

Dentinal Cracks After Root Canal Retreatment*: A Comparative Evaluation Using Hand and Three Rotary Ni-Ti Retreatment Systems

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ABSTRACT

Background: The aim of this study was to determine the cracks formation in root dentin after retreatment procedures performed by using three rotary retreatment systems and hand files.

Materials and methods: Forty mandibular premolars extracted for orthodontic reasons were selected. The teeth were prepared with F2 ProTaper hand files and filled with gutta-percha and AH Plus sealer. Specimens were then divided into 4 groups (n = 10), and retreatment procedures were performed with the following techniques: group 1 hand filing using H files, group 2 ProTaper Universal retreatment files, group 3 MicroMega retreatment files and group 4 Mtwo retreatment files and the average time taken for each sample was noted. All roots were then sectioned perpendicular to the long axis at coronal, middle and apical portions. The sections were inspected under a stereomicroscope, and crack formations were recorded. Statistical Analysis: The data was analyzed with a chi-square test and one way ANOVA test.

Results: There were crack formations in all the groups. Coronal cracks were significantly more than apical cracks in all the groups and M-two retreatment files showed significantly greater percentage of cracks as compared to other groups.

Conclusion: Dentinal cracks are associated with both hand and rotary files due to stresses on the root canal walls. However, hand files demonstrated lesser cracks when compared to rotary files and coronal cracks were more than apical files indicating areas of stress concentration.

Keywords: Retreatment, Rotary files, Dentinal cracks, Hand files.

INTRODUCTION

Mechanical instrumentation of the root canal system is an important phase of root canal preparation because it creates the space that allows irrigants and antibacterial medicaments to more effectively eradicate bacteria and eliminate bacterial by-products. However, it has been stated that root canal instrumentation has the potential to induce dentinal damage and generate cracks on the

apical surface. Rotary instrumentation requires less time to prepare canals compared with hand instrumentation. However, rotary nickel-titanium (NiTi) files with large tapers can generate increased friction and stresses than hand files with 0.02 taper on the canal wall and may thereby create more craze lines or dentinal microcracks in root dentin. Root fractures could occur as result of a microcracks or craze lines which propagate with repeated stress application by endodontic or

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restorative procedures and occlusal forces (1,2,3,4,5).

Nonsurgical endodontic retreatment is often indicated as the first choice to eliminate or reduce microbial infection when initial root canal treatment fails. Thus retreatment aims at completely removing the filling material from the canal system to allow effective cleaning, shaping, and filling of the root canal. Several techniques have been proposed to remove filling materials from the root canal system such as the use of endodontic hand files, NiTi rotary instruments, heat, ultrasonic instruments, and solvents. Now-a days clinicians prefer NITI systems because of their advantages such as saving time and better cutting efficiency (. However, some functions of NiTi rotary systems such as cleaning ability, increased stress, and the inability to adequately prepare oval canals are still controversial. Shemesh et al stated that because retreatment requires more mechanical manipulations in the canal and further preparation of the root canal, greater damage to the root canal wall may be caused after this procedure.(6, 7,8)

There have been few studies evaluating the effects of hand files and rotary NiTi retreatment systems on the incidence of dentinal microcrack formation during retreatment. Therefore, the purpose of this study was to evaluate the incidence of dentinal crack formation after retreatment procedures performed by using 3 rotary NiTi rotary systems (ProTaper, MicroMega R-Endo and Mtwo) and hand files.

MATERIALS AND METHODS

Tooth Selection and Preparation

Extracted human mandibular premolar teeth of similar length and with straight roots were selected. Radiographs were taken from bucco-lingual and mesio-distal angles to verify the presence of a single canal. The root surfaces of each tooth were observed under a stereomicroscope at 20 magnification for evidence of fracture lines, open apices, or anatomic irregularities and were discarded if any of these characteristics were found. Teeth with a deviated apical foramen were excluded from the study to ensure standardization. This study used 40 teeth with similar canal widths. Teeth were then stored in purified filtered water

throughout the study. To avoid anatomical variation and to standardize the measurements in this study, crowns of the teeth were sectioned perpendicular at the cemento-enamel junction using water-cooled diamond discs to leave a 12 mm root. Canal lengths were established visually by placing a size 15 K-type hand file into each root canal until the tip of the file was visible at the tip of the apical foramen and working length was established at 1 mm short of the apex. The surfaces of the all 40 roots were coated with a stretchable plastic material to simulate periodontal ligament space. These teeth were then embedded in a plastic tube filled with self-curing acrylic resin. The coronal 2 mm of the roots were exposed.

Instrumentation was performed by a single operator. All root canals were prepared by ProTaper Universal hand file using a crown-down technique up to a size F2. At each change of instrument, the canals were irrigated with 2 mL of a 3% NaOCl solution. When instrumentation of the root canals was completed, 17% ethylenediaminetetraacetic acid was applied for 3 minutes for smear layer removal, and the canals were again irrigated with 5 ml of normal saline.

Root canal obturation

All root canals were obturated with AH Plus sealer (Dentsply Maillefer) and F2 gutta-percha cones by using the single cone technique. AH Plus sealer was introduced into the root canal by using a lentulo spiral. A size F2 gutta-percha cone with good tug-back was coated with sealer and slowly inserted into the canal until the WL was reached. Excess material was seared off and condensed with a plugger 1 mm below the canal opening, and the root canal openings of all specimens were sealed with temporary filling material. The specimens were then stored at 37°C in 100% humidity for 2 weeks to allow complete setting of the sealer.

Retreatment Procedures

Group 1

Hand Instrument Group using H files (n = 10).

The canals were reinstrumented with Hedstrom files along with RC solvent using sizes 30, 25, 20, and 15, in a circumferential, quarter-turn, push-pull filing motion to remove filling material until WL

was achieved. Once WL had been reached with a size 15 file, sizes 20 and 25 were used at the WL. The total time taken was noted.

Group 2

ProTaper Retreatment Group (n = 10).

In this group, the canal filling material was removed by using the ProTaper Universal retreatment instruments (DentsplyMaillefer) and RC solvent. The retreatment instruments were used at a constant speed of 500 rpm with a torque of 2.5Ncm. The instruments were used in a brushing action with lateral pressing movements, according to the manufacturer's instructions: D1 (30/.09) worked in the coronal third, D2 (25/.08) in the middle third, and D3 (20/.07) throughout the entire WL. The time taken was noted.

Group 3

MicroMega Retreatment Group (n= 10).

In this group, the canal filling material was removed by using the MicroMega retreatment instruments with RC solvent. The instruments were used at a constant speed of 350 rpm with a torque of 2.5 Ncm. The instruments were used in a brushing action with apical pressure control and circumferential filling movements according to the manufacturer's instructions: Rm hand file (25/.04) 1/4 turn with pressure directed towards apex, Re (25/.12) 1 to 2 mm into the canal, R1 (12/.08) in the coronal third, R2 (25/.06) in the middle third and R3 (24/.04) throughout the WL.

Group 4

Mtwo Retreatment Group (n = 10).

The removal of canal fillings was performed by using an Mtwo R1 and R2 instrument and RC solvent at a speed of 250 rpm and a torque of 1 Ncm. A brushing action was performed against the canal walls in a crown-down direction until the WL was reached and the time was noted.

All rotary NiTi instruments were used with a torque and speed controlled motor at the torque and speed recommended by the manufacturer of each system used. In all specimens, RC solvent was used to soften the gutta-percha at the root canal orifice. During retreatment, the root canals were irrigated

with 1 mL 3% NaOCl. Retreatment was judged complete when no gutta-percha or sealer was detected on the instrument surfaces, inside the root canal, or on the dentinal walls.

EXAMINATION

All roots were then sectioned perpendicular to the long axis at coronal, middle and apical portion. Each section was then examined under a stereomicroscope at 20 magnification by another examiner who was blinded to the groups. To prevent dehydration, all of the sections were kept in distilled water between the procedures. "No crack" was defined as root dentin without cracks or craze lines either at the internal surface of the root canal wall or at the external surface of the root. "Crack" was defined as all lines observed on the slice that either extended from the root canal lumen to the dentin or from the outer root surface into the dentin

Statistical analysis-The results were expressed as the number and percentage of cracked in each group. The data were analyzed with a chi-square test and one way ANOVA test.

RESULT

Results showed that retreatment samples in group 1 exhibited least number of cracks and groups 2,3 and 4 which used rotary instrumentation for retreatment showed greater number of cracks (graph1).M two rotary files have shown significantly more number of cracks than the other 3 groups. The protaper universal group has taken significantly less time for removal of gutta percha and sealer as compared to other groups.

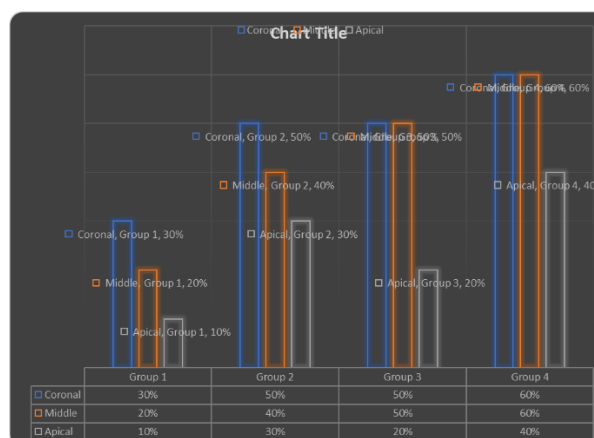


Table 1: Showing retreatment time

Retreatment time

Group 1 samples which is hand file group using Hfiles, took an average time of 30 minutes,

Group 2 - the protaper universal group took an average time of 5 to 10 minutes.

Group 3 -the MicroMega group took an average time of 15 to 20 minutes.

Group 4 -the M two group took an average time of 25 to 30 minutes.

DISCUSSION

Nonsurgical endodontic retreatment requires the removal of pre- existing root canal filling material to allow for adequate cleaning, disinfection, and obturation of the root canal space after the failure of previous root canal treatment. In this study, hand instrumentation did not cause much damage to the root canal wall which could be because of less aggressive movements of the hand files in the canal compared with engine operated files.

It is a known fact that instrumentation with NITI files can cause cracks.(9)All the rotary files used in the study have resulted in crack formation. In this study, M two files caused significantly greater number of cracks than the other rotary files and their location was mainly coronal rather than apical. It has also been observed that protaper universal acts faster than other files and also causes cracks.This observation correlates with other studies. (10,11,12).

Retreatment rotary files have different tapers and tip designs which contribute to crack formation.Larger taper of files,increase in root curvature,kinematics of the file(reciprocation versus rotary),stiffness of the files,Mwire technology wires,preparation upto apical foramen(instead of 1mm short of apex) and off centered files all have their unique effects on crack formation.Larger files can remove more debris and bacteria but maintaining canal preparations as small as practically possible can prevent crack formations.(13)

ProTaper universal and Micromega files have non-cutting tips whereas Mtwo has active cutting tips. In this study Mtwo NiTi rotary instruments cause

significantly greater dentinal cracks to occur after instrumentation which may be due to its active cutting tip.Protaper universal files have removed gutta percha and sealer efficiently and in lesser time.(9)

CONCLUSION

It can be concluded from this finding that there is no connection between the taper of the Ni-Ti retreatment instruments used in this study and the formation of the crack but the active cutting tip of Mtwo significantly increased the formation of the crack during retreatment.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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