

Evaluation of Residual and Removed Dentin Thickness in Mandibular Premolar Prepared with Hand and Rotary Instruments Using Morphometric Analysis Software

Prachi Pathak^{1*} Tanu Nangia² Aditya Saxena³ Swati Choudhary⁴ Atul Singh⁵ Madhulika Srivastava⁶

¹Senior Lecturer, Department of Pedodontics and Preventive Dentistry, I.T.S Dental College, Greater Noida, UP, India.

²Reader, Department of Pedodontics and Preventive Dentistry, I.T.S Dental College, Greater Noida, UP, India.

³Senior Lecturer, Department of Pedodontics and Preventive Dentistry, I.T.S Dental College, Greater Noida, UP, India.

⁴Senior Lecturer, Department of Oral Pathology, Shree Bankey Bihari Dental College, Ghaziabad, India.

⁵Senior Lecturer, Department of Pedodontics and Preventive Dentistry, Babu Banarasi Das College of Dental Sciences, Lucknow, India.

⁶Senior Lecturer, Department of Pedodontics and Preventive Dentistry, Babu Banarasi Das College of Dental Sciences, Lucknow, India.

ABSTRACT

Background: Evaluate the amount of residual and removed dentin after the root canal preparation using hand and rotary instruments in extracted teeth.

Materials and Method: Thirty extracted mandibular premolar teeth were taken and were divided in three groups as Gp 1 Hand Protaper files, Gp 2 Rotary Protaper Files and Gp 3 Hyflex files (n=10). Access opening of all the teeth were done and were analysed under morphometric analysis software at three levels as 3mm, 7mm and 14mm for dentin thickness. Canals were prepared with hand protaper, rotary and Hyflex Files, teeth were sectioned at three different levels using diamond Disc at 3, 7 and 14 mm and residual and removed dentin thickness was analysed under morphometric software.

Results: One way Anova showed that Hyflex Files Remove lesser amount of dentin as compared to Rotary and Hand Protaper Files In all Sections ($p < 0.001$). On applying Post HOC test for multiple comparison, it was found that there was no statistical difference seen at 7mm between Hand protaper file and Rotary protaper Files.

Conclusion: This study concluded that the Hyflex files remove lesser amount of dentin thickness at all three levels as compared to the hand protaper files and rotary files.

Keywords: Morphometric, Hyflex Files, Remaining dentin thickness.

INTRODUCTION

Success of endodontic treatment depends on the complete removal of microorganisms and necrotic tissue through Biomechanical preparation of root canal system that includes debridement of infected dentin and organic tissue¹. The aim of instrumentation is to prepare a continuous tapered root canal area with increasing apico-coronal diameter that facilitates the irrigation and handling of the instruments². Root canal preparation should

also provide a three dimensional area for proper condensation of root filling materials to establish an acceptable apical seal³.

Over the years hand as well as rotary instruments have been presented to overcome these problems, but only a few seem to be capable of obtaining the primary objectives of root canal preparation⁴. Recently demonstrated that instrumentation with automated devices using rotary nickel-titanium (Ni-Ti), Hyflex files

Received: June. 17, 2017; Accepted: Aug. 20, 2017

*Correspondence Dr. Prachi Pathak.

Department of Pedodontics and Preventive Dentistry, I.T.S Dental College, Greater Noida, UP, India.

Email: Not Disclosed

instruments with various tapers led to promising results; i.e. less straightening or decentralization of the canal, and a rounder canal preparation even in severely curved root canals⁵.

The thickness of the remaining dentine following intraradicular procedures may be the most important iatrogenic factor that correlates to incoming fracture resistance of the root⁶. Excessive flare of coronal third is not necessary⁷, since flaring could considerably reduce the residual dentin leading to greater susceptibility to vertical root fractures⁸. Moreover, preparation of the apical third can also reduce residual dentin resulting in weakened apical root structure⁹. This is particularly important in a root with an oval cross section (e.g. mesial roots of mandibular molars).¹⁰ Various authors stated that report dentin removal may not necessarily increase the risk of fracture¹¹ and suggest that there was no significant difference in fracture load between teeth prepared by SS hand instruments or those prepared by Ni-Ti rotary instruments or by hyflex rotary files¹².

Hence the present study was undertaken to compare the removed and residual dentin thickness in extracted teeth after biomechanical preparation with three different files at three different levels using Morphometric Analysis software.

MATERIALS AND METHOD

The study design and protocol was approved by ethical committee of the of the institutional review board. Thirty healthy human mandibular premolars with mature apices and intact roots were included in this study. They were divided into three groups as **Group I** (Densply Protaper), **Group II** (Densply Rotary Protaper Files) and **Group III** (Coltene Hyflex Files) with ten teeth in each Group.

Table 1: Mean of removed dentin thickness after instrumentation

Distance from apex	Hyflex Files Mean $\pm$ SD	Rotary Files Mean $\pm$ SD	Hand Protaper Files Mean $\pm$ SD	“F” Value	“P” Value	Post Hoc		
						1vs2	1vs3	2vs3
3mm	2.17 $\pm$.014	2.20 $\pm$.0063	2.23 $\pm$.0069	106.6	.001	.001	.001	.001
7mm	1.05 $\pm$	1.09 $\pm$	1.12 $\pm$	174.1	.001	.001	.001	.001

Access opening was performed for all the sample included, radicular portion of tooth was marked at three different intervals using morphometric software. Starting at 3mm, 7mm and 14mm from the apical foramina towards the coronal portion. Dentine radius and diameter were analysed each at three different levels (3mm, 7mm & 14mm) under morphometric analyses software, 2013 version

Biomechanical preparation was done using three different system i.e hand Protaper, rotary and hyflex files. In Group 2 and Group 3 biomechanical preparation was performed using Endo IT Motar with programmed torque control and speed settings in crown-down manner and initial dentin thickness was measured under the software. Biomechanically prepared teeth were horizontally sectioned at three different levels (3mm, 7mm & 14mm) with Diamond Disc and all the values were analysed under morphometric analyses software for residual and removed dentin thickness after instrumentation.

RESULTS

Data were compiled and analysed by using the statistical program SPSS 16.0 ANOVA with post hoc test was for multiple comparison. The amount of dentin removed at 3mm, 7mm and 14mm are presented in Table 1. These values show that the Hyflex Files Remove lesser amount of dentin as compared to Rotary and Hand Protaper Files In all Sections. Statistical analysis Found significant differences between all the three Files at 3mm, 7mm and 14mm ($p < 0.001$) respectively. However, on applying Post HOC test for multiple comparison, it was found that there was no statistical difference seen at 7mm between Hand protaper file and Rotary protaper Files Table 2.

	.008	.007	.028					
14mm	2.30± .018	2.31± .04	2.34± .054	34.8	.001	.001	.001	.001

Table 2: Comparison Of remained Dentin thickness at Different Level (Area Of Circle) after Instrumentation

Dentin Removed	Hyflex Files Mean ± SD	Rotary Files Mean ± SD	Hand Protaper Files Mean ±SD	“F” Value	“p” Value	Post Hoc		
						1vs2	1vs3	2vs3
3mm	1.12± .021	1.27± .075	1.33± .095	188.9	.001	.001	.001	.001
7mm	1.01± .021	1.00± .0133	1.02± .019	609.2	.001	.001	.001	.52
14mm	.738± .0435	.977± .0133	.859± .007	199.2	.001	.001	.001	.001

DISCUSSION

Morphometric refer to the quantative analysis of form, concept that encompasses size and shapes. They are commonly performed on organism and are useful in analyzing their fossil record, the impact of mutations of shape, developmental changes in form, as well for estimating quantitative-genetic parameters of shape¹³. There are three approaches of morphometric Analysis as Traditional Morphometric, Landmark based Morphometric and Outline Based Morphometric. Traditional Morphometric analyses length, width, masses, angles, ratio and areas, but in general it measure the size. Land mark based morphometric is use to analyse the landmark of homologous area eg; insects, fossil, leaf etc. Outline morphometric analysis is used for the analysis of the outline of the particular organism¹⁴.

In this study traditional morphometric or Geometric Morphometric analysis was performed. It represent each specimen by relative position of morphological landmarks that can be located precisely and establish one to one correspondence among all specimen included in analysis. Shape information extracted by the procedure called as Procrustes Superimposition, which remove variation in size, shape, position and orientation

from the data on landmark and core of geometric morphometric¹⁵.

Earlier it was used to analyses the development and evolutionary stage of fossil but nowadays it is widely been used in dentistry to analyse shape and size, especially in orthodontic dentistry. In this study it was used to measure area which includes diameter, radius and height of cone and circle.¹⁶ Bio-mechanical preparation of the root canals is one of the most important stages of a root canal treatment. Original canal curvature, especially at the apex and inner side of the root curvature should be preserved during canal shaping¹⁷. In this regard, any straightening which might interfere with canal integrity has to be prevented.¹⁸

This study revealed that in all dimensions hand Protaper Files removed more dentin than Dentsply rotary and Hyflex Files. This finding is consistent with other studies that found that the rotary files able to prepare curved root canals with greater conservation of tooth structure¹⁹.

In this study, dentin thickness was measured before and after instrumentation. These values suggested that the mechanical limits of the instruments used to enlarge the root canal to approximate predetermined values would significantly weaken the dentinal walls. It has been

indicated that 0.3 mm of canal wall should exist after canal preparation as the minimum remaining dentin thickness (RDT). This is important for providing enough resistance against lateral forces during canal filling and occlusal forces. On the other hand, Sathorn et al. suggested that removal of dentin may not necessarily lead to an increased risk of tooth fracture, and that a multitude of variables exist²⁰.

In this study torque limited electric motor [Endo ZT motor] was used for the instrumentation. This electric motor also controlled the speed and torque of the instruments. Endo IT electric motor can be programmed for different types of rotary instruments and is able to rotate the file in reverse direction when the file is locked in canal in order to prevent file separation²⁰.

The removed dentin thickness in the 7mm horizontal section by the Hand protaper and NiTi rotary files was Higher as compared to the Hyflex Files. This might be due to the shape memory of Hand protaper files. When protaper instruments are placed in curved root canals they will tend to reverse back to their straight shape leading to excessive removal of dentin in the outer surface of curvature at a apical zone. Excessive removal of dentin in the 7mm section may lead to strip perforation²¹.

The Hand Protaper files caused more enlargement towards the inner part (Danger Zone), but at the apical level, these files caused more enlargements toward the outer part compared to the Hyflex files. This demonstrates that the Hyflex Files decrease the risk of strip perforations in Danger zone and straightening in curved root canals²².

Hyflex Files have a single triangular cross sectioned shape with alternating cutting edges. Schafer and Lissa showed that the Hyflex files created no canal aberration and maintained working length well in curved canals. Other authors showed more canal transportation with Hyflex files, compared with Hand protaper files and Rotary files²⁴. Yun and Kim et al stated that the use of Hyflex files resulted in lowest canal transportation as compared to hand and rotary protaper files. The amount of dentin removal by Hyflex Files instruments at coronal and middle sections was

significantly less than other two files instrumentation²³.

The amount of dentin removal by hyflex files at 7mm and 14mm was significantly less than other groups. These differences again maybe due to different instrumentation technique between hyflex files and the other two system as hand protaper and rotary files instrumentation which is confirmed by Yun et al. The study showed that the more the surface area of cone and area circle there will be lesser amount of dentin removed²⁶.

CONCLUSION

The Hyflex Files remove lesser amount of dentin thickness as compared to Hand Protaper and Rotary Instrumentation.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. European Society of Endodontology. Quality guidelines for endodontic treatment: consensus report of the European Society of Endodontology. *Int Endod J* 2006;39:921-30.
2. Hülsmann M, Rummelin C, Schäfers F. Root canal cleanliness after preparation with different endodontic handpieces and hand instruments: a comparative SEM investigation. *J Endod* 1997;23:301-6.
3. Chen JL, Messer HH. A comparison of stainless steel hand and rotary nickel-titanium instrumentation using a silicone impression technique. *Aust Dent J* 2002;47:12-20.
4. Thompson SA, Dummer PM. Shaping ability of ProFile.04 Taper Series 29 rotary nickel-titanium instruments in simulated root canals. Part 2. *Int Endod J* 1997;30:8-15.
5. Pilo R, Corcino G, Tamse A. Residual dentin thickness in mandibular premolars prepared with hand and rotatory instruments. *J Endod* 1998;24:401-4.
6. Sathorn C, Palamara JE, Messer HH. A comparison of the effects of two canal

- preparation techniques on root fracture susceptibility and fracture pattern. *J Endod* 2005;31:283-7.
7. Lim SS, Stock CJ. The risk of perforation in the curved canal: anticurvature filing compared with the stepback technique. *Int Endod J* 1987;20:33-9.
8. Katz A, Tamse A. A combined radiographic and computerized scanning method to evaluate remaining dentine thickness in mandibular incisors after various intracanal procedures. *Int Endod J* 2003;36:682-6.
9. Schneider SW. A comparison of canal preparations in straight and curved root canals. *Oral Surg Oral Med Oral Pathol* 1971;32:271-5.
10. Zuckerman O, Katz A, Pilo R, Tamse A, Fuss Z. Residual dentin thickness in mesial roots of mandibular molars prepared with Lightspeed rotary instruments and Gates-Glidden reamers. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2003;96:351-5.
11. Pilo R, Tamse A. Residual dentin thickness in mandibular premolars prepared with Gates-Glidden and ParaPost drills. *J Prosthet Dent* 2000;83:617-23.
12. Abou-Rass M, Frank AL, Glick DH. The anticurvature filing method to prepare the curved root canal. *J Am Dent Assoc* 1980;101:792-4.
13. Gluskin AH, Brown DC, Buchanan LS. A reconstructed computerized tomographic comparison of Ni-Ti rotary GT files versus traditional instruments in canals shaped by novice operators. *Int Endod J* 2001;34:476-84.
14. Cleaning effectiveness and shaping ability in severely curved root canals of extracted teeth. *Int Endod J* 2006;39:203-12.
15. Schäfer E, Schlingemann R. Efficiency of rotary nickel-titanium K3 instruments compared with stainless steel hand K-Flexofile. Part 2. Cleaning effectiveness and shaping ability in severely curved root canals of extracted teeth. *Int Endod J* 2003;36:208-17.
16. Yang GB, Zhou XD, Zheng YL, Zhang H, Shu Y, Wu HK. Shaping ability of progressive versus constant taper instruments in curved root canals of extracted teeth. *Int Endod J* 2007;40(4):707-14.
17. Garip Y, Günday M. The use of computed tomography when comparing nickel-titanium and stainless steel files during preparation of simulated curved canals. *Int Endod J* 2001;34(3):452-7.
18. Jungmann CL, Uchin RA, Bucher JF. Effect of instrumentation on the shape of the root canal. *J Endod* 1975;1(4):66-9.
19. Tan BT, Messer HH. The quality of apical canal preparation using hand and rotary instruments with specific criteria for enlargement based on initial apical file size. *J Endod*. 2002;28:658-64.
20. Liu SB, Fan B, Cheung GS, Peng B, Fan MW, Gutmann JL, Song YL, Fu Q, Bian Z. Cleaning effectiveness and shaping ability of rotary ProTaper compared with rotary GT and manual K-Flexofile. *Am J Dent* 2006;19(8):353-8.
21. Al-Sudani D, Al-Shahrani S. A comparison of the canal centering ability of ProFile, K3, and RaCe Nickel Titanium rotary systems. *J Endod* 2006;32:1198-201.
22. Schäfer E, Erler M, Dammaschke T. Comparative study on the shaping ability and cleaning efficiency of rotary Mtwo instruments. Part 1. Shaping ability in simulated curved canals. *Int Endod J* 2006;39:196-202.
23. Schirrmeister JF, Strohl C, Altenburger MJ, Wrbas KT, Hellwig E. Shaping ability and safety of five different rotary nickel-titanium instruments compared with stainless steel hand instrumentation in simulated curved root canals. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2006;101:807-13.