RESEARCH ARTICLE

INFLUENCE OF GLIDE PATH TECHNIQUE ON THE DENTINAL CRACK FORMATION OF HYFLEX EDM SYSTEM WITH OR WITHOUT USING HYFLEX EDM GPF- AN VITRO STUDY


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ABSTRACT

Introduction: Cleaning and shaping of the root canal is the single most important phase of endodontic therapy. The goal of root canal instrumentation is to obtain a continuous tapering funnel flowing with the shape of the original canal from the coronal access to the apex, so the Glidepath is the answer. The present study evaluated the influence of different glide path techniques on the dentinal crack formation of Hyflex EDM system such as Hyflex EDM GPF, Proglider, Neendo flex Glide files. Aim: The aim of this study was to evaluate the influence of glide path technique on the dentinal crack formation of Hyflex EDM system with or without using Hyflex EDM GPF. Materials and Method: 30 single rooted teeth were selected for study. 10 teeth were left as unprepared as the control group. 10 teeth were prepared with Hyflex EDM without glidepath, and the remaining 10 teeth were assigned to Hyflex EDM GPF. All the specimens were sectioned perpendicular at 3.69mm. Digital images of each section were captured at 25X magnification using a digital camera attached to a stereomicroscope. The results were expressed as the number and percentage of cracked roots in each group. The Chi-square test with Yates correction was used to determine for difference between groups. P value of less than 0.05 was considered statistically significant for all tests. Result: There were no significant differences in crack formation between Hyflex EDM system with and without glide path preparation. Conclusion: The creation of a glide path with Hyflex EDM GPF before Hyflex EDM rotary system did not influence dentinal crack formation in root canals.

Key Words: Dentinal damage, Hyflex EDM, Hyflex EDM GPF.

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INTRODUCTION

Cleaning and shaping of the root canal is the single most important phase of endodontic therapy. The goal of root canal instrumentation is to obtain a continuous tapering funnel flowing with the shape of the original canal from the coronal access to the apex. And so the Glidepath is the answer. It is the starting point of radicular preparations. Without it, cleaning and shaping becomes unpredictable or impossible because there is no guide for endodontic mechanics (Anil et al., 2014). Endodontic glide path which has been defined as a smooth radicular tunnel from the canal orifice of the canal to the apical foramen of the root canal (Damla et al., 2017). During biomechanical preparation, a canal is shaped by the contact between instruments and dentinal walls. These contacts create many momentary stress concentrations in dentin. Such stress concentrations may induce dentinal defects and micro cracks or craze lines. These in turn, were associated with increased susceptibility to Vertical root fracture (VRF) because of applied stresses caused by root canal obturation, retreatment, repeated occlusal forces and can be exponentially amplified at the tip of those defects and can initiate or propagate into cracks (Ravi et al., 2015). Nickel-titanium (NiTi) rotary instruments were introduced to improve root canal preparation.

In clinical practice these instruments are associated with an increased risk of fracture, mainly because of bending normal stresses (failure by fatigue) and torsional shear stresses (failure by torque) (Berutti et al., 2009). Initially, when rotary files were introduced there was no recommendation for glidepath creation. Subsequently, instrument fracture became a significant issue until glide path creation became known as an adjunct to safe rotary use. Creating a manual or mechanical glide path was shown to be the first step for safer use of nickel titanium (Ni-Ti) rotary instrumentation because this procedure prevents fracture, shaping aberrations, and torsion of instruments. Additionally, creating a glide path is recommended to reduce the risk of taper lock and frictional forces to the canal walls especially in curved canals. Several path finding rotary systems are available for use in creating a glidepath. Numerous studies have investigated the effects of different path finding systems on root canal anatomy preservation, remaining dentin thickness, and separation incidence of instruments. It was reported that glide path preparation reduced root canal modification, canal aberrations, excessive dentin removal, and separation incidence (Uzungolgu and Turker, 2015). Another innovation has been introduced into Hyflex file series i.e. Hyflex EDM. Hyflex EDM 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. In fact, Hyflex EDM files are up to 700% more resistant to cyclic

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fatigue compared to traditional NiTi files. HyFlex EDM files follow the anatomy of the canal, which can significantly reduce the risk of ledging, transportation and perforation. Just like HyFlex CM files, HyFlex EDM files offer trusted controlled memory effect and regenerative properties. The built-in shape memory of HyFlex EDM files prevents stress during canal preparation by changing their spiral shape.

**HyFlex EDM GPF (Coltene)** will permit the clinician to negotiate working length quickly and efficiently. This controlled memory files track well in the apical third and allow safer, more efficient preparations. They are available in 25mm length with tip size 10 and taper of 0.05. Therefore, the aim of this study was to investigate the dentinal crack formation of Hyflex EDM system with or without using Hyflex EDM GPF.

**MATERIALS AND METHODS**

The present study was conducted in the Department of Conservative Dentistry and Endodontics, D.J. College of Dental Sciences and Research, Modinagar, Uttar Pradesh and Spectro-Analytical Lab New Delhi. 30 single rooted teeth that had been extracted for reasons unrelated to this study were collected and kept in distilled water. 10 teeth were left as unprepared as the control group. 10 teeth were prepared with Hyflex EDM without glidepath, and the remaining 10 teeth were prepared with Glidepath file Hyflex EDM GPF. The external root surfaces were inspected under a Stereomicroscope (Olympus BX43; Olympus Co, Tokyo, Japan) to exclude the possibility of any external defects or cracks.

**Specimen preparation:** To ensure standardization, the teeth were section under water cooling with a diamond disc 16 mm from the apex. The roots were covered with a single layer of aluminium foil. The root inserted in acrylic resin set in an acrylic tube. The roots were then removed from the acryl tube, and the aluminium foil suspended from the root surface. A light body silicon-based material was used to fill the space created by the foil and to simulate the periodontal ligament, and the root was replaced to the impression. The working length of the canals were determined by inserting a size 10 K-type file into the root canal terminus and subtracting 1 mm from this measurement.

**Control group:** 10 Teeth were left unprepared as control group.

**HYFLEX EDM [Group 1]:** Ten teeth were prepared using Hyflex EDM system, without using glide path files according to the manufacturer’s instructions at 500 rpm and 2.5 Ncm torque with torque-controlled endodontic motor (X-Smart; Dentsply Maillefer).

**HYFLEX EDM GPF/HYFLEX EDM [Group 2]:** Using the torque-controlled endodontic motor (X-Smart; Dentsply Maillefer), a glidepath is created with Hyflex EDM GPF(15/0.05) at 300 rpm and 1.8 NCm torque, then canal was shaped with Hyflex EDM system (25/0.06) according to the manufacturer’s instructions at 500 rpm and 2.5 Ncm torque. The root canals are irrigated with 1% sodium hypochlorite solution after each instrument change. After preparation, the specimens from the prepared groups were rinsed with distilled water.

**Sectioning and Microscopic Examination:** All of the roots were sectioned perpendicular to the long axis at 3.6 and 9 mm from the apex using a low-speed diamond disc under water cooling. Digital images of each section were captured by using a digital camera attached to a stereomicroscope. Digital images of each section were captured at 25X magnification using a digital camera attached to a stereomicroscope.

**Criteria for detection of cracks:** In order to avoid confusing descriptions of root fractures, two distinct categories were made: “no defect” and “defect”.

1. **No defect:** Root dentine was devoid of any lines or cracks where both the external surface of the root and the internal root canal wall did not have any evident defects.

2. **Defect:** The samples were classified as “with defect” if at least one of the three sections had a craze line, a partial crack, or a fracture.

- **Craze line:** a line extending from the outer surface of the root into the dentine without reaching the canal lumen.
- **Partial crack:** a line extending from the root canal walls into the dentine without reaching the outer surface.

**Statistical Analysis:** The results were expressed as the number and percentage of cracked roots in each group. The Chi-square test with Yates correction was used to determine for difference between groups. P value of less than 0.05 was considered statistically significant for all tests. Statistical analyses were performed using SPSS 19.0 software (SPSS, Inc., Chicago, IL, USA).

**RESULTS**

The numbers of roots with cracks for all groups are shown in Table 1. No cracks were observed in the control group. When considering the crack formation in total sections, crack formation was found to be 13.3% in group 2, while 16.6% was observed in group 1. However, there were no significant differences between the two experimental groups (p = 0.134). Regarding the different section levels (1, 2, 3, 4, 6, and 8 mm), no significant difference was found between the experimental groups at any level.

<table>
<thead>
<tr>
<th></th>
<th>Section level</th>
<th>From the apex</th>
<th>Total (%)</th>
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<tbody>
<tr>
<td></td>
<td>3mm</td>
<td>6mm</td>
<td>9mm</td>
</tr>
<tr>
<td>Control</td>
<td>30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hyflex EDM (Group1)</td>
<td>30</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Hyflex EDM GPF/ Hyflex EDM (Group2)</td>
<td>30</td>
<td>1</td>
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DISCUSSION

The use of nickel–titanium (NiTi) instruments during root canal preparation causes cracks in root dentine. Coronal enlargement and pre-flaring to produce a glide path have been recommended as the initial procedures for safe use of NiTi rotary instrumentation as they prevent taper lock, shaping aberrations, fracture of instruments and excessive instrument binding in root canal. The dentinal crack formation may increase due to the excessive instrument binding and the maximum contact between the file and dentin. Therefore, the present study aimed to compare the effect of different glide path Ni-Ti rotary systems on formation of dentinal crack on root canals (Damla et al., 2017). In our study, we used Hyflex EDM GPF to create glide path for Hyflex EDM system. There were no significant differences between Hyflex EDM and Hyflex EDM GPF group significantly. HyFlex® EDM is a new development in rotary endodontics. These files are produced using an innovative manufacturing process called Electrical Discharge Machining.

The EDM is a non contact machining procedure used in engineering for manufacturing the parts that would be difficult to machine with conventional techniques. The removal of material is performed by pulsating electric current discharges that flow between an electrode and the work piece are immersed in a dielectric medium. The electric current partially melts and evaporates small portions of the material in a well-controlled and repeatable manner. The material is therefore superficially removed, leaving an isotropic surface, characterized by regularly distributed craters. 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. 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 (Pirani et al., 2016; Miura et al., 2013).

Hyflex EDM GPF (Coltene) will permit the clinician to negotiate working length quickly and efficiently. This controlled memory files track well in the apical third and allow safer, more efficient preparations. They are available in25mm length with tip size 10 and taper of 0.05 (Bier et al., 2009). Bier et al. (2012) stated that the taper of the files could be a contributing factor in dentinal crack formation (Liu et al., 2012; Patino et al., 2015). Yoldas et al. (2012) claimed that the tip design of rotary instruments, cross-sectional geometry, constant or variable pitch and taper, and flute form could be related to crack formation (Yilmaz et al., 2017). Hyflex EDM and Hyflex EDM GPF have similar design, three different cross-sections over the entire length of working part (rectangular) in apical part, trapezoidal cross-section in middle part, triangular in coronal part to increase fracture resistance, and cutting efficiency. The use of different speed and torque settings for each file system could be a limitation of the present study. Peters et al stated that increased rotational speed was associated with increased cutting efficiency (Zanette et al., 2014). Unfortunately in the in vitro condition of the study, limit the clinical relevance due to variability in study design and evaluation technique. However the validity of this in vitro study is well appreciated by having more number of clinical trials and hence further randomized controlled clinical trials are recommended.

Conclusion

Within the limitations of this in vitro study, the creation of the glide path before Hyflex EDM rotary system did not influence dentinal crack formation in root canals. Further studies should be conducted to evaluate the effect of glide path created with different type of path-finding systems on crack formation.

REFERENCES


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