International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 7; Issue 10(E); October 2018; Page No.16029-16032
DOI: http://dx.doi.org/10.24327/ijcar.2018.16032.2943

Research Article

A COMPARATIVE EVALUATION OF DENTINAL DEFECTS INDUCED BY DIFFERENT NITI-ROTARY INSTRUMENTS DURING ROOT CANAL PREPARATION

Yogesh Ahirrao, Sana Mohani*, Sunanda Gaddalay, Anita Kale, Amol Badgire, Praveen Dhore and Abhishek Badade

Department of Conservative Dentistry, MIDSR Dental College, Vishwanathpuram, Ambajogai Road, Latur

ARTICLE INFO

Article History:

Received 06th July, 2018
Received in revised form 14th August, 2018
Accepted 23rd September, 2018
Published online 28th October, 2018

Key words:

Dentinal Defects, Stereomicrocope, Ni-Ti Rotary Instruments, Biomechanical Preparation

ABSTRACT

Aim: To compare the dentinal damage induced by stainless steel hand files and rotary nickel-titanium instruments using ProTaper Next, K3XF and Mtwo.

Materials and Method: Fourty single-rooted premolars were selected. All specimens were decoronated and divided into four groups, each group having 10 specimens. Group 1 specimens were prepared by Hand K-files (Mani), Group 2 with ProTaper Next (Dentsply Maillefer), Group 3 with K3XF (Sybron Endo) and Group 4 with Mtwo (VDW, Munich, Germany). Roots of each specimen were sectioned at 3, 6 and 9mm from the apex and were then viewed under a stereomicroscope to evaluate presence or absence of dentinal defects.

Results: On comparison of all different Ni-Ti rotary file systems in respect to dentinal damage; groups were significantly different from each other (P = 0.012). Group 1 (Hand files) showed no dentinal defects. Dentinal defects were found in the ProTaper Next, K3XF and Mtwo rotary groups. But the difference was non-significant when comparison was done among ProTaper Next, K3XF and Mtwo rotary group.

Conclusion: All rotary files induced increased changes of dentinal defects as compared to hand instrumentation.

INTRODUCTION

Success of endodontic treatment depends upon triad of proper diagnosis, thorough biomechanical preparation and three dimensional obturation of root canal system. Cleaning and shaping is major step for removal bacteria and debris in the root canal to achieve successful endodontic treatment.[1]It is done to completely remove organic tissue, microorganisms and debris by enlarging the canal diameter and creating a shape that allows a proper seal. [2]

Traditionally, the shaping of the root canal was achieved by the use of stainless steel hand files. Hand instruments clean canal superficially and create aberrations, such as ledges, perforation, zip, elbows.[3]To eliminate these shortcomings of stainless steel instruments, nickel titanium (Ni-Ti) instruments have been introduced. Canals prepared by rotary Ni-Ti instruments show increased canal cleanliness and less straightening, apical canal transportation and perforations. These benefits are because of greater flexibility and specific design features of Ni-Ti instruments allowing the natural canal curvature to be maintained.[4] Rotary instrumentation also requires less time to prepare canals as compared to hand instrumentation.[5]K3XF files (Sybron Endo) was developed with the R-phase heating and cooling protocol. K3XF provides clinicians with the safety, self-centering features of the original K3, increased flexibility and resistance to cyclic fatigue provided by R Phase Technology.[6]

Corresponding author:* **Sana Mohani
Department of Conservative Dentistry, MIDSR Dental College, Vishwanathpuram, Ambajogai Road, Latur

Mtwo (VDW, Munich, Germany) have an S-shaped cross sectional design with a non-cutting tip. The two cutting edges have a positive rake angle to cut dentine effectively. Moreover, the pitch length increases from the tip to the shaft. This design is claimed to eliminate threading and binding in continuous rotation, and to reduce transportation of debris towards the apex.[7]

Recently, ProTaper Next (PTN, Dentsply, Maillefer) files were introduced in the family of NiTi rotary instruments with a completely new design comprising of unique swaggering movement, greater flexibility, the M-wire technology, the 5th generation of continuous improvement, and its offset design.[8]

Furthermore, rotary Ni-Ti instrumentation could potentially cause dentinal defects in the walls of the canal which may act as areas of stress concentration and crack initiation. These Ni-Ti instruments increase the risk of dentinal damage to root in the form of complete cracks, incomplete cracks, craze lines or fractures. Craze lines can later propagate into vertical root fracture (VRF) if the tooth is subjected to repeated stresses from endodontic procedures[9] and VRF is a significant clinical problem which often leads extraction of tooth.[10]

Whether it is rotary or hand files, they are assumed to cause limited frictional forces within the canal, hence creating dentinal defects. Hence, there is a need to study the effect of different file systems on root dentin after endodontic preparations.

Hence, the purpose of the study was to compare and evaluate dentinal defects between Hand files, ProTaper Next (PTN), K3XF and Mtwo file systems using a stereomicroscope.

MATERIALS AND METHOD

Fourty single-rooted premolars were selected and cleaned with periodontal scaler and stored in purified filtered water. Teeth with curved roots, calcified canals, extracanals, and teeth with developmental anomaly or resorption were excluded from the study. The teeth were decoronated at cementoenamel junction by using a diamond disc leaving roots approximately of 16mm in length and divided into 4 groups with 10 specimen in each group. All the roots were inspected with transmitted light under ×12 stereomicroscope for detecting any pre-existing cracks or any craze-lines, to exclude teeth with such findings from this study.

Group 1: Prepared using stainless steel K-files (Dentsply Maillefer) up to apical size 25 at the working length and step-back technique was used till file no. 60.

In the remaining three groups, canal patency was established with a #10 K-file. Then, a size 15 K-file was introduced into the canal until it was visible at the apical foramen. The working length was determined by subtracting 1 mm from this measurement.

***Group 2*:** Prepared with ProTaper Next files (Dentsply Maillefer) in the sequence Pro-Taper Universal SX and then ProTaper Next X1(17/.04) and X2(25/.06) at a rotational speed of 300rpm and 200 g/cm torque. Each file was used with a brushing motion away from the root.

***Group 3*:** Prepared with K3XF rotary instruments were used in a crown down approach with the sequence of 25/.10 and 25/.08 for coronal shaping followed by 25/.04 upto working length and then master apical file 25/.06 was used in brushing motion.

***Group 4*:** Prepared with Mtwo in sequence of #10 with tapering0.04, #15 with tapering 0.05, #20 with tapering 0.06 and #25 with tapering 0.06 in a brushing motion.

In all groups, each canal was irrigated with 3% sodium hypochlorite between each instrument used in canal preparation. In groups with preparation with rotary system 17% EDTA was used between each sequential instrument. In all groups, Endo Activator (Dentsply Tulsa Dental, Tulsa, OK, USA) was used with no. 25 tip for 30 sec to agitate the solution vigorously to clean the canals more efficiently. All roots were kept moist in purified filtered water throughout the experimental procedures.

Sectioning and Microscopic Examination

The roots of all the teeth were sectioned horizontally at 3, 6, and 9 mm from apex. Digital images of each section were captured with the help of stereomicroscope at 25X .Each specimen was checked by for the presence of dentinal defects.
Defects were classified as: “No defect" was defined as root dentine devoid of any lines or cracks where both the external surface of the root and the internal root canal wall had no defects. "Fracture" was defined as a line extending from the root canal space to the outer surface of the root."Other defects" were defined as all other lines observed that did not extend from the root canal to the outer root surface. For example, craze line - line extending from the outer surface into the dentine that did not reach the canal lumen, or partial crack extending from the canal wall into the dentine without reaching the outer surface of the root.
Then, dentinal defects produced by these hand and different rotary systems were compared with each other. Results were expressed as number and percentage of defected roots in each group.

Statistical Analysis

The data were analyzed using statistical software SPSS 17.0 program. Chi-square test was performed to determine statistically significant difference in the appearance of defected roots between the experimental groups. The level of significance was set at $P < 0.05$.

RESULTS

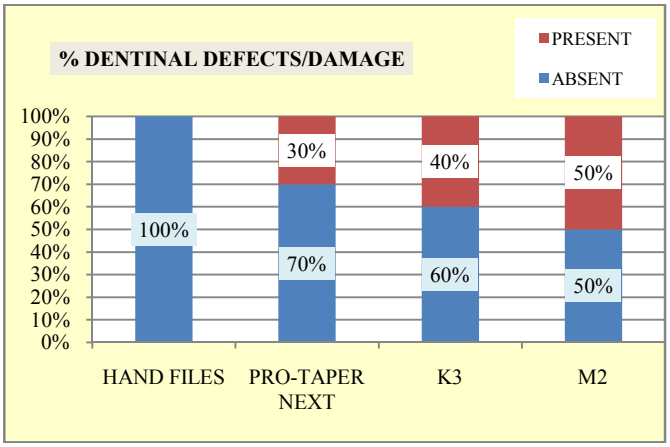
On comparison of all different Ni-Ti rotary file systems in respect to dentinal damage., groups were significantly different from each other ($P = 0.012$).Group1(Hand Files) show no dentinal defect. Dentinal defects were found in the ProTaper Next, K3XF and Mtwo groups (Table 1 and Graph 1) .But the difference was non significant(P>0.05) among Proper Next, K3XF and Mtwo rotary groups.(Table 2).

Table 1 Comparison of number and percentage of teeth showing defects/dentinal damage in respect to different Ni-Ti rotary file systems : (Chi-square test)

Defect	Hand files (group1)	Pro-taper next (group2)	K3 (group3)	M2 (group4)	Chi-Square value	P value
Absent	10(100%)	7 (70%)	6 (60%)	5 (50%)	0.012	0.012, Significant
Present	0 (0%)	3 (30%)	4 (40%)	5 (50%)		
Total	10(100%)	10(100%)	10(100%)	10(100%)		

Table 2 Individual Comparisons Among Different Ni-Ti Rotary File Sysytem In Respect To Defects / Dentinal Damage

	Group	‘p’ value and Significance
Group 1	Group 2	<0.01, significant
	Group 3	<0.01, significant
	Group 4	<0.01, significant
Group 2	Group 3	0.73, not significant
	Group 4	0.091,not significant
Group 3	Group 4	0.48, not significant



Graph 1 Comparison of percentage of teeth showing defects/dentinal damage in respect to Different Ni-Ti rotary file systems

DISCUSSION

Hand instrumentation which was the milestone of endodontic practice in the past though has lost its popularity, still remains integral part of root canal preparation. In the last decades, many new Ni-Ti rotary instruments have been developed and introduced by various manufacturers. Technological

advancement in rotary nickel–titanium (Ni-Ti) instruments has led to new design, concepts, easier, faster and better root canal shaping.[11]

Protaper Next

K3XF

Mtwo

Hand file

Figure 1 Stereomicroscopic examination to detect dentinal defects by different file

Root canal shaping procedures and rotary instrumentation with Ni-Ti rotary instruments can induce crack formation. Dentinal cracks or root fracture occur when the tensile stress in the root canal wall exceeds the tensile stress of dentin.[11-12] Rotary Ni-Ti files with large tapers can produce increased friction and stresses on the canal wall and cause dentinal cracks in root dentin.

Kim *et al*,[13] stated that taper of the files is the responsible for increase of stress on the walls of the root canal; whereas, Bier *et al*,[11] stated taper of the files as one of the contributing factor for crack formation in root dentin. Hence, we have prepare root canal upto (25/06) in all experimental group in our study. In addition, Kim *et al*.[13] have found a potential relationship between the design of Ni-Ti instruments and the incidence of VRFs. They concluded that file design affected apical stress and strain concentrations during root canal instrumentation.

ProTaper Next has a rectangular cross-section design, M wire technology, increased and decreased tapering over entire length. Off-centered rectangular design of ProTaper Next may have contributed to less number of cracks. This design generates a swaggering motion, which decreases screw effect, dangerous taper lock, and torque on the file.[14-15]

The difference between the various root canal preparation instruments in terms of dentinal cracks can be associated with preparation techniques and the cross sectional design of files. Mtwo have S-shaped cross-sectional design and their cutting tip are extremely sharp. They also have active rotating movement resulting in high levels of stress concentration in root canal walls.[16] K3XF files are manufactured in R-Phase heat treatment which provides it increased flexibility hence, it was proposed that less pressure might be required in advancing the file apically, resulting in lesser stress concentration on dentinal walls and less defects but, results depicted no statistical differences among ProTaper Next, Mtwo and K3XF groups. [17]

Sectioning techniques used in present study allowed us to investigate the effects of root canal treatment on dentin by direct observation. Regarding the method used in this study, no external force was applied and the effects of the preparation of root canal at canal walls and adjacent dentin were observed directly.[18] The use of different speed and torque settings for each file system could be a limitation in our study. Peters stated that increased rotational speed was associated with increased cutting efficiency.[19]Although fractures may be considered more important, we should not ignore the importance of other defects. They may propagate into complete fractures over time as a result of stresses produced during functional loadings or dental procedures.

Even though this was an *in vitro* study, in agreement with the previous studies, we can conclude that Ni-Ti instruments tend to induce various degrees of dentinal damage during root canal preparation. On the other hand, hand instrumentation showed satisfactory results with no micro crack defects.[20]

CONCLUSION

Within the limitations of this *in vitro* study we can conclude that all rotary Ni-Ti files can induce dentinal defects as compared to hand files.

References

1. Peters OA. Current challenges and concepts in the preparation of root canal systems: *A review. J Endod* 2004;30:559-67.
2. Bier CA, Shemesh H, Tanomaru-Filho M, Wesselink PR, Wu MK. The ability of different nickel-titanium

rotary instruments to induce dentinal damage during canal preparation. *J Endod* 2009;35:236-8.
3. Singh S, Nigam N. Comparative evaluation of surface characteristics of dentinal walls with and without using plastic finishing file. *J Conserv Dent* 2010;13:89-93.
4. Kim HC, Lee MH, Yum J, Versluis A, Lee CJ, Kim BM. Potential relationship between design of nickel-titanium rotary instruments and vertical root fracture. *J Endod* 2010;36:1195-9.
5. Pasqualini D, Scotti N, Tamagnone L, Ellena F, Berutti E. Hand-operated and rotary ProTaper instruments: A comparison of working time and number of rotations in simulated root canals. *J Endod* 2008;34:314-7.
6. Cheema J, Gupta AK, Minocha A. Comparison of Dentinal Cracks after Root Canal Preparation with Hand Files and Protaper NEXT, HYFLEX EDM, K3 XF and Twisted Rotary Files. *J Adv Med Dent Scie Res* 2018;6(5):30-35.
7. Kuzekanani M, Walsh LJ, Yousefi MA. Cleaning and shaping curved root canals: Mtwo vs ProTaper instruments, a lab comparison. *Indian J Dent Res* 2009;20:268-7.
8. Protaper next TM flexible performance. Available from: www.dentsplymaillefer.com.
9. Shemesh H, Bier CA, Wu MK, Tanomaru-Filho M, Wesselink PR. The effects of canal preparation and filling on the incidence of dentinal defects. *Int Endod J* 2009;42:208-13.
10. Barreto MS, Moraes Rdo A, Rosa RA, Moreira CH, Só MV, Bier CA. Vertical root fractures and dentin defects: Effects of root canal preparation, filling, and mechanical cycling. *J Endod* 2012;38:1135-9.
11. Bier CA, Shemesh H, Tanomaru-Filho M, Wesselink PR, Wu MK. The ability of different nickel-titanium rotary instruments to induce dentinal damage during canal preparation. *J Endod* 2009;35:236-8.
12. Dane A, Capar ID, Arslan H, Akçay M, Uysal B. Effect of different torque settings on crack formation in root dentin. *J Endod* 2016;42:304-6.
13. Kim HC, Lee MH, Yum J, Versluis A, Lee CJ, Kim BM. Potential relationship between design of nickel-titanium rotary instruments and vertical root fracture. *J Endod* 2010;36:1195-9.
14. Ruddle CJ. The ProTaper endodontic system: Geometries, features, and guidelines for use. Dent Today2001;20:60-7.
15. Capar ID, Arslan H, Akcay M, Uysal B. Effects of ProTaper universal, ProTaper next, and HyFlex instruments on crack formation in dentin. *J Endod* 2014;40:1482-4.
16. Burklein S, Hinschitza K, Dammaschke T, Schafer E. Shaping ability and cleaning effectiveness of two single-file systems in severely curved root canals of extracted teeth: Reciproc and WaveOne versus Mtwo and ProTaper. *Int Endod J.* 2012;45(5):449–61.
17. Shen Y, Zhou HM, Zheng YF, *et al*. current challenges and concepts of the thermo-mechanical treatment of nickel-titanium instruments. *J Endod* 2013;39:163-72.
18. Burklein S, Tsotsis P, Schafer E. Incidence of dentinal defects after root canal preparation: reciprocating versus rotary instrumentation. *J Endod.* 2013;39(4):501–4.
19. Tamse A, Fuss Z, Lustig J, Kaplavi J. An evaluation of endodontically treated vertically fractured teeth. *J Endod*1999;25:506‑8.
20. Capar ID, Arslan H, Akcay M, Uysal B. Effects of ProTaper Universal, ProTaper Next, and HyFlex instruments on crack formation in dentin. *J Endod* 2014;40:1482‑4.

How to cite this article:

Yogesh Ahirrao *et al* (2018) 'A Comparative Evaluation of Dentinal Defects Induced by Different Niti-Rotary Instruments During Root Canal Preparation', *International Journal of Current Advanced Research,* 07(10), pp. 16029-16032.
DOI: http://dx.doi.org/10.24327/ijcar.2018.16032.2943

****