumentation using different techniques". *International Endodontic Journal* 30.2 (1997):133-140.

19. Naenni N., *et al*. "Soft tissue dissolution capacity of currently used and potential endodontic irrigants". *Journal of Endodontics* 30.11 (2004): 785-787.

20. Coldero LG., *et al*. "Reduction in intracanal bacteria during root canal preparation with and without apical enlargement". *International Endodontic Journal* 35.5 (2002): 437-446.

21. Crumpton BJ., *et al*. "Effects on smear layer and debris removal with varying volumes of 17% REDTA after rotary instrumentation". *Journal of Endodontics* 31.7 (2005): 536-538.

22. Silva EJ., *et al*. "Microcomputed tomographic evaluation of canal transportation and centring ability of ProTaper Next and Twisted File Adaptive systems". *International Endodontic Journal* 50.7 (2017): 694-699.

23. Setzer FC., *et al*. "Comparison of apical transportation between two rotary file systems and two hybrid rotary instrumentation sequences". *Journal of Endodontics* 36.7 (2010): 1226-1229.

24. Gluskin AH., *et al*. "A reconstructed computerized tomographic comparison of Ni–Ti rotary GT™ files versus traditional instruments in canals shaped by novice operators". *International Endodontic Journal* 34.6 (2001): 476-484.

25. Venino PM., *et al*. "A Micro–computed Tomography Evaluation of the Shaping Ability of Two Nickel-titanium Instruments, HyFlex EDM and ProTaper Next". *Journal of Endodontics* 43.4 (2017): 628-632.

26. Marzouk AM and Ghoneim AG. "Computed tomographic evaluation of canal shape instrumented by different kinematics rotary nickel-titanium systems". *Journal of Endodontics* 39.7 (2013): 906-909.

27. Brasil SC., *et al*. "Canal transportation, unprepared areas, and dentin removal after preparation with bt-race and protaper next systems". *Journal of Endodontics* 43.10 (2017): 1683-1687.

28. Forghani M., *et al*. "Comparison of the shaping characteristics of Neolix and Protaper Universal systems in preparation of severely-curved simulated canals". *Journal of Clinical and Experimental Dentistry* 9.4 (2017): e556.

29. Staffoli S., *et al*. "Comparison of shaping ability of ProTaper Next and 2Shape nickel–titanium files in simulated severe curved canals". *Giornale Italiano Di Endodonzia* 32.2 (2018): 52-56.

30. Saber SE., *et al*. "Comparative evaluation of the shaping ability of ProTaper Next, iRaC e and Hyflex CM rotary NiTi files in severely curved root canals". *International Endodontic Journal* 48.2 (2015): 131-136.

**Assets from publication with us**

- Prompt Acknowledgement after receiving the article
- Thorough Double blinded peer review
- Rapid Publication
- Issue of Publication Certificate
- High visibility of your Published work

**Website:** www.actascientific.com/

**Submit Article:** www.actascientific.com/submission.php

**Email us:** editor@actascientific.com

**Contact us:** +91 9182824667