Research Article

JRAD Journal of Research and Advancement in Dentistry

J Res Adv Dent 2020;10:3:6-10.

Comparative Evaluation of Removal of Root Dentin and Apical Transportation with Wave One Single File System & Protaper Continuous File System

Buggaveeti Pradeep Kumar[1*] Butta Viswanath[2] T Sai Krishna[3] Kambhampati Bhargav[4] D.S.S. Vinay Kumar[5] Ravi Kumar Kongala[6]

[1]Reader, Department of Conservative Dentistry & Endodontics, Mamata Dental College, Khammam, Telangana, India.
[2]Professor, Department of Conservative Dentistry & Endodontics, Mamata Dental College, Khammam, Telangana, India.
[3]Reader, Department of Conservative Dentistry & Endodontics, Mamata Dental College, Khammam, Telangana, India.
[4]Senior Lecturer, Department of Conservative Dentistry & Endodontics, Mamata Dental College, Khammam, Telangana, India.
[5]Senior Lecturer, Department of Conservative Dentistry & Endodontics, Anil Neerukonda Institute of Dental Sciences, Visakhapatnam, Andhra Pradesh, India.
[6]Reader, Department of Conservative Dentistry & Endodontics, Gitam Dental College & Hospital, Visakhapatnam Andhra Pradesh, India.

ABSTRACT

Background: Objective in root canal preparation is to develop a shape that tapers from apical to coronal, maintaining the original canal shape. With advent of instruments manufactured from nickel-titanium (NiTi) alloys, there was a significant improvement of quality of root canal shaping, with predictable results and less iatrogenic damage. Hence; the present study was undertaken for comparing the removal of root canal dentin and apical transportation with two different rotary systems.

Material and methods: 60 freshly extracted single rooted premolars teeth were collected and stored in normal saline. The length of all sample teeth were standardised to 19 mm by carrying out coronation of each sample if required. A CBCT of each sample tooth was taken as a pretreatment record. The sample teeth were then categorised into two groups based on the file system used for their instrumentation. A post canal preparation CBCT was carried out to compare differences with the pretreatment status. Three different levels were selected to compare the canal transportation, and Remaining Dentine Thickness (RDT) at 4mm, 8mm and 12mm from the root apex. Canal transportation at these landmarks was evaluated. The value of remaining dentine thickness was obtained by calculating the difference between the un-instrumented and instrumented dentine.

Results: The mean and standard deviation at the first reference point for group 1 file system was .03 and .06 respectively. The mean and standard deviation at the first reference point for group 2 file system was .08 and .10 respectively. The mean and standard deviation at the second reference point for group 1 file system was .06 and .05 respectively. The mean and standard deviation at the second reference point for group 2 file system was .14 and .11 respectively. The mean and standard deviation at the third reference point for group 1 file system was .04 and .10 respectively. The mean and standard deviation at the third reference point for group 2 file system was .07 and .13 respectively. A statistically significant difference was observed in the canal transportation values in group 1 at point 4mm and 8mm from the apex. At point 12mm from the apex, group 1 showed non-significant variation. Group 2 on the other hand did not show statistically different figures at all the three reference points. The remaining dentin thickness value at all the three reference point was non-significant statistically.

Received: Apr. 4, 2020**: Accepted**: May. 22, 2020
*__Correspondence Dr. Buggaveeti Pradeep Kumar.__
Department of Conservative Dentistry & Endodontics, Mamata Dental College, Khammam, Telangana, India.
Email: Not Disclosed

pISSN 2278-0076
eISSN 2321-9270

Conclusion: Wave One single reciprocation file system was better than ProTaper file system as far as maintaining the original canal anatomy was concerned.

Keywords: Wave One, ProTaper, Remaining dentin thickness.

INTRODUCTION

Since the beginning of modern-day Endodontics, there have been numerous concepts, strategies, and techniques for preparing root canals and one of the objectives in root canal preparation is to develop a shape that tapers from apical to coronal, maintaining the original canal shape.[1, 2]

The introduction of NiTi rotary instrumentation has revolutionized the endodontics in the past few decades with predictable success. The rotary files have been subjected to constant evaluation in the form of metallurgy, design features, the number of instruments, and the manner in which these instruments are driven (rotary/reciprocation). Various rotary NiTi endodontic file systems have been introduced to improve shaping ability.[3]

Transportation of the root canal is a frequent mishap during the instrumentation of curved root canals.[4] Apical transportation changes the physical shape and physiologic environment of the root canal terminus.[5] The aim of the present experimental study was to compare the canal transportation, and remaining dentin thickness of Wave One and ProTaper systems using cone beam computed tomography.

MATERIAL AND METHODS

60 freshly extracted single rooted teeth were collected and stored in normal saline. The length of all sample teeth were standardised to 19 mm by carrying out coronation of each sample if required. After this access cavity was prepared in each tooth using Endo access bur. RVG was used for radiographic interpretation. A bucco-lingual radiograph of each tooth was obtained. Based on radiographic interpretation, only those teeth were selected for this study which had an angle of curvature between 8-25 degrees. Once shortlisted the samples were embedded in acrylic resin blocks. A CBCT of each sample tooth was taken as a pretreatment record. The sample teeth were then categorised into two groups based on the file system used for their instrumentation:

a) Group 1: sample teeth in which canal preparation was done using Wave One files

b) Group 2: sample teeth in which canal preparation was done using ProTaper rotary files

A preparation CBCT was carried out to compare differences with the pretreatment status. Three different levels were selected to compare the canal transportation, and Remaining Dentine Thickness (RDT):

- First reference point : At a point 4mm from the root apex.
- Second reference point : At a point 8mm from the root apex.
- Third reference point : At a point 12mm from the root apex.

Canal transportation at these landmarks were evaluated by using the formula given by Gambill *et al* : $([x_1 - x_2] - [y_1 - y_2])$.[6]

Where,

- x_1 is the least distance from the mesial edge of the root to the mesial edge of the uninstrumented canal.
- x_2 is the least distance from the mesial edge of the root to the mesial edge of the instrumented canal.
- y_1 is the least distance from distal edge of the root to the distal edge of the uninstrumented canal,
- y_2 is the least distance from distal edge of the root to the distal edge of the instrumented canal.

The value of remaining dentine thickness was obtained by calculating the difference between the uninstrumented and instrumented dentine.SPSS software was used for statistical analysis of the collected data. Student t test was used for comparative evaluation. P value less than .05 was considered significant.

RESULTS

The data was collected and statistically analysed. The canal transportation was evaluated at three different levels and their means and standard deviation were compared. The mean and standard deviation at the first reference point for group 1 file system was .03 and .06 respectively. The mean and standard deviation at the first reference point for group 2 file system was 0.08 and 0.10 respectively(Table 1).

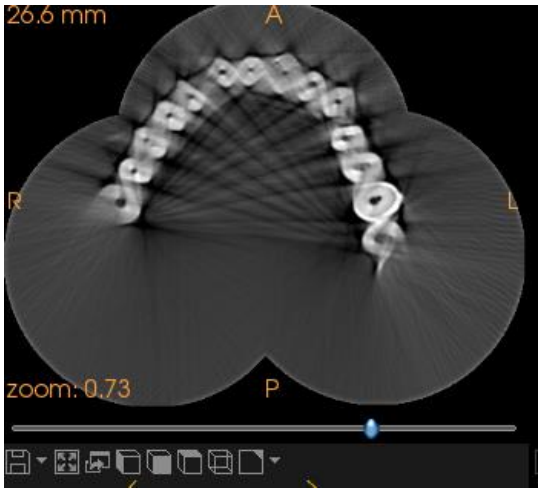

Fig 1: Image of CBCT showing dentinal thickness of group I.

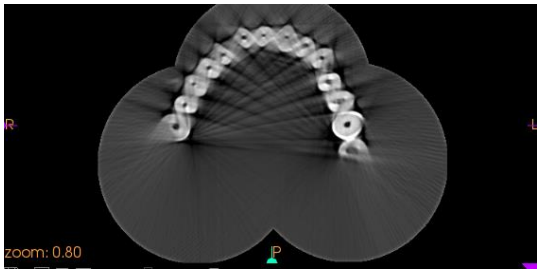

Fig 2: Image of CBCT showing dentinal thickness of group II.

Table 1: Canal transportation at 4mm the apex.

File System	Mean	Standard deviation	P value
Wave One	0.03	0.06	0.002
ProTaper	0.08	0.10	0.084

The mean and standard deviation at the second reference point for group 1 file system was 0.06 and 0.05 respectively. The mean and standard deviation at the second reference point for group 2 file system was 0.14 and 0.11 respectively(Table 2).

Table 2: Canal transportation at 8mm the apex

File System	Mean	Standard deviation	P value
Wave One	0.06	0.05	0.0034
ProTaper	0.14	0.11	0.24

The mean and standard deviation at the third reference point for group 1 file system was .04 and .10 respectively. The mean and standard deviation at the third reference point for group 2 file system was .07 and .13 respectively(Table 3).

Table 3: Canal transportation at 12mm the apex

File System	Mean	Standard deviation	P value
Wave One	.04	.10	.062
ProTaper	.07	.13	.075

A statistically significant difference was observed in the canal transportation values in group 1 at point 4mm and 8mm from the apex. At point 12mm from the apex, group 1 showed non-significant variation. Group 2 on the other hand did not show statistically different figures at all the three reference points. The remaining dentin thickness value at all the three reference point was non-significant statistically.

DISCUSSION

Successful endodontic treatment includes proper root canal shaping and effective debridement of the root canal system. The purpose of mechanical instrumentation is to remove the infected soft and hard tissues from the root canal and to create a sufficient taper for the subsequent placement of root filling materials. The biomechanical preparation of the root canal system is particularly important. This involves cleaning, modelling and disinfection, as well as the introduction of Nickel-Titanium (NiTi) wires, associated with a new design of endodontic files, and the consequent "replacement" of manual preparation by automatic modelling techniques.[6, 7]

Systems that use a reduced number of instruments for mechanical preparation of root canals are a contemporary trend, making the treatment faster and consequently diminishing both operator and patient fatigue.[6-8] According to this concept, it would be expected that these systems would also be used for filling material removal, thereby obtaining success as relevant as that achieved when this procedure is performed by traditional methods.[8] Cone beam computed tomography (CBCT) can be used to assess the amount of dentin removed from the root canal walls during root canal preparation. This imaging modality enables assessment of volume, surface area, cross-sectional shape, and taper of canal with no damage to tooth structure.[9] Hence; the present study was undertaken for comparing the removal of root canal dentin and apical transportation with two different rotary systems.

In this study the canal transportation was evaluated at three different levels and their means and standard deviation were compared. The mean and standard deviation at the first reference point for group 1 file system was .03 and .06 respectively. The mean and standard deviation at the first reference point for group 2 file system was .08 and .10 respectively. Here wave one file system prepare the canals in reciprocating movement. In this type movements file rotates in back and forth movements instead of complete rotation with this type of movement less transportation and maintains original anatomy of the canal. In a previous study conducted by De Albuquerque MS et al, authors compared root canal transportation, centering ability, and amount of dentin removed after root instrumentation with different rotary and reciprocating systems, using micro-computed tomography (micro-CT). For canal transportation, no significant differences were verified between the groups at 6 mm or 9 mm from the apex. At the apical third, LOG (prodesign logic)had a smaller mesial deviation when compared with PTN (protaper next). A significant difference was found at the apical and coronal thirds, though with LOG having the best centering ability at the apical third and the worst one at the coronal third. All systems caused a greater wear at the coronal third (9 mm), decreasing at the apical one (3 mm), with statistically significant differences. LOG removed less dentin from the apical third (3 mm) than did the other instruments. The systems evaluated presented different results for canal transportation, centering ability, and dentin removal at each third.[10]

In the present study, a statistically significant difference was observed in the canal transportation values in group 1 at point 4mm and 8mm from the apex. At point 12mm from the apex, group 1 showed non-significant variation. Group 2 on the other hand did not show statistically different figures at all the three reference points. The remaining dentin thickness value at all the three reference point was non-significant statistically. In a previous study conducted by JM Gambill et al, authors compared Nickel-Titanium and Stainless Steel Hand-File Instrumentation Using Computed Tomography. Thirty-six single-rooted teeth of similar shape and canal size were divided into three groups. The teeth were scanned by computed tomography before instrumentation. In group A, canals were instrumented using a quarter turn/pull technique with K-flex files. In group B, canals were prepared with Ni-Ti hand files (Mity files) using the same technique as group A. Group C was prepared with Ni-Ti hand files (Mity files) using a reaming technique. Instrumented teeth were again scanned using computed tomography, and reformated images of the uninstrumented canals were compared with images of the instrumented canals. Ni-Ti instruments (Mity file) used in a reaming technique caused significantly less canal transportation ($p < 0.05$), removed significantly less volume of dentin ($p < 0.05$), required less instrumentation time ($p < 0.05$), and produced more centered and rounder canal preparations than K-flex stainless steel files used in a quarter turn/pull technique. The computed tomography imaging system used in this study provided a repeatable, noninvasive method of evaluating certain aspects of endodontic instrumentation.[6]

CONCLUSION

The present study concluded that the Wave One single reciprocation file system was better than ProTaper file system as far as maintaining the original canal anatomy was concerned. Further studies on the current subject would help to validate this claim.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

REFERENCES

1. Pansheriya E, Goel M, Gupta KD, Ahuja R, Kaur RD, Garg V. Comparative Evaluation of Apical Transportation and Canal Centric Ability in Apical Region of Newer nickel-titanium File Systems Using cone-beam computed tomography on Extracted Molars: An In Vitro Study. Contemp Clin Dent. 2018;9(Suppl 2):S215-S220.

2. Gergi R, Rjeily JA, Sader J, Naaman A. Comparison of canal transportation and centering ability of twisted files, Pathfile-ProTaper system, and stainless steel hand K-files by using computed tomography. Journal of Endodontics. 2010 May 1;36(5):904-7.

3. Singh S, Abdul MSM, Sharma U, Sainudeen S, Jain C, Kalliath JT. An in vitro Comparative Evaluation of Volume of Removed Dentin, Canal Transportation, and Centering Ratio of 2Shape, WaveOne Gold, and ProTaper Gold Files Using Cone-Beam Computed Tomography. J Int Soc Prev Community Dent. 2019;9(5):481-485.

4. Jain A, Asrani H, Singhal AC, Bhatia TK, Sharma V, Jaiswal P. Comparative evaluation of canal transportation, centering ability, and remaining dentin thickness between WaveOne and ProTaper rotary by using cone beam computed tomography: An in vitro study. J Conserv Dent. 2016;19(5):440-444.

5. Shivashankar MB, Niranjan NT, Jayasheel A, Kenchanagoudra MG. Computed Tomography Evaluation of Canal Transportation and Volumetric Changes in Root Canal Dentin of Curved Canals Using Mtwo, ProTaper and ProTaper Next Rotary System-An In-vitro Study. J Clin Diagn Res. 2016;10(11):ZC10-ZC14.

6. Gambill JM, Alder M, del Rio CE. Comparison of nickel-titanium and stainless steel hand-file instrumentation using computed tomography. J Endod. 1996;22:369–75

7. Lopes DS, Pessoa MA, Aguiar CM. Assessment of the Centralization of Root Canal Preparation with Rotary Systems. Acta Stomatol Croat. 2016;50(3):242-250.

8. Arruda EDS, Sponchiado-Júnior EC, Pandolfo MT, Fredson MAC, Roberi Garcia LDF, Marques AAF. Apical Transportation and Centering Ability After Root Canal Filling Removal Using Reciprocating and Continuous Rotary Systems: A CBCT Study. Eur J Dent. 2019;13(4):613-618.

9. Saberi E, Farhad-Mollashahi N, Bijari S, Daryaeian M. Comparative evaluation of root canal transportation by three NiTi single-file systems in curved canals: a cone beam computed tomography study. International journal of dentistry. 2018;2018..

10. de Albuquerque MS, Nascimento AS, Gialain IO, de Lima EA, Nery JA, de Souza Araujo PR, de Menezes RF, Kato AS, Braz R. Canal Transportation, Centering Ability, and Dentin Removal after Instrumentation: A Micro-CT Evaluation. J Contemp Dent Pract. 2019 Jul 1;20(7):806-811.