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Evaluation Of Apical Transportation Using 3 Different Rotary Systems: Hyflex Files, Twisted Files, Protaper Next By Morphometric Analysis.

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Abstract: *Aim: This in vitro study was performed to evaluate the apical transportation between Hyflex files, Twisted files and Protaper next single file rotary system by motic imaging. Materials & Methods: Sixty Endo Training Blocks were used in the study. Pre instrumentation photos of the simulated apical foramen are recorded using an optical microscope and then coupled into the motic imaging software and the position of the apical foramen was located. It was divided into three groups of twenty samples each and instrumented with Hyflex, Twisted and Protaper next rotary files. Irrigation was done with saline. Post instrumentation photos of the simulated apical foramen were recorded using the optical microscope and then coupled into the motic imaging software to locate the position of the apical foramen post instrumentation. Result: The minimum transportation was shown by the Hyflex rotary files (mean =31.18µm) followed by the Twisted rotary files (mean =41.67µm) and maximum transportation was seen in the Protaper next group (mean = 47.08µm).The intergroup difference was statistically significant($p<0.05$).Conclusion: Hyflex files preserved the shape of the canal and the position of the apical foramen. It was followed by Twisted files. Maximum apical transportation was brought about by Protaper next files.*
Keywords*:apical foramen, apical transportation,motic, rotary files.)*

I. Introduction

Cleaning and shaping of root canal system is an important phase of pulp spacetherapy. The clinical goal of pulp space therapy is to satisfy the biological and mechanical objectives. Biological objectives include total debridement anddisinfection of the root canal system and mechanical objectives include developing a continuous tapering form of the canal and maintaining the original shape and position of apical foramen.(Schilder,1974).These objectives are difficult to achieve in curved canals. During preparation of narrow and curved canals various procedural accidents may be encountered such as transportation, ledging, blockages, rootperforations, strip perforations, elbowing apical zipping, extrusion of debris and instrument fracture. These procedural errors were termed as mishaps by Torabinejad (1990)[1.]Endodontic mishaps are unfortunate occurrences that can occur during treatment. Failure to grasp the rationale behind cleaning and shaping concepts can increase the incidence of procedural complications.[2]

According to the Glossary of Endodontic Terms of the American Association of Endodontists, canal transportation is defined as follows; removal of canal wall structure on the outside curve in the apical half of the canal due to the tendency of files to restore themselves to their original linear shape during canal preparation.[3]Various undesirable effects of apical transportation are damage to the apical foramen, elbow formation, zip formation and perforation which can result in a poorly cleaned root canal, which contributes to leakage, infection and failure.[3]

Apical transportation can be categorized[4] into:
Type I: represents a minor movement of the position of the physiologic foramen,
resulting in its iatrogenic relocation.
Type II: represents a moderate movement of the physiologic position of the foramen, resulting in a considerable iatrogenic relocation on the external root surface. In this type, a larger communication with the periapical space exists, and attempt to create a more coronal shape may weaken or perforate the root.
Type III: represents a severe movement of the physiologic position of the canal,
resulting in a significant iatrogenic relocation of the physiologic foramen.

Apical transportation impairs the proper cleaning of the entire extension of root canal space resulting in failure and therefore can compromise the outcome of pulp space therapy. The development of nickel-titanium (NiTi) rotary instruments with improved flexibility has resulted in safer mechanical preparation of curved root canals. The use of these flexible instruments reduces iatrogenic errors such as canal transportation[5]

The Twisted File (TF) has been developed by SybronEndo (Orange,CA), have a triangular cross section with constant tapers of 0.04,0 .06,0 .08, 0.10and 0.12. The manufacturer claims the 3 new design methods of these files, namely R-phase heat treatment, twisting of the metal and special surface conditioning, significantly increase the instrument resistance to cyclic fatigue and flexibility, maintaining the original canal centre and minimizing canal transportation even in severely curved root canals.[6]The ProTaper Next (DentsplyMaillefer, Ballaigues, Switzerland) is the successor of the ProTaper Universal system (DentsplyMaillefer). It has an innovativeoff-centred rectangular cross section that gives the file a snake-like swaggering movement as it advances into the root canal. The manufacturer claims that therotation of this cross section generates enlarged space for debris removal.These instruments are manufactured from M-wire alloy that is claimed to improve file flexibility and resistance to cyclic fatigue whilst retaining cutting efficiency. Hyflex CM (Coltene-Whaledent, Altstatten, Switzerland) is a new NiTi rotary system. These files are produced by an innovative methodology that uses a unique process to control the material memory[7].The purpose of this study was to evaluate the apical transportation between Hyflex files, Twisted files and Protaper next single file rotary system by motic imaging.

II. Materials And Methods

2.1 Preparation of Specimen

Sixty ISO 15,0.02 taper Endo Training Blocks (DentsplyMaillefer, Ballaigues,Switzerland) were used in the study. Pre instrumentation photos of the simulated apical foramen were recorded using an optical microscope at 4X magnification. It was then coupled into the motic imaging software. The position of the apical foramen was located in each Endo training blocks according to the measurement techniques in the software. The measurement was done in micrometers(µm).The Endo Training Blocks were randomly divided into three groups. The sample size of each group was twenty. The groups were Group Hyflex, Group Twisted and Group Protaper next.

2.2 Root canal instrumentation

The working length (WL) was established with a size 15 K-file (DentsplyMaillefer, Ballaigues, Switzerland), which was introduced into each endo training bloc until the file tip became visible at the simulated apical foramen.1mm was reduced from the point where the file tip became visible and the working length was established at 16 mm. Each endo training blockwas instrumented according to the the manufacturers' recommendations using an endodontic motor(X Smart, DentsplyMaillefer).The training block was prepared to the working length. For Group Hyflex instrumentation was done with file size 20 tip,0.04 taper, size 25 tip ,0.04 taper and size 20 tip ,0.06 taper.Group Twisted instrumentation was done with file size 0.08 taper and size 25 tip,0.06 taper. Group Protaper next instrumentation was done with ProTaper Next X1 (size 17, .04 taper) and size X2 (size 26, .06 taper). Irrigation was done with saline using a 27 gauge needle after the change of every file.Post instrumentation photos of the simulated apical foramen were recorded for the three groups of Twisted, Hyflex and Protaper next using the optical microscope at 4X magnification. It was then coupled into the motic imaging software and the position of the apical foramen post instrumentation was located in each Endo training blocks according to the measurement techniques in the software.

2.3Statistical Analysis

The difference in the apical foramen position between the pre and post instrumentation samples for the three groups was statistically analysed using the One-way ANOVA and PosthocTukey test.

III. Results

The minimum transportation was shown by the Hyflex rotary files with a mean of 31.18µm followed by the Twisted rotary files which showed a mean of 41.67µm. Maximum transportation was seen in the Protaper next group with a mean of 47.08µm(Table 1,Figure1).

Inter group comparison between the experimental groups using One-way ANOVA test showed statistical significance with p=**<0.001 (**highly significant)**.**In the PosthocTukey's Multiple Comparison Test comparison between Hyflex files and Twisted files there was a mean difference of -10.49 µm which was statistical significant **p< 0.05.** Comparison between Hyflex files and Protapernext files showed a mean difference of -15.9µm and

Tukey's Multiple Comparison Test showed a statistical significant difference between the goups (**P<0.05)** . Tukey's.Multiple Comparison Test between Twisted files and Protaper next files showed a mean difference of -5.41which showed a statistical significance of **P<0.05**.(Table 2)

Table 1 One way anova for comparison of the three groups

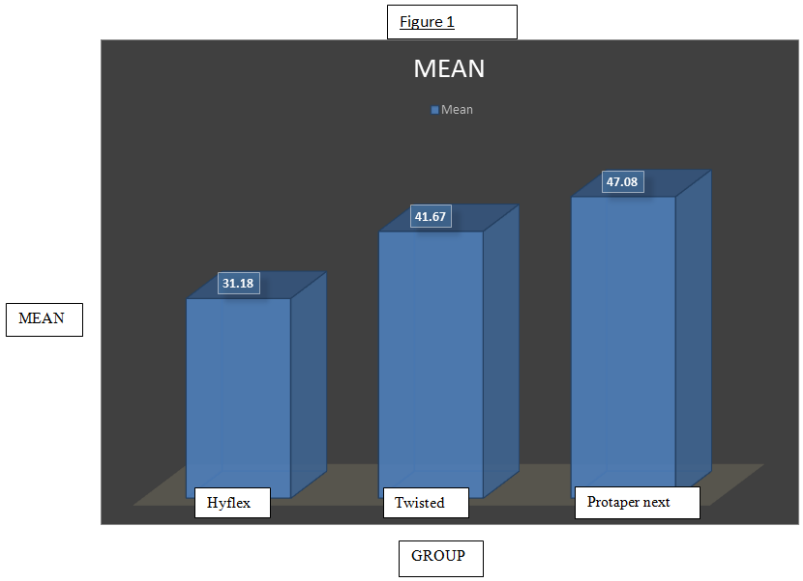
	Number of values	Mean	Std. Deviation	SS	df	MS	F	P VALUE
HYFLEX	20	31.18	6.068	2614	2	1307	38.39	**<0.001**
TWISTED	20	41.67	5.556					
PROTAPERNEXT	20	47.08	5.87					

Table 2
POSTHOC TUKEY TEST

Inter Group ComparisionOf The Test Results

Tukey's Multiple Comparison Test	Mean Diff.	q	Significant? P < 0.05?	Summary	95% CI of diff
HYFLEX vs TWISTED	-10.49	8.04	Yes	***	-14.93 to -6.047
HYFLEX vs PROTAPER NEXT	-15.9	12.19	Yes	***	-20.34 to -11.46
TWISTED vs PROTAPER NEXT	-5.41	4.146	Yes	*	-9.853 to -0.9666

Figure 1



IV. Discussion

Apical transportation is a procedural error observed in the mechanical preparation of root canals that present pronounced curvature. It occurs due to the tendency offiles to restore themselves to their original linear shape during canal preparation[5].

In the present study the minimum transportation was shown by the Hyflex rotary files with a mean of 31.18µm.The apical transportation in the Twisted files was found to be a mean of 41.67µm. These results are similar to a study done by Saber et al to compare the in vitro shaping ability of ProTaper Next, iRaCe and Hyflex CM rotary NiTifileswhich showed the use of iRace and Hyflex files resulted in significantly less canal straightening than Protaper Next[7].Our study supports this as Protaper next had more apical transportation than both Hyfex and Twisted files . Zhao et al compared the canal shaping properties of Hyflex CM, Twisted Files (TF), and K3 rotary nickel-titanium files , the Hyflex CM and the Twisted File system produced significantly less transportation than K3 files in the apical third of root canals[8].Another study conducted by Shiva Kumar et al to compare canal transportation and centering ability of Twisted and Hyflex Rotary Files with stainless steel hand K -flexofiles,showed that K- flexo files showed highest transportation and less centering ability when compared to the Twisted and Hyflex rotary files. No significant difference was found in apical transportation between Twisted Files and Hyflex CM instruments[9]. The results were consistent with studies done by El Batouty and Elmallah to compare the canal transportation and the changes in canal curvature after canal preparation with 2 Ni-Ti rotary instruments, Twisted files and K3 file

systems ,the twisted file system produced significantly less transportation and preserved the original canal to a greater degree than did the K3 system[10]. Similar results were obtained in a study done by Duran-Sindreu et al to evaluate apical transportation in root canals after use of twisted files &Flexmaster rotary files no statistically significant differences in apical transportation were found between the 2 groups[11].Studies conducted by AlannaJunaid&Laila Gonzales Freire to study apical transportation in curved root canals during intrumentation with a single WaveOne file with reciprocating motion & Twisted Files, no significant difference ($P > .05$) was found between the Wave One and Twisted File Groups[12.]Studies done by Gergi et al to compare canal transportation and centering ability of 2 rotary nickel-titanium (NiTi) systems Twisted FilesandPathfile-ProTaper with conventional stainless steel K files,less transportation and better centering ability occurred with Twisted File rotary instruments[13].The difference in results in the above mentioned studies could be attributed to the difference in methodology.The present finding that Hyflex CM files maintained the original canal curvature well is corroborated by recent studies conducted under similar experimental conditions. The Protaper next files produced maximum apical transportation.

Hyflex files are produced by an innovative methodology that uses a unique process to control the material memory .The CM-wire(Controlled memory)alloy is a nearly equiatomic alloy composed of 52%wt Ni, whereas the majority of commercially available NiTi rotary instruments are composed of 54.5–57%wt Nickel. The manufacturer claims that this alloy, together with the unique design features of the instruments, provides a superior flexibility allowing better maintenance of the original canal curvature and increased efficiency and safety.[7]

V. Conclusion

The present study was done to evaluate the the apical transportation between hyflex files, twisted files and protaper next single file rotary system by motic imaging. From this in vitro study conclusions drawn were Hyflex rotary files preserved the shape and position of the apical foramen. It can be used as first choice in the treatment of curved canals in the clinical setup. Twisted files also could be used in the treatment of curved canals but does not maintain the shape of the canal and position of the apical foramen like the Hyflex files. Protaper next single file system were least effective in maintaining canal centricity and apical foramen position when cleaning and shaping curved root canals.

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References

[1]. Mandel E,AdibYazdiM,Benhamou L M, Lachkar T, Mesgouez C, Sobel M. Rotary Nickel Titanium Profile Systems for Preparing Curved Canal in resin Blocks: influence of operator on instrument breakage. International Endodontic Journal 1999; 32:436-443.
[2]. Mantri S P, Kapur R, Gupta N A, Kapur C A. Type III apical transportation of root canal. ContempClin Dent 2012;3:134-6
[3]. American Association of Endodontists Glossary of Endodontic terms. 7th ed. Chicago : AAE;2003
[4]. Gluskin AH, Peters CI, Wong RD Ming, Ruddle CJ. Retreatment of non-healing endodontic therapy and management of mishaps. In: Ingle JI, Bakland LK, Baumgartner C, editors. Text book of Endodontics. 6th ed. Hamilton, Ontario, USA: BC Decker; 2008. pp. 1088–61.
[5]. Brito Junior, Manoel. Apical transportation associated with ProTaper Universal F1, F2 and F3 instruments in curved canals prepared by undergraduate students. J Appl Oral Sci 2014; 22(2):98-102.
[6]. Gergi R, Rjeily J A, 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. JOE, Volume 36, Number 5, May 2010.
[7]. Saber SEDM,Nagy MM ,Schäfer E. Comparative evaluation of the shaping ability of ProTaper Next, iRaCe and Hyflex CM rotary NiTi files in severely curved root canals International endodontic journal, Apr 3,2014.
[8]. Zhao D, Shen Y, Peng B, HaapasaloM.Micro-computed tomography evaluation of the preparation of mesiobuccal root canals in maxillary first molars with Hyflex CM, Twisted Files, and K3 instruments. J Endod. 2013 Mar;39(3):385-8.
[9]. Shiva Kumar B, Pattanshetty S, Prasad M,Soni S, Pattanshetty KS, ShivaPrasad. An in-vitro Evaluation of canal transportation and centering ability of two rotary Nickel Titanium systems (Twisted Files and Hyflex files) with conventional stainless Steel hand K-flexo files by using Spiral Computed Tomography.Journal of International Oral Health. Sept-Oct 2013;5(5):108-15.
[10]. Kariem M. El Batouty,Waleed E Elmallah.Comparision of Canal Transportation and Changes in Canal Curvature of Two Nickel-Titanium Rotary Instruments.JOE 2011;37(9):1290-1292.
[11]. Duran SindreuF,GarciaM,Olivieri G J, MercadeM,MorelloS,Roig M.A comparison of apical transportation between flexmaster and twisted file rotary instruments.J Endod 2012 Jul;38(7):993-5
[12]. JunaidA,Freire LG. Influence of Single file Endodontics on Apical transportation in curved root canals. An *Ex Vivo* Micro–Computed Tomographic Study,JOE,Vol 40,Issue 5,pg 717-720,May 2014
[13]. Gergi R, Rjeily J A, 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. JOE, Volume 36, Number 5, May 2010.