ORIGINAL RESEARCH ARTICLE

COMPARATIVE EVALUATION OF DENTINAL CRAZING FOLLOWING INSTRUMENTATION WITH THREE DIFFERENT ROTARY FILE SYSTEMS USING STEREOMICROSCOPE- AN IN VITRO STUDY

Authors:

Sriram Sankar[1]
Vijay Venkatesh Kondas[2]

[1]PG Student,
SRM Kattankulathur
Dental College,
SRM University, Chennai.

[2]Professor and Head,
SRM Kattankulathur
Dental College,
SRM University, Chennai.

Address for correspondence:
Dr. Sriram Sankar,
PG Student,
SRM Kattankulathur
Dental College,
SRM University, Chennai,

ABSTRACT

Introduction: Root canal preparation is one of the most important steps in the success of root canal therapy. Research has shown that different root canal shaping systems damage the root canalwall to various degrees resulting in dentinal cracks that have the potential to develop into vertical root fractures. TF adaptive technology is a recently introduced technology which shows both continuous rotation and reciprocation movements depending on the root canal morphology.

Materials and Methods: 40 freshly extracted single rooted human mandibular premolars were collected. Teeth with pre-existing defects were excluded from the study. The teeth were sectioned coronally to a length of 13mm. The mesiodistal and buccolingual width of canals were measured radiographically to standardize canal dimensions. All the teeth were mounted on acrylic blocks. Based on root canal instrumentation protocol the teeth were divided into four groups of (n=10) each. Group A: Control- No instrumentation was done. Group B: Teeth were instrumented using Twisted files Adaptive (Sybron Endo) motion. Group C: Teeth instrumented with Protaper used in reciprocation movement. Group D: Teeth instrumented Twisted files used in continuous rotation. After instrumentation root canals were sectioned at 3, 6,9mm from the apices and examined under Stereomicroscope for cracksunder 25X magnification.

Results:

The study results showed that control group showed no dentinal defects which was significantly lower than ($P<0.05$) other three groups. There was no statistical difference ($P>0.05$) between the TF used in adaptive rotation and Protaper used in reciprocating motion. The TF used in continuous rotation showed maximum dentinal cracks amongst the test groups which was significantly lower ($P>0.05$) than other two test groups.

Conclusion: Within the limitations of the study it can be concluded that instrumentation with rotary file systems induce dentinal cracks/craze lines. TF adaptive motion showed less dentinal cracks compared to TF in continuous rotation, Protaper in reciprocation.

Key Words: TF adaptive, Reciprocation, Protaper, Dentinal crazing.

J Odontol Res 2017;5(1)5-9.

Introduction:

Successful endodontic therapy depends upon combination of proper diagnosis, locating all canals, thorough biomechanical preparation and three dimensional obturation of root canal system. Biomechanical preparation is one of the most important factors for successful root canal treatment and determines the efficacy of all subsequent procedures.[1,2], It is done to completely remove organic tissue, microorganisms and debris by enlarging the canal diameter and creating a shape that allows for a proper seal of the obturating material. This procedure of cleaning and shaping could be done with hand files or rotary Nickel Titanium files. Rotary Ni-Ti instrumentation has significant advantages over hand filing as it saves considerable amount of time and shaping procedure could be accomplished much easily[3].However 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[4]. Craze lines can later propagate into vertical root fracture (VRF). VRF is a significant clinical problem which often leads to tooth extraction. Several factors such as force of instrumentation, pressure applied during lateral compaction, masticatory forces, irrigants used during cleaning and shaping that determines the development of dentinal cracks within the root canal system1-2.

Aim:

Comparative evaluation of dentinal crazing following instrumentation with three different rotary file systems using Stereomicroscope- an in vitro study

1) Twisted file (rotation)
2) Protaper files (reciprocation)
3) TF Adaptive (adaptive motion)

Materials and Method:

Forty freshly extracted, single rooted human mandibular first pre molars with mature apices and single, straight canals (<5°) were collected, ultrasonically cleansed and stored in distilled water. Teeth were examined under2.5X magnification to rule out visible cracks/ fractures. Pre-operative radiograhs were taken in buccolingual and mesiodistal directions. The buccolingual and mesiodistal diameters of canals at 3mm and 9 mm from apex were measured to standardize the samples. All the teeth were decoronated at the level of CEJ to obtain standard root length of 13mm,and covered with a thin layer of silicone and mounted on acrylic blocks. Apical patency was established with a #10 K file and working length determination was done. All the samples were randomly allocated to one of the four test groups

GROUPS (n=10 per group)

GROUP A-CONTROL Group -No instrumentation done

GROUP B: Instrumentation was done with Twisted Files Used with adaptive motor (Sybron Endo).Instrumentation sequence was SM 1 (20/0.04) And SM2 (25/0.06)

GROUP C-Instrumentation was done with Protaper files used in reciprocation motion with (X Smart plus, Dentsply, Motor). Instrumentation sequence SX, S1, S2, F1, F2

GROUP D- Instrumentation was done with Twisted files used in continuous rotation (X Smart, Dentsply). Single Instrument (25/0.06%)

The torque and speed settings were followed as per manufacturer's recommendation. Cleaning and shaping was completed with the different rotary file system. 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 (RC help) was used between each sequential instrument. The roots of all the teeth were sectioned horizontally at 3, 6, and 9 mm from apex using slow speed saw (Figure 1).Digital images of each section were captured under stereomicroscope (Expert DN 25X). Each specimen was checked by for the presence of dentinal defects

Crack Determination:

NO CRACK" was defined as root dentine devoid of any lines or cracks at the external and internal surface of the tooth.(Figure 2)

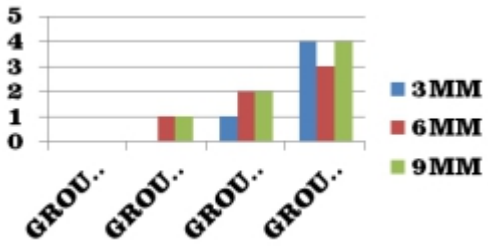
"CRACK" was defined as a presence of craze lines, cracks, fractures at any point on the tooth (Figure 3).

Statistical Analysis:

The data were analyzed using SPSS 17.0 software. Chi-square test was performed to determine the defects at different horizontal sections in each group and between groups. The level of significance was set at $P < 0.05$.

Results:

DENTINAL Cracks (%)	Group A (%)	Group B (%)	Group C (%)	Group D (%)
AT 3MM	0 (0)	0(0)	1 (10)	4 (40)
AT 6MM	0 (0)	1 (10)	2 (20)	3 (30)
AT 9MM	0 (0)	1 (10)	2 (20)	4 (40)
Total no of cracks	0 (0)	2 (6.6)	5 (16.6)	7 (36)



Group D showed the maximum number of cracks which was significantly higher (P<0.05) than Group B, Group C and there was no significant difference between Group C and Group B. While group A showed no dentinal cracks. Within groups there was no statistically significant difference in Group A, Group B, Group C, Group D (P>0.05) at 3mm, 6mm, 9mm respectively

Discussion:

The files used in the study were selected because they had similar cross sections (triangular).Other parameters such as apical diameter, taper were standardizedand the variable was kinematics of rotation so that the effect of kinematics of rotation on dentinal crack formation could be assessed.[5-7]There are no previous studies in the literature evaluating the kinematics of rotation on the development of dentinal cracks.The study results showed that control group showed no dentinal defects which was significantly lower than (P<0.05) than groups which were instrumented with TF continuous rotation (Group D), Protaper used in reciprocation movement (Group C), TF adaptive (Group B).This finding is in accordance with previous study by Ashwinkumar et al that instrumentation with rotary file system induce dentinal crack formation17.

There was no statistical difference (P>0.05) between the TF used in adaptive motion and Protaper used in reciprocating motion. The TF adaptive system showed least dentinal cracks amongst the test groups which was not significantly different (P>0.05) than other two test groups. The TF Adaptive system was introduced by Sybron Endo in 2013 uses both reciprocation and continuous rotation movements with existing Twisted files in an new elements motor showing adaptive motion. According to the manufacturer adaptive motion utilizes a combination of rotation and reciprocation movement depending on the stress experienced by the file in the root canal system. When there is no stress on the file it shows a continuous rotational movement with no backward rotation. But when there is a stress on the file it shifts to reciprocation mode with clockwise and counter clockwise angles ranging from 600 to 0º and 370 up to 50º. The degree of clockwise and counter clockwise rotation varies based on stress experienced by the file. One major difference between adaptive and conventional reciprocation movement is that the clockwise and counter clockwise rotation angles are fixed for reciprocation movement. This adaptive movement along with R phase manufacturing process of TF allows the file to adapt to different levels of intra canal torsional forces causing fewer dentinal damage there by produces less incidence of dentinal cracks compared to continuous rotation[9-13].

The null hypothesis in the study was rejected as (P<0.05) between TF adaptive and Protaper (Reciprocation), TF (continuous rotation)

In the present study there was no difference in dentinal crack formation at 3mm, 6mm, 9mm respectively in all three groups which suggests that

stress exhibited by a file on canal wall is distributed evenly. However this finding is in contrast to a previous study by Kim et al where it was stated that more dentinal cracks were observed in the apical sections[16]. This may be explained by the usage of varying tapered file (Protaper) exhibiting different stress at different sections.

In the present study teeth were mounted on acrylic blocks and silicone impression material to simulate the clinical scenario of bone and periodontal ligament. In order to create an even thickness (0.2-0.3 mm) of silicone rubber simulating the PDL, the roots were first immersed in fluid wax and then removed. A layer of 0.2-0.3 mm wax remained on the root surface. The tooth with the wax was then immersed in the acrylic resin block. After the resin had cured, the teeth and wax were removed from the block. The wax was removed from the tooth and the tooth was then replaced in the resin block with silicone rubber.

In the present study all the samples were evaluated for presence of cracks at the beginning of the study and also after sectioning the samples. This was done to eliminate other causes such as force of extraction, sectioning methods which could induce dentinal cracks.

Limitations of the study include the different manufacturing process w employed for different files could influence the development of dentinal cracks. Also that all the files used in the study were used as per manufacturers recommendation. This difference in torque and speed settings could influence crack formation.

Conclusion:

Within the limitations of the study it can be concluded

1) Instrumentation with rotary file systems induce dentinal cracks/craze lines.

2) TF adaptive motion showed less dentinal cracks compared to TF in continuous rotation, Protaper in reciprocation.

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. Shemesh H, Bier CA, Wu MK, Tanomaru-Filho M, Wesselink PR. The effects of canal preparation and filling on the incidence of dentinal defects.IntEndod J 2009;42:208-13.
7. Barreto MS, MoraesRdo 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.
8. Onnink PA, Davis RD, Wayman BE. An in vitro comparison of incomplete root fractures associated with three obturation techniques. J Endod 1994;20:32-7.
9. Shemesh H, Roeleveld AC, Wesselink PR, Wu MK. Damage to root dentin during retreatment procedures. J Endod 2011;37:63-6.
10. Sim TP, Knowles JC, Ng YL, Shelton J, Gulabivala K. Effect of sodium hypochlorite on mechanical properties of dentine and tooth surface strain.IntEndod J 2001;34:120-32.
11. Adorno CG, Yoshioka T, Suda H. The effect of root preparation technique and instrumentation length on the development of apical root cracks. J Endod 2009;35:389-92. 12. Ruddle CJ. Endodontic disinfection tsunami irrigation.EndodPrac 2008;11:7-15.
13. Slutzky-Goldberg I, Maree M, Liberman R, Heling I. Effect of sodium hypochlorite on dentin microhardness. J Endod 2004;30:880-2.
14. Yoldas O, Yilmaz S, Atakan G, Kuden C, Kasan Z. Dentinal microcrack formation dur-

ing root canal preparations by different NiTi rotary instruments and the self-adjusting file. J Endod 2012;38:232-5.

15. Hin ES, Wu MK, Wesselink PR, Shemesh H. Effects of self-adjusting file, Mtwo, and ProTaper on the root canal wall. J Endod 2013;39:262-4.
16. Kim HC, Lee MH, Yum J et al. Potential relationship between design of nickel titanium rotary instruments and vertica root fracture. J Endod 2010;36:1195-9.
17. Ashwinkumar V, Krithikadatta J, Surendran S, Velmurugan N. Effect of reciprocating file motion on microcrackformation in root canals: an SEM study. Journal of Endodontics 2012;38, 101-4.