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Original Article

Evaluation of effect of HyFlex EDM on root dentin during root canal preparation- A stereomicroscopic study

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ABSTRACT

Background: *Root canal preparations done using many rotary endodontic instruments results in formation of root dentin defects because of the stress induced by the instruments within the root canal during cleaning and shaping, thereby worsening the long term prognosis of the root canal treated teeth. Many rotary instruments are been globally studied for the purpose of generating a correct instrument for root canal preparation.*

Objective: *This study was done to evaluate the effect of HyFlex EDM, which is a new rotary system on root dentin during root canal preparation.*

Materials and methods: *Fourteen single rooted premolars were selected and divided into two groups, Group 1- Protaper Universal and Group 2-HyFlex EDM. All the specimens were decoronated. Roots of each specimen were sectioned at 3mm, 6mm and 9mm and were then viewed under stereomicroscope for dentinal defects. t-test was done for the statistical analysis and level of significance was set at p= 0.05.*

Results: *Protaper Universal showed highest percentage of defect than HyFlex EDM.*

Conclusion: *HyFlex EDM showed lowest percentage of defects in root dentin. Thus, HyFlex EDM is more efficient in root canal preparation than that of Protaper Universal thereby preventing dentinal defects or microcracks leading to root fractures.*

Key Words: *HyFlex® EDM, dentinal defects, protaper universal, root canal preparations*

Introduction

The main mechanical objective of cleaning and shaping of root canal is complete and centered incorporation of the original canals into the prepared shape as well as to retain as much cervical and radicular dentin as possible so as not to weaken the root structure, thereby preventing root fractures.[1] Root canals prepared by Nickel-Titanium instruments have shown better results over the traditional hand files concerning ledge & zip formations, canal transportations and perforations.[2] This better results are because of increased flexibility and superelasticity of the nickel-titanium alloy and specific geometric design feature of each instrument. But, cleaning and shaping with rotary nickel-titanium instruments having active cutting edges & larger taper which produce significant forces on root dentin during root canal preparation and leads to dentinal defects in the root, or apical root microcracks which have higher amount of potential to develop into root fracture, thus weakening the integrity of the root and worsening the long term prognosis of root canal treated teeth.[3]

ProTaper universal file system (Dentsply Maillefer, Ballaigues, Switzerland), is the gold standard in endodontics since many years. With its progressively tapered design and efficiency they help to achieve a fully tapered canal exhibiting a uniform shape. It has been proven that canals prepared by ProTaper Universal have always shown consistent outcomes in the success of every root canal treatment till date. HyFlex® EDM (Coltene) is a new rotary system developed recently. Due to its controlled properties HyFlex® EDM files follow the anatomy of the canal, which can significantly reduce the risk of ledging, transportation and perforation. The built-in shape memory of HyFlex® EDM files prevents stress during canal preparation by changing their spiral shape thus preventing formation of microcracks and root dentin defects.

Thus, the purpose of this present study was to evaluate the effect of HyFlex® EDM in comparison to that of Protaper® Universal, in forming root dentin defects or root microcracks in the surface of the root after root canal shaping.

Materials and Methods

Fourteen single-rooted human extracted premolars were collected and kept in distilled water until use. Teeth with developmental anomalies, root caries, root fractures, resorption and teeth with calcifications in the canal and curved roots were all excluded from the study. To ensure standardization all the collected teeth were decoronated by using a diamond disc under water cooling, maintaining length of the root approximately 10mm from the apex. The root surface was inspected under stereomicroscope at 12X to exclude teeth with any external defects or cracks. During the study, specimens were wrapped in a 4x4 wet gauze and kept moist.

The working length of the canals was then established using #10 K-file (Dentsply Maillefer, Ballaigues, Switzerland). The specimens were then divided into two groups, each group containing seven specimens each. Group 1: Protaper® Universal and Group 2: HyFlex® EDM. In both the groups, preparation of the canals was done using speed and torque controlled motor (X-SMART; Dentsply, Maillefer). In Group 1 (Protaper® Universal) preparation of canals was done at 300rpm using ProTaper Ni-Ti rotary files. The shaping file X was used for coronal enlargement, and then S1 and S2 files consecutively used at the working length. In Group 2 (HyFlex® EDM) all files were used at 500 rpm and at a torque of up to 2.5 Ncm except the Glidepath file, which was used with 300 rpm and at a torque of up to 1.8 Ncm according to the manufacturer's instructions upto the working length. Initially 25/0.12 Orifice Opener file was used, followed by #10 K-file(Dentsply Maillefer, Ballaigues, Switzerland), and then consecutively 10/0.05 Glidepath File and 25/~ HyFlex one shaping file. Irrigation of root canals of specimens in both the groups was done using 5.25% sodium hypochlorite solution constantly before proceeding to the next instrument. Flutes of instruments were cleaned repeatedly to check any signs of wear or distortion.

Sectioning and Microscopic Evaluation

All the specimens were then sectioned at 9mm, 6mm and 3mm from the apex, perpendicular to the long axis using diamond disc under water cooling. Each section was then observed under digital stereomicroscope at 40X magnification. Digital images of each section were taken using digital camera (Olympus, Tokyo, Japan). There were two operators to check each specimen for the presence or absence of root dentin defects. All the root specimens were then divided into three categories: Defect, no defect and other defect. Defect includes a line extending from the root canal walls all the way to the external root surface. In No defect, no defect is seen on both the external and internal surface of the root. Other defect includes other lines observed which are not complete for example, a crack extending from external root surface into the dentin but not reaching the canal lumen or any other small crack extending from canal lumen into the dentin but not reaching the external root surface.

The results were expressed as the number and percentage of defects in both of the groups. The data was analyzed using t-test. The level of significance was set at $P = 0.05$. Statistical analysis was performed using SPSS software.

Results

Group 1 (Protaper® Universal) showed highest percentage of defect (4/7) in comparison to Group 2, that is HyFlex® EDM (1/7). Statistical difference was seen between both the groups ($P < 0.05$). Figure 1 is a bar chart which shows the number of root dentin defects in both the groups. Figure 2 and Figure 3 shows the stereomicroscopic digital images of the specimens.

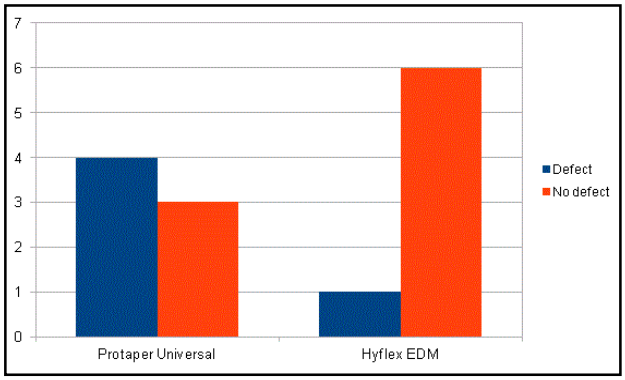

Fig.1 Number of root dentin defects in group 1 & 2

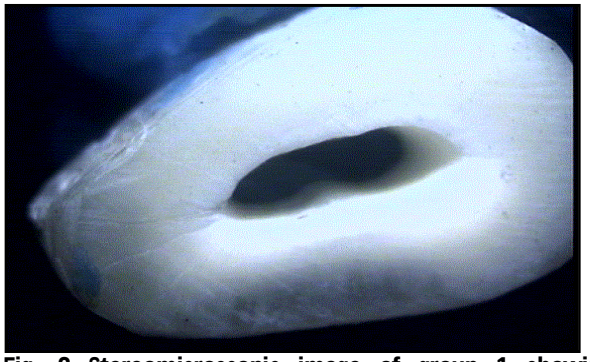

Fig. 2 Stereomicroscopic image of group 1 showing complete fracture line seen extending from canal lumen to the external surface

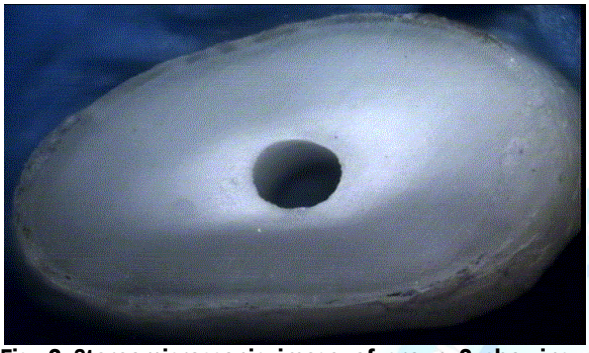

Fig. 3 Stereomicroscopic image of group 2 showing no defect

Discussion

In this study, the root dentin defect observed in Group 1 (Protaper® Universal) was 4/7(57.14%) and in Group 2 (HyFlex® EDM) was 1/7(14.28%). The results of the present study are in accordance with the results by Bier et al., where the Protaper® Universal rotary files showed highest incidence of dentinal damage.[3] Root dentin defects or micro cracks were incident more in number in the apical 3mm sections of the root which may be due to maximum stress in the apical third of the root canals during cleaning and shaping by rotary files.

HyFlex® EDM is a new development in rotary endodontics. These files are produced using an innovative manufacturing process called Electrical Discharge Machining. The EDM process results in a file that is extremely flexible and fracture resistant. HyFlex® EDM files are up to 700% more resistant to cyclic fatigue compared to traditional Ni-Ti files. Because of their controlled properties they have the ability to follow the anatomy of the root canal and thereby reduce the risks of perforations, ledging and transportations. The combination of flexibility, fracture resistance and cutting efficiency of the HyFlex® EDM make it possible to reduce the number of files required for cleaning while preserving the anatomy. Provided as a modular system of sterile instruments, HyFlex® EDM includes Shaping, Glidepath, OneFile, Orifice Opener and Finishing files and may be used in combination with HyFlex CM files. The built-in shape memory of HyFlex® EDM files prevents stress during canal preparation by changing their spiral shape. A normal autoclaving process is enough to return the files to their original shape and fatigue resistance.

ProTaper universal files whereas have active rotating movements which leads to increased amount of stress concentration within the canal while doing root canal instrumentation.[4] Kim et al in his article stated that increased stress on the root canal walls is caused due to the taper of files.[5] The progressive greater taper of ProTaper universal causes removal of coronal dentin more, thus leading to more number of defects or micro cracks. More the forces generated during root canal instrumentation more is the risk of root fracture.[5] As the basic goal of endodontic treatment is resistant to tooth fracture, success rate of the treatment decreases along with the long term survival rate due to such fractures in the root dentin.[6,7] Liu et al, reported that 25% of roots have shown defect or cracks which were instrumented using ProTaper.[8] Hin et al. reported that ProTaper caused cracks in 35% of roots instrumented with it.[9] Kansal et al. in his study also concluded that ProTaper when used in full sequence results in more microcracks formation than the other systems.[10] Wilcox et al. stated that the if the removal of root dentin is more, then the chances of root fractures also increases.[11]

The periodontal ligament was not been stimulated in this study. Capar ID et al, expressed that stimulation of periodontal ligament was important for investigating the influence of forces on forming crack or fracture strength. Including this periodontal ligament also has a viscoelastic property which helps in dissipation of forces

created by the application of various loads to the teeth.[12]

Hence, it's clear that defects in root dentin is due rotational forces within the canal while root canal preparation, in relation with the instrument design, cross-sectional geometry, taper and the form of their flutes.[13] ProTaper files have progressive taper and thus increased stiffness which results in more dentin removal.[14] Therefore, within the limitations of this study its concluded that HyFlex® EDM is more efficient in root canal cleaning and shaping in comparison to Protaper® Universal thereby maintaining the integrity of the tooth by preventing root dentin defects resulted due to excess amount of stress within the canal wall.

References

1. Kenneth M Hargreaves, Louis H Berman. Cohen's Pathways of the pulp. First south Asia Edition. USA: Elsevier - Saunders, Mosby, Churchill; 2016.p.210-11.
2. Park H. A comparison of Greater Taper files, Profiles, and stainless steel files to shape curved root canals. Oral Surg Oral Med Oral Pathol Oral radiol Endod 2001;91:715-8.
3. Bier CAS, 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.
4. West JD. Introduction of a new rotary endodontic system: progressively tapering files. Dent Today 2001;20:50-7.
5. 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.
6. 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.
7. 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.
8. Liu R, Kaiwar A, Shemesh H, Wesselink PR, Hou B, Wu MK. The 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.
9. 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.
10. Kansal R, Rajput A, Talwar S, Roongta deR, Verma M. Assessment of dentinal damage during canal preparation using reciprocating and rotary files. J Endod 2014;40:1443-6.
11. Wilcox LR, Roskelley C, Sutton T. The relationship of root canal enlargement to finger-spreader induced vertical root fracture. J Endod 1997; 23:533–4.
12. 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.
13. 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.
14. Bergmans L, Van Cleynenbreugel J, Beullens M, Wevers M, Van Meerbeek B, Lambrechts P. Smooth flexible versus active tapered shaft design using NiTi rotary instruments. Int Endod J 2002;35:820-8.

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