Evaluation of Shaping Potential of Rotary Protaper using CT: An In vitro Study

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ABSTRACT

AIM: To assess the shaping potential of Rotary Pro-Taper instruments in narrow canals using CT.

OBJECTIVE: to assess the shaping potential of Rotary Pro-Taper and analyzing the final outcome of shaped canals using CT and determining different variables like

- Change in volume
- Change in cross- sectional area.

MATERIAL AND METHOD: From a pool of thirty freshly extracted permanent Maxillary Molars (1st and 2nd), fifteen were selected with curvatures (20 to 40 degrees) Schneider (1971). Tissue fragments and calcified debris were removed from the teeth by scaling. The teeth were then stored in normal saline until used. All the mesiobuccal canals were scanned by CT to obtain pre-instrumented images. Teeth was scaled and stored normal saline. No attempt was made to locate or shape the second mesiobuccal canals because there anatomy was too variable for the purpose of this study.

The canals were instrumented with PROTAPER ROTARY instruments using Crown Down technique according to manufacturer's instructions.

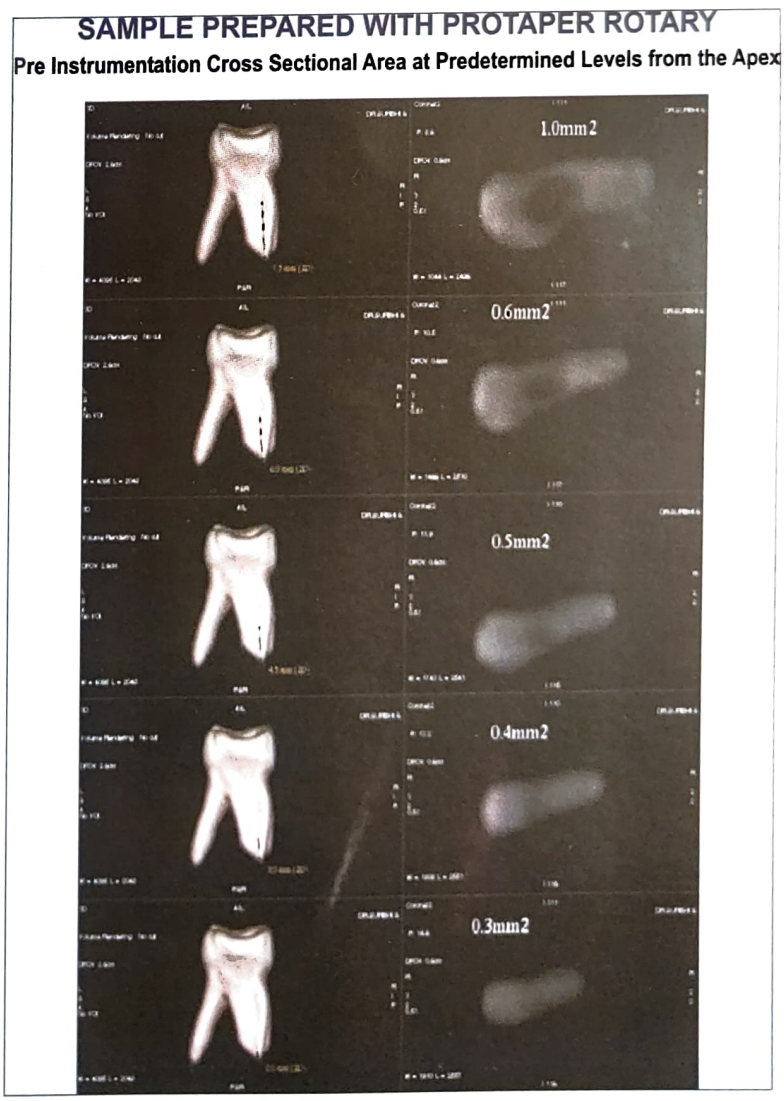
CT ANALYSIS AND MEASUREMENTS:

The samples were analyzed and evaluated for

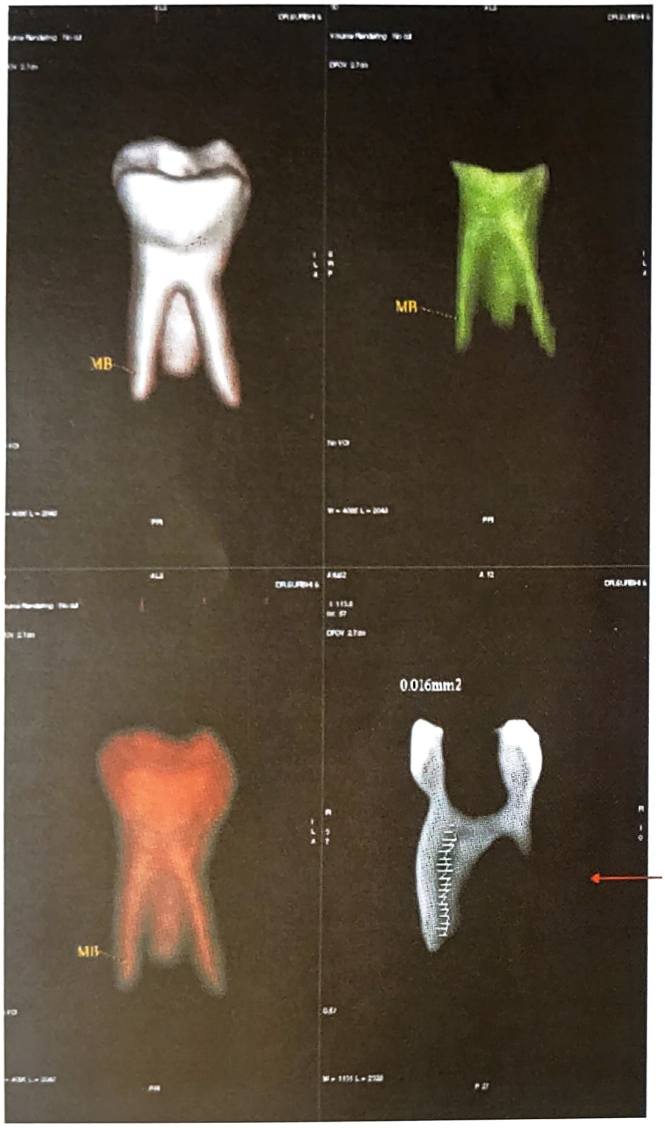
- Post instrumentation change in volume.
- Post instrumentation change in cross-sections area.
- RESULT:

From the observations and statistical analysis carried out in this study, it was found that-

There was a statistically difference between all the parameters judged for the present study that is-



SAMPLE PREPARED WITH PROTAPER ROTARY



1. No obvious procedural errors such as apical zips, perforations or ledges were detected after canal preparation with Rotary ProTaper.

2. Change in the canal volume showed and overall percentage increase of 50.21% following instrumentation with Pro Taper Rotary.

3. a. change in cross section area at 2mm and 3 mm from the apex was lesser significantly greater with manual Ni-Ti K file as compared to Pro Taper Rotary.

b. change in cross sections at 4.5 mm, 6 mm and 7.5 mm from the apex with Pro Taper Rotary was significantly greater than at apex.

CONCLUSION:

This clearly establishes based on the results that Rotary ProTaper used with crown down technique showed no procedural errors and may be effective in shaping narrow canals effectively.

KEYWORDS: Shaping Potential; Pro Taper Rotary; Change in volume; Change in Cross-Section area.

INTRODUCTION

Root canal preparation aims to remove infected pulp and microbial debris from the root canal system. Shaping the root canal provides more efficient disinfection by removing infected dentin and creating space for irrigants, medicaments and inert root canal filling.1 Inadvertent procedural errors can occasionally occur during the instrumentation of narrow curved canals. One major advancement is the development and use of nickel titanium alloys for manufacture of endodontic instruments.

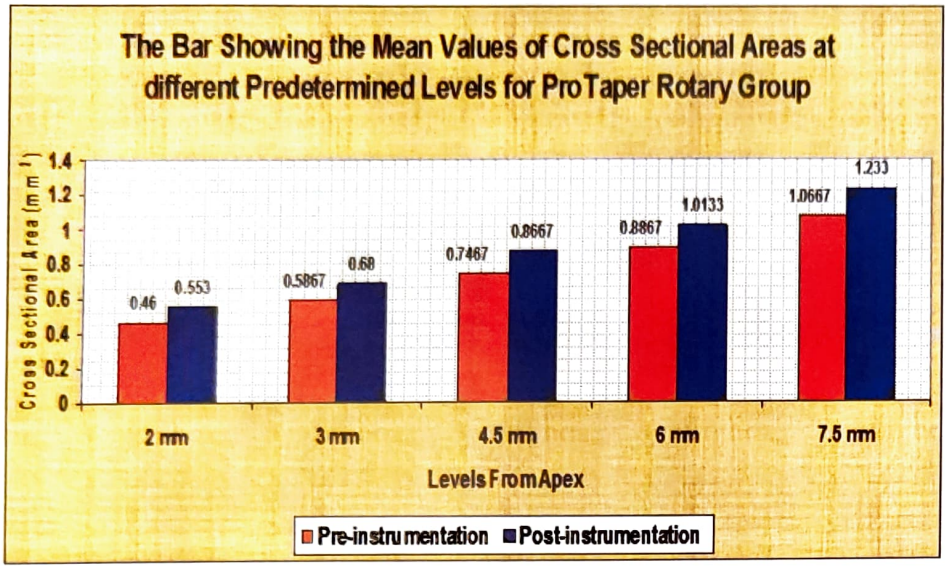
Recently, techniques that allow the teeth to be evaluated for shaping ability without destroying the specimens have been suggested to compare root shape prior to and after instrumentation. With the use of computed tomography (CT), appropriate and measurable sections can be prepared and 3D images can be reconstructed. Root canal instruments and preparation methods can be compared by using CT 1.

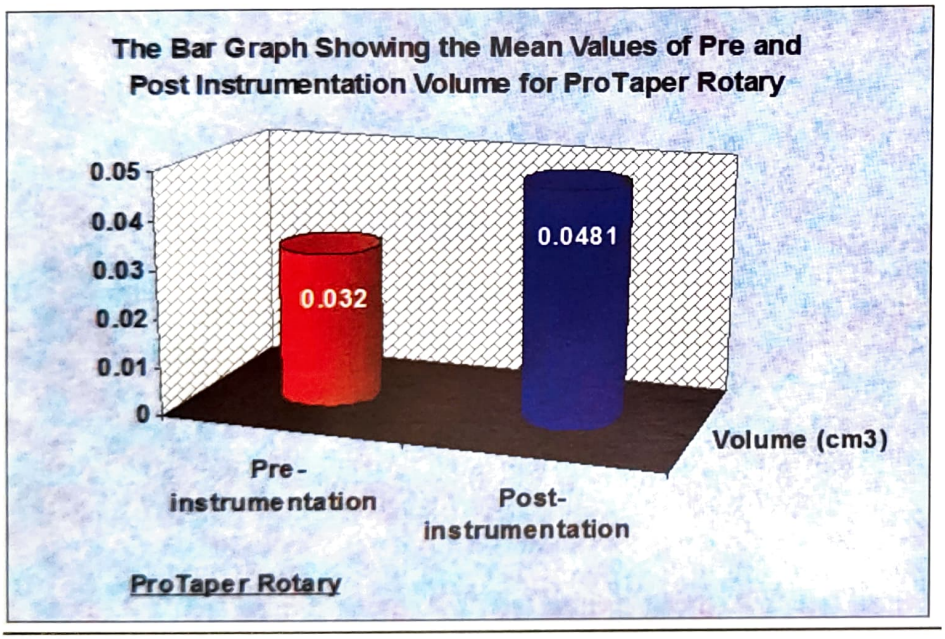
The aim of the present study was to evaluate the shaping potential of Rotary Protaper in narrow canals using computed tomography.

MATERIALS AND METHODS

For this study from a pool of thirty freshly extracted permanent maxillary molars (1s1 and 2nd), fifteen were selected based on measurement of root canal curvature (20 to 40 degrees) from pre operative radiograhs after insertion of a size 15 K Flexofile (Schneider 1971) 2. Tissue fragments and calcified debris were removed from teeth by scaling and the teeth were stored in normal saline until further use. After the access cavity preparations Radiographs were taken buccolingually and mesiodistally of each canal with size 15 K-flexofile (Dentsply Maillefer) is situ. To determine the working length (WL), a size 10K Flexofile was inserted into the mesiobuccal canals until it was visible at the apical foramen. The working length of each canal was calculated to be 1mm less than the length obtained with this initial file 5.

The samples were now mounted on circular wax stumps. All teeth were scanned by Multidetector Multislice GE lightspeed pro scanner. The purpose of scanning was to acquire the preinstrumented images. The images were scanned at an isotropic resolution of 50 microns. The volume data set was analyzed on Advantage Windows 4.2 software release and the 3D reconstruc-





tional volumetric and cross sectional area analysis was performed on this software.

Not attempt was made to locate or shape the second mesiobuccal canals because their anatomy was to variable for the purpose of this study. Mesio-buccal canals of all 15 samples were instrumented with rotary Protaper instruments using Crown Down technique, according to manufacturers recommendation. Instrumentation was done at a speed of 300 rpm using an 1/64 reduction hand piece (Anthogyr) powered by Marathon NSK micromotor. Master apical file was F2 Protaper Rotary instruments 3.

CT ANALYSIS & MEASUREMENTS:

The samples were analysed and evaluated for Post instrumentation change in volume

Post instrumentation change in cross-section area.

After the volume data set acquisition from the samples 3D analysis of the data was done for Protaper group first. The volumetric analysis was done using advantage windows 4.2 software release on Advantage Windows Workstation. The volume analysis of the data was performed using 0.625mm thin slice stack. The volume of the MB canals were calculated both for the preinstrumented and post instrumented images of all 15 samples.Change in cross section area was calculated from the 5 pre determined (2mm, 3mm, 4.5mm, 6mm, 7.5mm from apex) where 2mm and 3mm denotes the apical region, 4.5mm middle, 6mm and 7.5mm coronal third of the canal respectively. Change in cross section area was evaluated for each canal from both the pre and post instrumented image.

RESULTS AND OBSERVATIONS:

FORMULA USED FOR STATISTICAL ANALYSIS

On completion of the study of the obtained values were statistically analyzed to find the level of significant using mean, standard deviation (SD), standard error mean (SEM) etc. statistical analysis was further done using Paired 't' test, Percentage increase and Z test.

From the observations and statistical analysis carried out in this study, it was found that-

There was a statistically difference between all the parameters judged for the present study that is-

1. No obvious procedural errors such as apical zips, perforations or ledges were detected after canal preparation with Rotary ProTaper.

2. Change in the canal volume showed and overall percentage increase of 50.21% following instrumentation with Pro Taper Rotary.

3. a. change in cross section area at 2mm and 3 mm from the apex was lesser significantly greater with manual Ni-Ti K file as compared to Pro Taper Rotary.

b. change in cross sections at 4.5 mm, 6 mm and 7.5 mm from the apex with Pro Taper Rotary was significantly greater than at apex.

Based on the results it was concluded that Rotary ProTaper used with crown down technique showed no procedural errors and may be effective in shaping narrow canals effectively.

DISCUSSION:

For the evaluation of root canal preparation of different instruments, two experimental models often use are simulated

PREDETERMINED LEVEL (mm)	PROTAPER DIFFERENCE (Post – Pre)	t_{CAL}	t_{TAB}	P_{VALUE}
2	0.093333 ± 0.045774	7.9093	t(14, .05) 1.761 t (14, .01) 2.624	P < .05 P < .01
3	0.093333 ± 0.02582	13.93	t(14, .05) 1.761 t (14, .01) 2.624	P < .05 P < .01
4.5	0.12 ± 0.056061	8.2873	t(14, .05) 1.761 t (14, .01) 2.624	P < .05 P < .01
6	0.126667 ± 0.045774	10.7163	t(14, .05) 1.761 t (14, .01) 2.624	P < .05 P < .01
7.5	0.166667 ± 0.061721	10.4561	t(14, .05) 1.761 t (14, .01) 2.624	P < .05 P < .01

root canals in clear resin blocks or root canals in extracted human teeth. Another reason for its use was to simulate in vivo conditions. The shaping ability of progressive versus constant paper instruments was compared previously insulated canals. (Yang et al).9 The ProTaper Rotary system consisting of three "Shaping" and three "Finishing" files. The distinguishing features of the Protaper System (Dentsply / Tulsa Dental) a "progressive preparation" in both vertical and horizontal directions. The file blades engage a smaller area of dentin, thus reducing torsional load that leads to instrument fatigue and file separation. During rotation, there is also an increased tactile sense when compared with traditionally shaped rotary instruments.8An S1 file (shaping files no. 1, Taper .02 - .11; size 17) was used to one-third of the working length

An SX (auxillary shaping file; Taper .035 - .19; size 19) used to one-half of the working length.

An S1 file was used to one-half to two -thirds of the working length.

An S2 file (shaping file no. 2; Taper .04 - .115; size 20) was used to two-thirds of the working length.

An F1 file (finishing file no. 1; Taper .07 - .055; size 20) was used to the full working length.

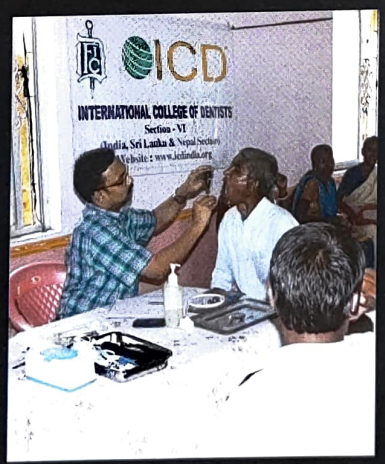
An F2 file (finishing file no.2; Taper .08-

.055; size 25) was used to the full working length [6,7]

In this study canals prepared with ProTaper instruments had larger cross-sectional areas in the coronal and middle parts, (4.5, 6, 7.5 mm from apex). This could be attributed to the larger diameters of the instrument F2. Another study which supports this results is the shaping ability of progressive versus constant taper instruments in curved root canals of extracted teeth. (G.B. Yang et al 2007). 9 In the progressive ProTaper system (Dentsply Maillefer), the shaping files (S) have an increasing taper from tip to coronal, whereas the finishing files (F) have a decreasing taper. It has been claimed that the increasing taper instruments have enhanced flexibility in the middle region and at the tip, and that the decreasing taper instruments provided a larger taper in the important apical resign but make them stiff (Bergmens *et al*, 2003).10 There was significant change increase in volume detected in this study confirming finding reported in another study in which relative performance of ProTaper Ni-Ti instruments were evaluated in shaping root canals of varying preoperative canal geometry 7.

In this study Rotary Pro-Taper which is an Ni-Ti instrument is used as the advantage of this alloy's performance over stainless steel files have been reported to be less straightening the original canal shape, less development of ledges, apical zipping, canal transportation, and perforations.Ni-Ti instruments function differently than those made of stainless steel, even when cross-section design, taper, flutes, and tip are identical.8Furthermore Rotary Pro-Taper retained the original from in all instrumented canals, with curvatures varying from 20 degrees to 40 degrees, compared with stainless steel instruments.11The use of the CT scan at 50 micron resolution proves a practical & non-destructive technique for assessment of canal morphology before and after shaping13. The volume data set was analyzed using Advantage Windows 4.2 software on advantage windows workstation. The CT scans were an improvement over the technique designed by Bramante et al (1987).14 and enhanced by other subsequent investigators. No destructive sectioning of the specimens is required and there is no loss of root material during sectioning which could affect instrumentation outcomes. The CT scans allow easy measurement of canal changes, as each image has an accurate scale, decreasing the potential of a radiographic or photographic transfer error and helps overcome safely and effectively some other problems associated with conventional radiograph. The cost of scanning procedure is also a consideration that currently inhibits the universal utilization of this methodology.13There are various studies in accordance with the results of this study (G.B. Yang *et al.* 2007). 9 (O.A. Peters et al. 2003). 4

Eastern Zone of International College of Dentist section VI organized a Dental and Health camp (Diabetic screening) on Sunday 12th May2013. About 150 patients of a village, near Ranchi, Jharkhand state, were checked up and demonstrated the oral hygiene maintenance methods. The program was held by ICD Fellow Dr. Anshu Sahu under the guidance of ICD Section VI, Dy Zonal Regent Prof. Dr. Rajeev Lall. The villagers were screened for their overall dental and general health and diabetic problems. Free medicines, toothpastes, mouthwashes and toothbrushes, were distributed.
The project was well attended and supported by Fellows Dr. Amit Ram, Dr. Prabhat Chandra. The event was well covered in the local dailies.



REFERENCES:

1. Tasdemir T, Aydemir H, Inan U and Ünal O. Canal preparation with Hero 642 rotary Ni-Ti instruments compared with stainless steel hand K-file assessed using computed tomography, Int. Endodontic Journal 2005; 38; 402-08.
2. Versumer J, Hülsmann M and Schafers F.A comparative study of root canal preparation using Profile. 04 and Lightspeed rotary Ni-Ti instruments. Int. Endodontic Journal 2002;35, 37-46
3. Walia H, Brantley W A, Gerstein. An initial investigation of the bending and torsional properties of nitinol root canal files. JOE. 1988; 14, 346-51.
4. Peters O A, Schönenberger K et al. Effects of four Ni-Ti preparation techniques on root canal geometry assured by micro computed tomography. Int. Endodontic Journal 2001; 34, 221-30
5. Calberson FLG et al. shaping ability of ProTaper Nickel- Titanium files in simulated resin root canal. Int. Endodontic Journal 2004; 37, 613-23.
6. Veltri Mario, Mollo Aniello et al. In Vitro comparison of shaping abilities of ProTaper and GT Rotary files.
7. Peters O A, Peters C I et al. Protaper rotary root canal preparation: effects of canal anatomy on final shape analysed by micro CT. Int. Endodontic Journal 2003; 36, 86-92.
8. Ingle, Bakland. Endodontics, Fifth Edition; Elsvier:405-570.
9. Yang G.B, Zhou XD et al. Shaping ability of Progressive versus Constant Taper Instruments in curved root canals of Extracted Teeth. Int. Endodontic Journal 2007;40;707-14.
10. Bergmens L *et al.* Progressive versus Constant Tapered shaft design using Ni-Ti. Rotary instruments. Int. Endodontic Journal 2003;35;820-8.