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Research Article

EVALUATION OF DENTINAL DAMAGE AFTER ROOT CANAL PREPARATION WITH PROTAPER UNIVERSAL, TWISTED FILES AND MTWO ROTARY SYSTEMS – AN INVITRO STUDY

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Abstract :

Aim: To compare and evaluate the incidence of dentinal damage during canal preparation with three different Ni-Ti Rotary systems (ProTaper Universal, Twisted files and Mtwo files).**Material and Methods:** 40 teeth were selected and canal preparation done with three different rotary systems: ProTaper Universal, Twisted files and Mtwo. Roots were then sectioned at 3mm, 6mm, and 9 mm from the apex and observed under Stereomicroscope. The dentinal defects were observed. **Results:** ProTaper Universal, Twisted files and Mtwo canal preparations showed 30%, 10% and 10% of dentinal defects respectively. No defects were found in the unprepared roots and those prepared with hand files. Significant difference was found between ProTaper Universal and Twisted files and between ProTaper Universal and Mtwo files.**Conclusion:** It can be concluded that irrespective of the rotary systems instruments with greater taper when used for root canal preparation could result in an increased chance for dentinal defects

Key-words: Dentinal defects, Nickel-Titanium instruments, Root canal preparation, Vertical Root Fracture

Key Message: ProTaper Universal, Twisted files and Mtwo files of taper greater than 0.06 when used for root canal preparation results in an increased chance for dentinal defects.

INTRODUCTION

The combination of the use of contemporary available modern devices and files with a solid base of anatomic and biologic knowledge will lead to a predictable higher quality of root canal treatment. Cleaning, Shaping and Obturation of the root canal are the main factors responsible for the success of Root Canal Treatment.

The Nickel–Titanium (NiTi) instruments were introduced for better preparation of root canal. These NiTi instruments prepare the root canal more easily and uniformly than stainless steel instruments [1]. Rotary NiTi instruments revolutionized endodontics by preparing root canal in less chairside time without any ledge formation.

Now there are numerous NiTi rotary file systems available. In spite of their unique properties which improve the Quality and success rate of Root Canal Treatment, NiTi Rotary instruments can induce dentinal damage that leads to fracture of the tooth [2]. The purpose of this invitro study is to compare the dentinal damage after canal preparation with most commonly used rotary systems ProTaper Universal (Dentsply Maillefer, Ballaigues, Switzerland), Twisted Files (Sybron Endo, Orange, CA) and Mtwo (VDW, Munich, Germany).

MATERIALS AND METHODS

Forty extracted Maxillary molars were selected and stored in purified filtered water [3]. Soft tissue and calculus were removed from these teeth mechanically. Mesiobuccal roots of Maxillary molars were selected for this study. Resection of Mesiobuccal root of maxillary molars done with low speed saw under water coolant and observed with a stereomicroscope under magnification X25 to exclude defective teeth.

Forty Mesiobuccal roots of maxillary molars were randomly divided into five experimental groups:

Group I: Ten canals were prepared with ProTaper Universal (Dentsply Maillefer, Ballaigues, Switzerland) using the crown-down technique.

Group II: Ten canals were prepared with Twisted Files (Sybron Endo, Orange, CA) using the crown-down technique.

Group III: Ten canals were prepared with Mtwo (VDW, Munich, Germany) using the crown-down technique.

Group IV: Five canals were instrumented using hand files (K-files, Dentsply Maillefer, Ballaigues, Switzerland) using a balanced force technique.

Group V: Five teeth were left unprepared and served as control group

The length of the root canal was determined with a size 10 K-file; the working length was set at 1 mm short of the apical foramen [4]. In all experimental groups, each canal was instrumented according to the manufacturer's instructions.

Instrumentation with ProTaper Universal system:

Straight line access was prepared and manual glide path with size 10 K-file was achieved. Shaping file S1 was used to the two-third of the working length and Sx is used with brushing action for the coronal enlargement. A size 15 K-file was used to recapitulate the working length and S1 file was used to the working length followed by S2. Then finishing file F1was used to the working length and size 20 K-file was used to gauge the foramen. As this instrument is loose at working length, F2 was used to the working length and size 25 K-file was used to gauge the foramen. Snug fit with size 25 K-file was obtained for all the roots so the instrumentation was terminated at F2 in this group.

Instrumentation with Twisted Files:
Straight line access was achieved and establishment of apical glide path with size 15 K-file was done. Twisted file of ISO size 25 and 0.08 taper (25/0.08) was used to resistance and then withdrawn immediately. Two samples didn't encounter any resistance till it reached to working length. So in these two samples preparation was terminated with 25/0.08 Twisted file. In the remaining eight samples, resistance was encountered with 25/0.08 Twisted file. So 25/0.06 Twisted file was used to the working length and the preparation terminated for those eight teeth with 25/0.06 Twisted file.

Instrumentation with Mtwo system:
Straight line access is achieved and establishment of apical glide path with size 15 K-file was done. The Mtwo file of ISO size 10 and 0.04 taper (10/0.04) was used to the working length followed by Mtwo 15/0.05 file. As soon as working length was reached, then Mtwo 20/0.06 file was used followed by Mtwo 25/0.06 file. In the remaining three samples since this file is loose to working length, Mtwo 25/0.07 file was used to working length. So in three samples preparation terminated at Mtwo 25/0.07 file.

All roots were kept moist in distilled water throughout the experimental procedures. In root canals of all groups, EDTA is used as lubricant and all canals were flushed after each instrument with 5 ml of 3% NaOCl solution and at the end of instrumentation with 5 ml of distilled water using a syringe and a 27-G needle.

After instrumentation, roots were sectioned horizontally at 3mm, 6mm and 9mmfrom the apex with a low-speed saw under water cooling and the slices were then observed under stereomicroscope with 25x magnification. The pictures were then blindly inspected by the second author. Scoring of dentinal defects was given as "no defect," "fracture," and "other defects" [2].

"No defect" was defined as root dentin devoid of any lines or cracks where both the external surface of the root and the internal root canal wall did not present any evident defects [2].

"Fracture" was defined as a line extending from the root canal space all the way to the outer surface of the root [2].

"Other defects" were defined as all other lines observed that did not seem to extend from the root canal to the outer root surface (eg, a craze line, a line extending from the outer surface into the dentin but does not reach the canal lumen, or a partial crack, a line extending from the canal walls into the dentin without reaching the outer surface) [2].

RESULTS

Roots were classified as "defected" if at least one of three sections showed either a craze line, partial crack, or a fracture. Control group (unprepared canals) and Group IV (hand preparation) showed no defects. Craze lines and partial cracks ("other defects") were found in the Protaper Universal, Twisted Files and Mtwo rotary systems. In Protaper Universal system out of ten samples, three samples showed defects, in Twisted Files and Mtwo rotary systems out of ten samples, one sample showed defect.

Statistical analysis is done with Paired t-test to compare the appearance of defected roots between the experimental groups by using the SPSS/PC version 15. Significant difference was found between ProTaper Universal and Twisted files and between ProTaper Universal and Mtwo files. ($p < 0.03$).

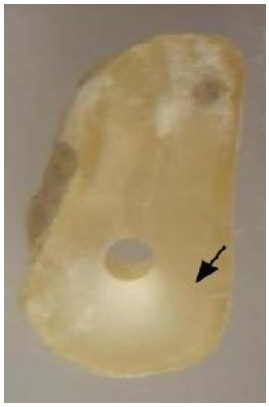
Figure 1

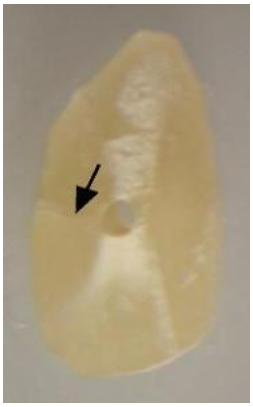
Figure 2

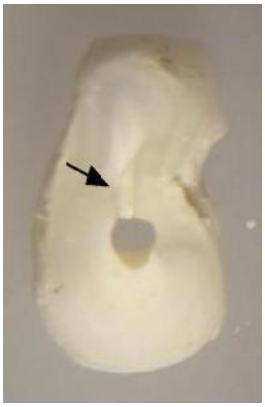
Figure 3

Figure 1. Protaper Universal sample with defect
Figure 2. Twisted Files sample with defect
Figure 3. Mtwo sample with defect

DISCUSSION

Vertical root fracture (VRF) is a uncommon fracture that occurs in Endodontically treated teeth [5]. In most incidences where VRF that occurs in these teeth is due to the canal filling procedures or due to the post placement [6]. But when canal preparation is carried out with NiTi rotary instruments it may result in dentinal defects like craze lines or cracks in the dentin [4, 7]. These defects may not result in VRF immediately but due to forces of mastication or during retreatment procedures these craze lines or cracks may lead to VRF. The dentinal defect that arises in the root during the canal preparation depends on the taper of the instrument, design of the instrument and rotations per minute (rpm) of the instrument [8]. All these factors contribute to the development of cracks and crazelines in the root.

Hyeon-Cheol Kim et.al., concluded that the design of rotary file affect the shaping forces on root dentin resulting in an increased risk of root fracture [8]. Chankrit S et.al., explained through his study that after root canal preparation, the reduction in dentin wall thickness is an important factor for increased fracture susceptibility [9]. Tannaz Zandbiglari et.al., came to a conclusion that roots were significantly weakened by preparation with greater taper instruments [10]. A similar study was done by Carlos Alexandre Souza Bier et.al., in which they used three rotary instruments namely ProTaper, Greater Taper and S Apex files to evualate the dentinal defects after canal preparation with these files. They concluded that when NiTi rotary instruments with a taper of atleast 0.06 or greater are used for canal preparation results in dentinal defects [2].

This study was carried out to evaluate the dentinal damage by three different most commonly used rotary instruments namely ProTaper universal, Twisted files and Mtwo after canal preparation. The results of the present study were in accordance of the previous studies in which dentinal damage has occurred when rotary instruments of greater than 0.06 taper were used [2, 8, 9, 10].

In the present study Group I (ProTaper Universal system) has showed three defects when compared to Group II (Twisted Files rotary system) and Group III (Mtwo rotary system) which showed only one defect. The reason may be attributed that in Group I (ProTaper Universal system), all samples were terminated at finishing file F2 which has a tip diameter of ISO size 25 and a taper of 0.08 mm/mm which increases from D0 to D3. From D4 to D16 it shows a decreased taper.

In Group II (Twisted Files rotary system) out of ten samples, two samples were prepared with 25/0.08 in which one sample showed defects. The reason is that 25/0.08 instrument has a tip diameter of ISO size 25 and has a taper of 0.08mm/mm which increases from D0 to D16.

In Group III (Mtwo rotary system) one sample showed defects out of three samples prepared with 25/0.07. The reason is that Mtwo 25/0.07 instrument has a tip diameter of 25 and has a taper of 0.07mm/mm which increases from D0 to D16.

No defects were seen in samples prepared with taper equal to or less than 0.06 in experimental groups or in samples prepared with hand files.

In the present study, methodology of the root canal preparation in all the samples was carried out according to the manufacturer's instructions. In Group I (ProTaper Universal system) all the samples preparation were terminated with more than 0.06 taper instruments, out of which only three showed the dentinal defects i.e., 30% of the samples showed defects. In Group II (Twisted Files rotary system) two samples preparation were terminated at more than 0.06 taper instruments, out of which one showed the dentinal defect i.e., 50% of the samples showed defects. In Group III (Mtwo rotary system) three samples preparation were terminated at more than 0.06 taper instruments, out of which one showed the dentinal defect i.e., 33% of the samples showed defects.

When preparation of the samples were terminated at more than 0.06 taper, the dentinal defects percentage is not uniform in all the three groups. This is because the dentinal defects that occur in root canal preparation are not only because of the taper of the instrument but also due to design of the instrument and rpm (speed) of the instruments which were not tested in this study [11]. In the present study only taper of the instrument was considered for evaluating the dentinal defects.

In overall comparison of all the groups irrespective of all the rotary systems, out of thirty samples fifteen samples preparation were terminated at more than 0.06 taper instruments. Out of fifteen samples, five samples have showed the defects. When taper of the instrument is increasing, it tends to remove more root dentin compromising the root which is more likely to get dentinal defects [5, 7].

CONCLUSION

Under the tested conditions and within the limitations of this in-vitro study, it may be concluded that irrespective of the rotary systems, greater than 0.06 taper instruments when used for root canal preparation could result in an increased chance for dentinal defects.

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REFERENCES

1. Veltri M, Mollo A, Pini PP, Ghelli LF, Balleri P. In vitro comparison of shaping abilities of ProTaper and GT rotary files. J Endod. 2004; 30:163-6.
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. Strawn SE, White JM, Marshall GW, Gee L, Goodis HE, Marshall SJ. Spectroscopic changes in human dentine exposed to various storage solutions - short term. J Dent. 1996; 24:417-23.
4. 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.
5. Shemesh H, van Soest G, Wu MK, Wesselink PR. Diagnosis of vertical root fractures with optical coherence tomography. J Endod. 2008; 34:739-42.
6. Fuss Z, Lustig J, Katz A, Tamse A. An evaluation of endodontically treated vertical root fractured teeth: impact of operative procedures. J Endod. 2001; 27:46-8.
7. Pilo R, Corcino G, Tamse A. Residual dentin thickness in mandibular premolars prepared with hand and rotatory instruments. J Endod. 1998; 24:401-4.
8. 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.
9. 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.
10. Zandbiglari T, Davids H, Schäfer E. Influence of instrument taper on the resistance to fracture of endodontically treated roots. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2006; 101:126-31.
11. Uzun O, Topuz O, Aydýn C, Alaçam T, Aslan B. Enlarging characteristics of four nickel-titanium rotary instrument systems under standardized conditions of operator-related variables. J Endod. 2007; 33:1117-20.