ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 3, Issue – 5, October - 2020, Page No. : 388 - 393

Comparative Evaluation of Dentinal Crack Formation After Root Canal Preparation Using Fanta S-One, M3 Pro Gold, And Protaper Universal-A Stereomicroscopic Study.

[1]Dr Nikita Bhosale, Post Graduate Student, MDS, Dept of Conservative Dentistry And Endodontics, Nathajirao G. Halgekar institute of dental sciences and research Centre, Belagavi.

[2]Dr Pallavi Gopashetti, Reader , Dept Of Conservative Dentistry And Endodontics, Nathajirao G. Halgekar institute of dental sciences and research Centre, Belagavi.

[3]Dr Madhu pujar, Head of the Department , Dept Of Conservative Dentistry And Endodontics, Nathajirao G. Halgekar institute of dental sciences and research Centre, Belagavi

[4]Dr Nikita Kapshe, Post graduate student, Dept Of Conservative Dentistry And Endodontics, Nathajirao G. Halgekar institute of dental sciences and research Centre, Belagavi

Corresponding Author: Dr Nikita Bhosale, Post Graduate Student, MDS, Dept Of Conservative Dentistry And Endodontics, Nathajirao G. Halgekar institute of dental sciences and research Centre, Belagavi.

Citation of this Article: Dr Nikita Bhosale**,** Dr Pallavi Gopashetti, Dr Madhu pujar, Dr Nikita Kapshe , “Comparative Evaluation of Dentinal Crack Formation After Root Canal Preparation Using Fanta S-One, M3 Pro Gold, And Protaper Universal-A Stereomicroscopic Study.”, IJDSIR- October - 2020, Vol. – 3, Issue - 5, P. No. 388 – 393.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Introduction

Introduction The purpose of this study was to compare the incidence of dentinal micro crack formation after root canal preparation using Fanta S-one, M3 Progold, and Protaper universal(PTU).

Materials and Methods: A total of 60 extracted mandibular premolars were selected and divided into four groups. The length was standardized at 16mm. Group 1 served as a control in which no treatment was performed. Teeth in Group 2, 3, and 4, were instrumented with Fanta S-one, M3 Progold, and Protaper universal respectively in rotary motion. The samples were dyed with methylene blue, sectioned into slices perpendicular to the long axis at 3-, 6- and 9-mm length and were observed under a stereomicroscope (under 25×) to determine the absence or presence of a crack. Data was analyzed using a chi-square test .P - value of less than 0.05 was considered to be statistically significant.

Results The control group did not present any defects and the differences between the control and experimental groups were statistically significant ($P<0.05$).Pro taper universal caused more number of microcracks than Fanta s one and M3 Progold .No significant differences between the groups in the 3-mm and 9 mm sections were observed. There were significant differences in the 6-mm sections.

Conclusion: All of the instrumentation systems used in this study created cracks in the root dentin. The Fanta S-one and M3 Progold instruments caused fewer dentinal cracks compared with the ProTaper Universal instruments at all three sites.

Keywords: Dentinal Microcrack, Protaper Universal, Fanta S One, M3progold

Introduction

Root canal preparation has become faster, and better due to technological advancements attributed to the new designs and concepts of the rotary nickel-titanium instruments. However, instrumentation with these produce significant forces on root dentin inducing root dentinal microcracks[1] and the application of repeated tension via occlusal forces, these dentinal microcracks may have the potential to develop vertical root fracture.[2] Therefore improving the flexibility of endodontic files will likely reduce iatrogenic errors; reduce the stress created on the dentinal walls and increase the efficiency and safety of root canal treatment. Flexibility as a whole is dependent upon the geometry and composition of the metal and its thermomechanical treatments.[3]

ProTaper Universal (PTU, Dentsply Tulsa Dental Specialities, Tulsa, OK) NiTi rotary files which are gold standard since many years are machined from conventional superelastic (SE) austenitic NiTi wire. It has variable taper over the entire cutting blade length with convex triangular cross-sections .However it is associated with a tendency to induce more microcracks and dentinal damage than other file systems.[4]

Recently Fanta s one and m3 pro gold are introduced with advanced metallurgy. M3 Progold a successor of M3file system was introduced which was based on CM-wire technology. It is subjected to novel thermomechanical processing and gold treatment, which allows greater flexibility.[5]Another file, Fanta-S-One (Fanta Dental, Shanghai, China), characterized by a S-shaped cross-section has been developed. The manufacturer claims that the S-shape confers advantages in terms of reducing blade engagement and increasing fatigue lifespan. Moreover, it is claimed that it reduces stress by sweeping the debris from flutes to relieved areas.[6]

To the best our knowledge, there are no studies regarding the incidence of dentinal microcracks comparing these file systems.

Thus, the study aims to compare the incidence of cracks in root dentin after root canal instrumentation with Fanta S-one, M3 pro gold and ProTaper universal system using stereo microscope.

Materials and Method

A total of 60 extracted human mandibular premolars with mature apices and straight root were selected and kept in distilled water. The root surfaces were examined under a stereomicroscope to exclude external defects and cracks. The teeth were then decoronated with a slow speed saw under water coolant to obtain a standardized root length of 16 mm. The roots of the teeth were then covered with a thin layer of wax, and each root was embedded into acrylic resin set in an acrylic block. Roots were then removed, from the block, and the wax from the root. A light-body silicon-based material was used to replace space created by wax simulating periodontal ligament following which the root was immediately inserted into impression material. The specimens were then randomly divided into three experimental and one control group with 15 teeth in each group respectively for cleaning and shaping using the following rotary file systems.

Group 1 - Unprepared root canal (control group)

Group 2 – Fanta s one files

Group 3 – M3 pro gold.

Group 4 –Protaper universal

Biomechanical preparation

Patency of the canal and glide path was established using no. 10 K and no. 15 K file (Mani, Japan) respectively. All canals were then enlarged up to size 20 K- file. Working length was established by advancing file into the canal until just visible at the apical foramen and then subtracting 1 mm from it. Apical preparation was completed with instrument of corresponding tip size 25 of each system using X-smart Endo motor (Dentsply).

Group 1 was a control group which was uninstrumented. Group 2- Fanta s one and Group 3 -M3 pro gold files were used in the instrumentation sequence until the working length has reached in a continuous rotary movement with speed of 350 rpm and 2 N/cm2 of torque to prepare the root canal with a brush motion on the buccolingual extension. Group 4 -ProTaper universal files were used to prepare the canals as recommended by the manufacturer at 300 rpm and 3 Ncm torque following the sequence S1, S2, F1, and F2.

The canals were irrigated using 3% NaOCl and 17% EDTA between each instrument during the procedure. Normal saline was used as intermittent rinse between 3%Naocl and 17%EDTA. In the final stage, each tooth was irrigated using normal saline as the final rinse. Following preparation, the root apices of all samples were stained with 1% methylene blue dye to simplify the crack detection

Sectioning and microscopic examination

Roots were sectioned perpendicular to long axis at 3, 6, and 9 mm from the apex using a low speed saw under water cooling. Digital images of each section were captured at ×25magnification using a digital camera attached to a stereomicroscope. (Fig no 2)Each specimen was checked by two operators for the presence of dentinal defects. To define crack formation, 2 different categories were made (ie, ‘‘no crack’’ and ‘‘crack’’) ‘‘No crack’’ was defined as root dentin without cracks or craze lines either at the internal surface of the root canal wall or the external surface of the root.

‘‘Crack’’ was defined as all lines observed on the slice that either extended from the root canal lumen to the dentin or from the outer root surface into the dentin

Results

The numbers of cracks in each group are shown in table no 1 and figure no 1. Table 2 summarizes a statistically significant difference among the experimental groups ($P < 0.05$). Defects were found in all NiTi rotary instrumented groups. No statistical difference ($p<0.05$) between Protaper universal, Fanta s one and M3 pro gold groups was observed when compared with the control group at 3mm and 9mm. A statistically significant difference ($p>0.05$) was observed when Protaper universal, Fanta s-one and M3 pro-gold, were compared to the control group at 6mm. Number of cracks present at 6mm were more as compared to cracks at 3mm and 9mm for all the experimental groups

Table 1: Number of cracks in each group at different levels

Group	No of samples	No of samples presenting Micro cracks at different levels		
		9mm	6mm	3mm
Control group	15	0	0	0
Fanta S-one group 2	15	2	3	1
M3 progold group 3	15	2	3	2
Protaper universal group 4	15	6	8	3

Figure 1: The number of microcracks in each group

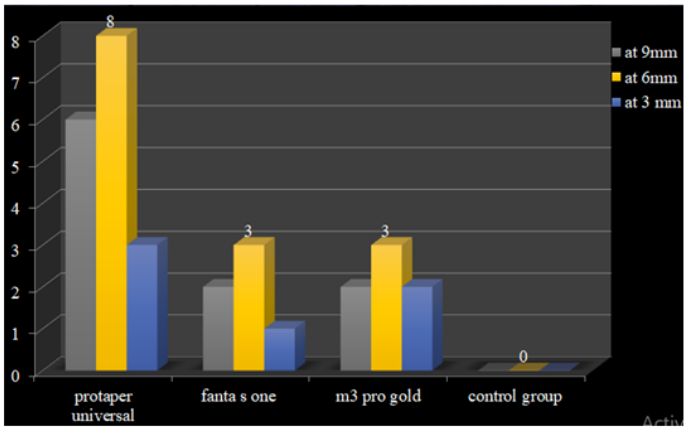
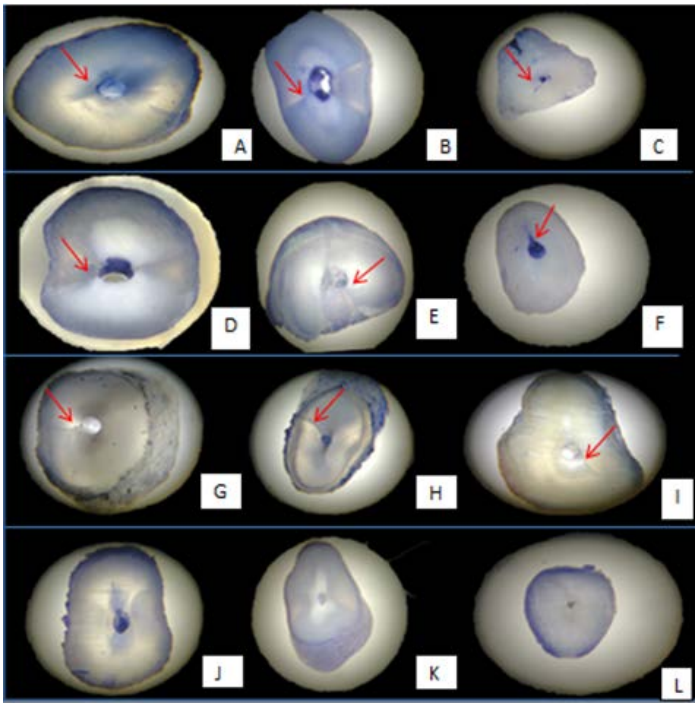


Table 2: Comparison between groups using Chi-square test Statistical analysis

Group comparison	Chi square value x2	P value	Level of significance
At 3mm	3.704a	.295	Not significant
At 6mm	14.44a	.002	Significant
At 9mm	9.12a	.028	Not significant

Figure 2: Stereomicroscopic images showing presence of microcracks



Images A , B and c shows microcracks at 9mm , 6mm and 3 mm section in Fanta s- one group, images D ,E and F shows microcracks at 9 mm , 6 mm ,and 3 mm sections in M3 Progold group , image G,H and I shows microcrack at 9mm,6mmand 3mm in Protaper group and image J ,K and L shows absence of microcrack in control group

Discussion

During cleaning and shaping of the root canals, the contact between the instrument and canal walls creates transient stress concentrations in dentin which may lead to dentinal defect and initiate vertical root fracture.[7]

In this study, all the groups were inspected for preexisting cracks or fracture but ruling out is difficult as some cracks could be internal and cannot be visible externally. The control group, however, presented no cracks which signify that micro cracks seen were as a result of preparation procedures with Niti rotary files. All three experimental groups presented with cracks, among which preparation done with Protaper universal showed a greater number of cracks at all three levels.

Studies state that metallurgical properties of various Niti systems have more dentin damage potential rather than motion of the instrument.[3] The more number of microcracks for protaper might be because of its stiff nature and conventional niti metallurgy which can generate comparatively higher tensile and compressive strength.[8]

Microcrack formation may be influenced by instrument features such as tip design, taper, pitch design, flute form and cross section geometry.[9] Corelating this to our study results protaper presented with greater number of cracks which can be attributed to its design features comprising of the smaller pitch, triangular and off-Centre cross-section, progressively greater taper. These results are as per the studies done by Ismail capar et al [4] and Monga P et al.[10]Micro crack formation with Fanta s-one and M3 pro gold was less as compared to pro taper universal relating to few of its characteristics features also it is speculated that flexibility provided by the heat treatment of the Niti alloy is another aspect which reduces the

production of tension on dentinal walls. However, the flexibility can be influenced by the design of the instrument.[11] The M3 pro gold files are made up of CM wire technology with gold treatment exhibiting super elasticity and convex triangular cross-section.[5] On the other hand Fanta s-ONE is made up of AF-H wire technology exhibiting high flexibility and has multisection crossection over entire length of working part. This file with three different cross section increases fracture resistance and cutting efficiency.[12]

In this study, although cracks were observed in all groups, cracks at 6mm were more than cracks in apical 3mm section. Similar study results were found with study conducted by Adorna et al [13] and Liu et al.[14]The reason could be due to increase in taper of various files which can generate significant forces as file progresses apically and crown down technique used for preparation [2] and also the stresses generated at 1 mm short of the apical foramen were one third of stresses at more coronal levels due to increase in taper of various files towards the coronal third.[15] The results were insignificant between Fanta s one and m3 pro gold at all three levels which can be due to similar uniform recommended speed and torque along with the advanced metallurgical properties .

The limitations of this study are application of elastomeric material to simulate the periodontal ligament may disrupt and permit direct tooth to acrylic contact; and clinical situation influences the distribution of stresses. Teeth with only straight root canals were selected without anatomic complexities which did not reproduce true clinical presentation. Use of other methods like optical coherence tomography or infrared thermography would have eliminated destructive sectioning procedure.

Conclusion

Within the limitations of present study, it can be concluded that-

1. All instruments produced cracks on dentinal wall, with highest number of cracks produced by Protaper universal as compared to Fanta S-one and M3 pro gold
2. There were considerably more cracks produced at 6mm level than at 3mm and 9mm.

References

1. Vagarali, H., Patil, C. et al Comparative Evaluation of root micro cracks by different rotary and reciprocating endodontic file systems.IOSR Journal of Dental and Medical SciencesVolume 14, Issue 9 Ver. II (Sep. 2015), PP 18-22
2. Marcely Cassimiro a, Kaline Romeiro a et al Effects of Reciproc, ProTaper Next and WaveOne Gold on Root Canal Walls: A Stereomicroscope Analysis Iranian Endodontic Journal 2018;13(2): 228-233
3. Nishad SV, Shivamurthy GB. Comparative analysis of apical root crack propagationafter root canal preparation at different instrumentation lengths using protaper universal, protaper next and protaper gold rotary files: An *In vitro* study. Contemp Clin Dent 2018;9:S34-8.
4. 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
5. Pedullà E, Lo Savio F, La Rosa GR, Miccoli G, Bruno E, Rapisarda S, Chang SW, Rapisarda E, La Rosa G, Gambarini G, Testarelli L. Cyclic fatigue resistance, torsional resistance, and metallurgical characteristics of M3 Rotary and M3 Pro Gold NiTi files. Restorative dentistry & endodontics. 2018 Mar 6;43(2).
6. Gambarini G, Miccoli G, Seracchiani M, Khrenova T, Donfrancesco O, D'Angelo M, Galli M, Di Nardo D, Testarelli L. Role of the Flat-Designed Surface in Improving the Cyclic Fatigue Resistance of

Endodontic NiTi Rotary Instruments. Materials. 2019 Jan;12(16):2523.

7. Langaliya AK, Kothari AK, Surti NR, Patel AR, Doshi PR, Pandya DJ. In vitro comparative evaluation of dentinal microcracks formation during root canal preparation by different nickel-titanium file systems. Saudi Endod J 2018;8:183-8.
8. Abou El Nasr HM, Abd El Kader KG. Dentinal damage and fracture resistance of oval roots prepared with single-file systems using different kinematics. J Endod 2014;40:849-51
9. Yoldas O, Yilmaz S, Atakan G, Kuden C, Kasan Z. Dentinal microcrack formation during root canal preparations by different NiTi rotary instruments and the self-adjusting file. J Endod 2012;38:232-5.
10. Monga P, Bajaj N, Mahajan P, Garg S. Comparison of incidence of dentinal defects after root canal preparation with continuous rotation and reciprocating instrumentation. Singapore dental journal. 2015 Dec 1;36:29-33
11. Pongione G, Pompa G, Milana V, Di Carlo S, Giansiracusa A, Nicolini E, De Angelis F. Flexibility and resistance to cyclic fatigue of endodontic instruments made with different nickel-titanium alloys: a comparative test. Ann Stomatol (Roma). 2012;3(3- 4):119-22.
12. Das S, Pradhan PK, Lata S, Sinha SP. Comparative evaluation of dentinal crack formation after root canal preparation using ProTaper Next, OneShape, and Hyflex EDM. J Conserv Dent 2018;21:153-6.
13. Adorno CG, Yoshioka T, Suda H. Crack initiation on the apical root surface caused by three different nickel-titanium rotary files at different working lengths. J Endod 2011;37:522-5
14. Liu R, Kaiwar A, Shemesh H, Wesselink PR, Hou B, Wu MK, et al. Incidence of apical root cracks and apical dentinal detachments after canal preparation with hand and rotary files at different instrumentation lengths. J Endod 2013;39:129-32.
15. A. Versluis, H.H. Messer, M.R. Pintado, Changes in compac- tion stress distributions in roots resulting from canal pre- paration, Int. Endod. J. 39 (2006) 931–939