

Comparative Evaluation of Dentinal Crack Formation by Three Different Heat Treated Single File Systems in Rotation Motion- A Scanning Electron Microscopic Study

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Abstract:

➤ Aim

The aim of the study was to compare the dentinal crack formation by different heat treated single file systems ,namely TruNatomy ,One Curve, AF F One and Protaper F1 using Scanning Electron microscopy.

➤ Materials And Methods

Forty extracted mandibular premolars were taken. After cleaning the soft tissue debris and calculus from the surface of the teeth, the teeth were decoronated with a low speed diamond disc under water cooling to obtain the roots of standardized lengths of 12mm.

In group 1, root canals were prepared with the TruNatomy files. In Group 2, One Curve files were used to prepare the canals. In Group 3, AF F One file was used . In Group 4, the root canals were prepared with Protaper F1. During cleaning and shaping ,irrigation was performed with sodium hypochlorite and normal saline. Then after root canal preparation ,all canals were irrigated with 2 ml distilled water and the roots were kept moist in distilled water throughout all experimental procedures to prevent the effect of dehydration on roots.

➤ Conclusion

TruNatomy rotary files produced fewer dentinal cracks when compared to other files tested. AF F One files caused statistically significant increase in dentinal crack formation than other tested groups.. There was no statistically significant difference in crack formation between One Curve and ProTaper Gold files.

Keywords: Dentinal Crack, Heat Treated Files, Scanning Electron Microscope.

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I. INTRODUCTION

Formation of microcracks in root dentine is initiated by various factors such as design of the rotary instruments, thermal treatments, cross sectional design and kinematics. Cleaning and shaping procedures and instrumentation by rotary files have the potential to induce crack formation, which can lead to complete fractures under functional load.¹

The use of NiTi files with full rotation is standard in endodontics despite frequent fractures which occur as a result of possible screwing in the canal . The fear of possible

breakage is increased in sets with more files, so new concepts of preparation with a smaller number of files in a set (three) or with only one file have been introduced.²⁻⁵

Single file canal preparation shortens the duration of an endodontic intervention , eliminates cross contamination and saves time and cost. This minimizes the fatigue of the file thereby reducing the risk of fracture.²⁻⁵

Regardless of the advances made in rotary instrumentation, dentinal defects are observed with most of the systems. Only limited studies have examined the

influence of heat treated single files in dentinal crack formation.

➤ Aim

To compare the dentinal crack formation by different heat treated single file systems ,namely TruNatomy ,One Curve, F One and Protaper F1 using Scanning Electron microscopy.

II. MATERIALS AND METHODS

A total of 40 mandibular premolars devoid of caries and restorations extracted for orthodontic purposes were selected. They were equally distributed in the following groups.

- 1] Group 1- Endodontic rotary NiTi file ,TruNatomy[Dentsply Sirona]
- 2]Group 2 – Endodontic rotary NiTi file ,One Curve [Micromega,Besancon,France]
- 3]Group 3- Endodontic rotary NiTi file , F One[Fanta Dental Materials]
- 4]Group 4 – Endodontic rotary NiTi file , Protaper F1[Dentsply Sirona][control group]

After cleaning the soft tissue debris and calculus from the surface of the teeth, the teeth were decoronated with a low speed diamond disc under water cooling to obtain the roots of standardized lengths of 12mm[fig 1]. The samples were equally divided into four groups with each group having 10 samples . Following this, root canal preparation was done .



Fig 1: DE Coronation of Samples

The glide path was established using a 10 k file .Then, rotary file was taken and attached to the endomotor at 300 rpm speed and 2.5 NCm torque. The stopper was adjusted to 12mm . The file was coated with EDTA gel and preparation was done using this single file system .Irrigation was done with normal saline and 5.25 % sodium hypochlorite .

After the root canal preparation, all the roots were sectioned 3mm horizontally from the apical region with a low speed diamond saw under water cooling. The sections were then viewed under a scanning electron microscope. A total of 40 images were examined and classified as crack and no crack. [figure 2 and 3]

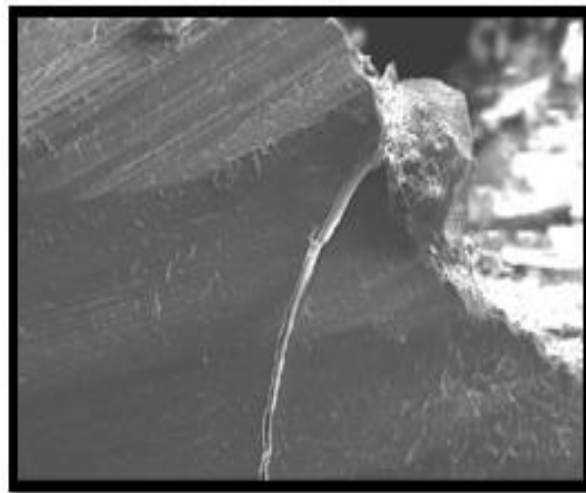


Fig 2 : Crack Formation in AF F One Group

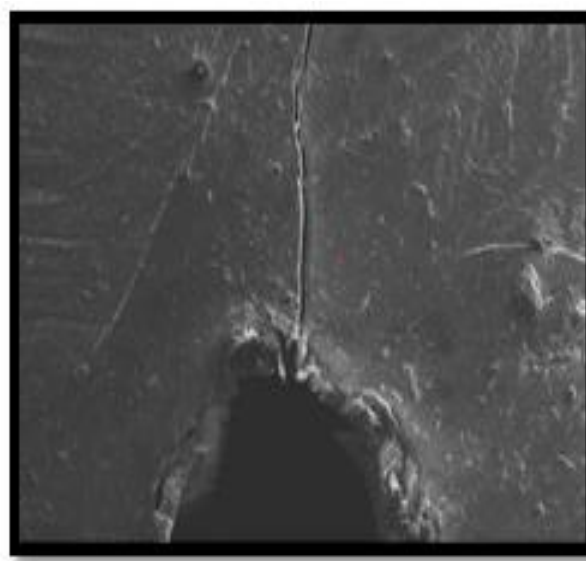


Fig 3: Crack Formation in One Curve Group

III. RESULTS

TruNatomy rotary files induced fewer dentinal cracks when compared to other files tested.

IV. STATISTICAL ANALYSIS

Data was analyzed using the statistical package **SPSS 26.0** (SPSS Inc., Chicago, IL) and level of significance was set at **p<0.05**. **Descriptive statistics** was performed to assess the mean and standard deviation of the respective groups.. **Inferential statistics** to find out the difference between the groups was done using **Chi square test**. **One way Anova followed by Tukey's HSD posthoc test** was used for comparison the data in a continuous scale.

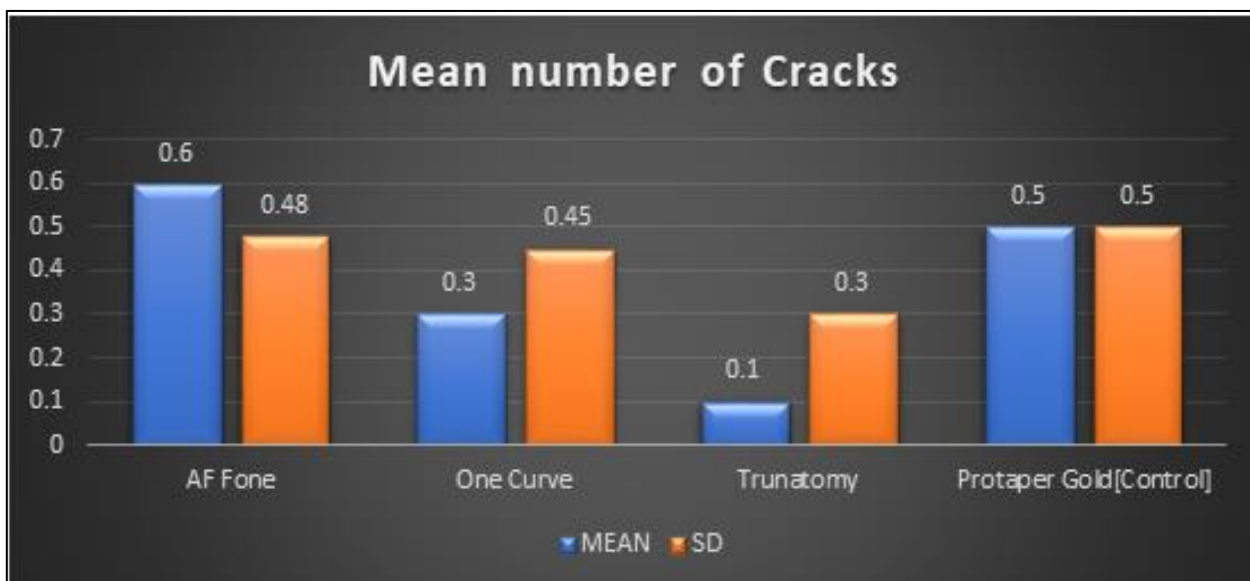


Fig 4 Inferential Statistics

V. DISCUSSION

The effect of nickel titanium rotary instruments on root dentine is still a concern and manufacturers are focusing on improving the properties and minimizing the damage caused by these files. Nickel titanium rotary instruments are preferred by the clinicians due to their increased cutting efficiency and decreased time of preparation.

Despite the irrefutable clinical advantages of rotary instruments over hand instrumentation, the influence of the design of the cutting blades could generate increased stresses within the root canal wall. These rotary instruments require less time to prepare canals as compared with hand instruments but result in significantly more rotations of the instruments within the canal. This may cause more friction between the files and the root canal walls.⁶⁻⁸ Since vast majority of files manufactured uses continuous rotation motion, the present study used continuous rotation.

Single file systems helps in speeding up the endodontic treatment and saves the time of both the dentist and the patient. When single files are used in rotation motion, there are chances of screwing within the canal. But, single files manufactured using thermal treatment have increased flexibility and cyclic fatigue resistance. When there is improved flexibility and fatigue resistance, there are better chances of preservation of original canal anatomy and reduction in the occurrence of microcracks.

Scanning electron microscope was used to detect the presence of crack as it produces magnified images using electrons instead of light. Scanning electron microscopy has got a larger depth of field and high resolution which helps in better visualization of the defects.

In the present study, TruNatomy produced fewer cracks when compared to other systems used. This can be attributed to the metallurgical properties and design features of TruNatomy. TruNatomy is manufactured using thermal

treatment post grinding and this offer superior flexibility for the file. Unlike conventional rotary instruments which has got blank diameter of 1.1mm, TruNatomy has got a blank diameter of 0.8mm. TruNatomy instruments has got an off centered parallelogram cross section, regressive taper and thinned design.

When compared to TruNatomy, One Curve files have more constant taper. This might have contributed to increased number of cracks in One Curve group when compared to TruNatomy.

In this study, AF F One showed highest incidence of micro cracks when compared to other files. This system has got a patented flat sided design and improved cyclic fatigue resistance. It has got s shaped cross section. It does not have controlled memory and is not pre-bendable. The unique flat sided design and heat treatment might have contributed to improved cyclic fatigue resistance of the file but did not reduce the effect of the files on the root dentine.

VI. CONCLUSION

Within the limitations of the present in vitro study, TruNatomy files produced fewer cracks when compared to the other files. AF F One files produced the maximum number of cracks. Files with reduced core diameter and regressive taper produced fewer number of cracks.

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