

ORIGINAL RESEARCH



Comparison of different rotary files and dentinal damage during root canal treatment seen in stereomicroscope

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ABSTRACT

Background: This research compared the stereomicroscopically observed effects of using various rotary files on dentin during root canal therapy.

Material and methods: One hundred newly extracted mandibular premolars had been divided into five groups of twenty teeth each for biomechanical preparation. Group I consisted of untreated teeth, Group II utilized manual files, Group III used ProTaper rotary instruments, Group IV used K3 rotary instruments, and Group V used Easy RaCe rotary instruments. Then, roots were horizontally sliced at 3, 6, as well as 9 mm from the tip for microscopic analysis. The dentin was found to be flawed. The groups were analyzed using a chi-square test.

Results: There was a statistically significant split between the groups ($P = 0.006$). No faulty roots were found in Group I. The Hand K-file, ProTaper, K3 SybronEndo, as well as Easy RaCe rotary groups all had imperfect dentin. However, the difference between the several rotary systems tested here was not statistically significant. The presence of dentinal flaws was not significantly different across groups.

Conclusion: When compared to hand instrumentation, there may be a higher risk of dentinal abnormalities when using rotational tools.

Keywords: rotary nickel-titanium files, dentinal damage

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INTRODUCTION

The irrevocable aim of endodontics is a three-dimensional unblemished seal of the root canal system which is achieved by perfect designing of the canal diameter and canal form. The biomechanical preparation is one of the major steps for removal of bacteria and debris in the root canal so as to achieve a successful endodontic treatment.^{1,2} During root canal instrumentation there are complications such as perforations, ledge formation, transportation

of canal, and formation of cracks in the root dentin.^{3,4} At times, in the zeal of biomechanical preparation of the canal we inevitably end up damaging the root dentin, which becomes a gateway to dentinal cracks and minute intricate fractures; thereby, causing failure of treatment.⁵⁻⁷

As a result of craze lines or microcracks, there might be occurrence of root fracture that propagates due to repeated application of stress by the occlusal forces.⁸ Shemesh et al.⁹ observed more dentinal defects in teeth which were obturated with spreader than teeth obturated without spreader. In different degrees, dentinal damage can occur due to procedures like biomechanical preparation, obturation, and retreatment.^{10,11}

Hence, this study was conducted to assess the Comparison of different rotary files and dentinal damage during root canal treatment seen in stereomicroscope.

MATERIAL AND METHODS

One hundred newly extracted mandibular premolars had been chosen, cleaned with periodontal scaler, and then kept in pure filtered water until further examination. After using a diamond disk to remove the coronal sections of each tooth, the remaining root length was measured to be sixteen millimeters. In order to rule out the possibility of cracks on any of the root surfaces, a stereomicroscope with a magnification of 12 was used.

Group I: Left unprepared and served as Group 1.

Group II: Prepared using stainless steel K-files up to apical size 25 at the working length and step-back technique was used till file no. 60.

The patency of the canal was determined in each of the following three groups using a #10 K-file. After that, a K-file measuring fifteen millimeters in width was inserted into the canal until it could be seen via the apical foramen. After deducting one millimeter from this measurement, we were able to calculate the working length.

Group III: Prepared using ProTaper rotary system sequentially at the speed of 300 rpm using a crown-down technique. Canal preparation was finished with F2 (25/.08) till working length.

Group IV: K3 rotary system sequentially at the speed of 300 rpm using a crown-down technique. Canal preparation was done with file 25/.06 till working length.

Group V: Easy RaCe rotary system sequentially at the speed of 300 rpm. Canal preparation was done with file 25/.06 till working length.

Between each instrument that was used in the canal preparation process, each canal was irrigated with three percent sodium hypochlorite. This was done for all of the groups. Dolo Endogel, which contains seventeen percent EDTA and ten percent carbamide peroxide, was utilized between each successive instrument in the groups that underwent preparation using a rotating system. In all of the groups, the EndoActivator with the no. 25 tip was used for thirty seconds to vigorously agitate the solution in order to thoroughly clean the canals. During the entirety of the procedures for the experiment, all of the roots were kept damp in filtered and purified water.

The statistical tool SPSS 17.0 was used to do the analysis on the collected data. In order to evaluate whether or whether there was a statistically significant difference between the experimental groups regarding the presence of defective roots, a Chi-square test was carried out. In addition to this, a chi-square test was carried out to determine the number of flaws present in each group at various horizontal portions. The threshold for statistical significance was established at P less than 0.05.

RESULTS

Table 1: Comparison of number and percentage of teeth showing defects

Defect	Control group	Hand K-file	ProTaper-rotary	K3-rotary	Easy RaCe rotary	Total
Absent	05	05	10	20	40	80
Present	00	03	08	04	05	20
Total	05	08	18	24	45	100

It was determined that there was a statistically significant difference between the groups ($P = 0.006$). In Group I, there were no abnormal roots found. It was discovered that the Hand K-file, ProTaper, K3 SybronEndo, and Easy RaCe rotary groups all had dentinal imperfections. However, the difference was not statistically significant across the board for all of the rotary systems that were investigated in this study. The findings indicated that there were differences in the presence of dentinal abnormalities; however, these differences were not statistically significant.

DISCUSSION

The primary aim of chemomechanical root canal preparation includes the preservation of original course of the canal and cleaning of the entire root canal system. One common complication associated with mechanical canal preparation is vertical root fracture (VRF), which usually leads to tooth loss.¹² Various NiTi instruments with different design have been introduced, but all of them result in incomplete cracks or even VRF. Hence, such defects should be prevented. Bier et al. suggested that craze lines occurred in 4% to 16% which may develop into fractures during retreatment or after long-term functional stresses such as chewing. This proves that root canal preparation with NiTi rotary systems and every following additional procedure in endodontics as obturation and retreatment with rotary system can create fractures or craze lines.¹³

According to our study, incidence of crack observed in root dentin was greater after instrumentation with OneShape as compared to HEDM and ProTaper Next. Similar results were found by Liu et al.¹⁴ they reported cracks in 35% of roots instrumented with OneShape. The design of file may affect shaping forces on root dentin; these forces may cause root fracture.^{15,16} ProTaper Next has a rectangular cross-section design, increased and decreased tapering over entire length. Off-centered rectangular design of ProTaper Next may have contributed to less number of cracks than OneShape. This design generates a swaggering motion, which decreases screw effect, dangerous taper lock, and torque on the file.¹⁷ OneShape has asymmetrical cross-section over entire length and variable pitch, noncutting safety tip.^{18,19}

In this particular investigation, there was a statistically significant gap between the groups ($P = 0.007$). In Group I, there were no abnormal roots found. It was discovered that the Hand K-file, ProTaper, K3 SybronEndo, and Easy RaCe rotary groups all had dentinal imperfections. However, the difference was not statistically significant across the board for all of the rotary systems that were investigated in this study. The findings indicated that there were differences in the presence of dentinal abnormalities; however, these differences were not statistically significant.

Wilcox et al.²⁰ claimed that the amount of tooth structure removed was associated with vertical root fractures. A previous study²¹ reported that the ProTaper Next X2 instrument removed similar amounts of dentin compared with other instruments with larger taper sizes. The design features of the ProTaper Next might be related with the greater crack formation at the 3- and 9-mm levels than with the K3XF and RECIPROC. Furthermore, Bier et al.²² stated that the instrument taper affected the incidence of microcracks in root dentine. In this study, the apical preparation size was standardized to the size of #25 instrument. Nevertheless, for

the final apical taper there were two different sets: 0.06 for K3XF and ProTaper Next and 0.08 for RECIPROC and TF Adaptive system. The larger apical taper in the TF Adaptive group may have contributed to the greater crack formation at the 3-mm level.

Abou El Nasr and Abd El Kader²³ stated that the alloy of the instrument affects the number and percentage of dentinal cracks. Root canal instruments with greater flexibility were associated with fewer microcracks in the root structure. The total frequency (percentage) of microcracks in the groups were 3 (3%) for K3XF, 13 (14%) for ProTaper Next, 3 (3%) for RECIPROC, and 16 (17%) for TF Adaptive. In the present study, the results revealed a significant difference in the incidence of microcracks among the experimental groups at the 3- and 9-mm levels. Hence, the null hypothesis is rejected.

CONCLUSION

Despite the fact that Ni-Ti rotary devices have several advantages over hand instruments, the preparation of root canals can result in various degrees of dentinal injury depending on how aggressively the device is used. Because they can increase the stresses that are placed on the dentin wall, higher taper, more rotations, and aggressive cutting could be the culprits in this case. This could result in the development of dentinal abnormalities. According to the findings of this research project, the dentin is harmed more by the ProTaper rotary system than by other rotary systems (K3, Easy RaCe).

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