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Comparison of Different Rotary Files and Dentinal Damage During Root Canal Treatment Seen in Stereomicroscope.

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KEYWORDS

rotary nickel-titanium files, dentinal damage

ABSTRACT:

Background: 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: 5 experimental groups of twenty teeth each were formed from 100 freshly extracted mandibular premolars, and biomechanical preparation was carried out on each group. Unprepared teeth were in Group I, hand files were used in Group II, ProTaper rotary instruments were used in Group III, K3 rotary instruments were used in Group IV, and Easy RaCe rotary instruments were used in Group V. Following that, roots were cut horizontally 3, 6, and 9 mm from the apex, and they were examined under a stereomicroscope. Defects in the dentin were discovered. Chi-square analysis was used to examine groups.

Results: the groups were significantly different from each other (P = 0.006). Group I showed no defected roots. Dentinal defects were found in the Hand K-file, ProTaper, K3 SybronEndo, and Easy RaCe rotary groups. But the difference was nonsignificant among all rotary systems used in this study. Results showed that nonsignificant differences were present for the presence of dentinal defects.

Conclusion: use of rotary instruments could result in an increased chance for dentinal defects as compared to hand instrumentation.

Introduction

Optimum cleaning and shaping principles are positively related to prognosis in endodontic treatment.[1] For efficient disinfection, root canal shaping instruments should provide maximum contact with the root canal walls,[2] whereas the remaining root structure should be solid and stable.[3] Since 1998, nickel-titanium (Ni-Ti) alloys have been used in endodontics,[4] also new techniques, design concepts, and instrumentation kinematics are being developed and marketed continuously. Despite these technological advances, vertical root fracture and crack formation still remain as significant problems during root canal shaping procedures using Ni-Ti instruments.[5]

Stainless steel root canal instruments clean the canal superficially and can create canal aberrations such as

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ledges, zips, and elbows.[6] To eliminate these shortcomings of stainless steel instruments, nickel-titanium (Ni-Ti) instruments have been developed.

Canals prepared by rotary Ni-Ti instruments show increased canal cleanliness and less straightening, apical canal transportation and perforations. These benefits are because of greater flexibility and specific design features of Ni-Ti instruments allowing the natural canal curvature to be maintained.[7] Rotary instrumentation also requires less time to prepare canals as compared to hand instrumentation.[8]

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

100 freshly extracted mandibular premolars were selected and cleaned with periodontal scaler and stored in purified filtered water. The coronal portions of all teeth were removed with diamond disk, leaving roots 16 mm in length. All root surfaces were observed with stereomicroscope (Trinocular Stereo Zoom Microscope, Nikon, NY, USA) under ×12 to exclude cracks.

Group I: Left unprepared and served as Group 1.

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

In the remaining three groups, canal patency was established with a #10 K-file. Then, a size 15 K-file was introduced into the canal until it was visible at the apical foramen. The working length was determined by subtracting 1 mm from this measurement.

Group III: Prepared using ProTaper rotary system (Dentsply Maillefer, Ballaigues, Switzerland) 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 (SybronEndo, Orange, CA, USA) 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 (FKG Dentaire, La Chaux-de-Fonds, Switzerland) sequentially at the speed of 300 rpm. Canal preparation was done with file 25/.06 till working length.

In all groups, each canal was irrigated with 3% sodium hypochlorite between each instrument used in canal preparation. In groups with preparation with rotary system, Dolo Endogel (17% EDTA with 10% carbamide peroxide) was used between each sequential instrument. In all groups, EndoActivator (Dentsply Tulsa Dental, Tulsa, OK, USA) was used with no. 25 tip for 30 s to agitate the solution vigorously to clean the canals efficiently. All roots were kept moist in purified filtered water throughout the experimental procedures.

The data were analyzed using statistical software SPSS 17.0 program (SPSS Inc., Chicago). A Chi-square test was performed to determine statistically significant difference in the appearance of defected roots between the experimental groups. Chi-square test was also performed to determine the defects at different horizontal sections in each group. The level of significance was set at $P < 0.05$.

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	10	10	15	30	70
Present	00	05	10	08	07	30
Total	05	15	20	23	37	100

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Groups were significantly different from each other (P = 0.006). Group I showed no defected roots. Dentinal defects were found in the Hand K-file, ProTaper, K3 SybronEndo, and Easy RaCe rotary groups. But the difference was nonsignificant among all rotary systems used in this study. Results showed that nonsignificant differences were present for the presence of dentinal defects.

Discussion

Recently, there has been an explosion of innovative root canal preparation tools and methods thanks to the development of rotary nickel-titanium devices. Dentinal flaws, which may lead to vertical root fractures, are a serious risk with rotary nickel instrumentation (VRF) [9]. The instruments tend to come apart when made of nickel-titanium, which is another issue. Most cases of instrument separation may be traced back to cyclic fatigue or torsional fatigue [10]. Making Ni-Ti files with higher mechanical qualities via varied cross-sectional designs, surface treatment, and manufacturing procedures has been an ongoing endeavor by manufacturers to address the issue of instrument isolation and boost the versatility of Ni-Ti rotary instruments [11].

In this study, the groups were significantly different from each other (P = 0.007). Group I showed no defected roots. Dentinal defects were found in the Hand K-file, ProTaper, K3 SybronEndo, and Easy RaCe rotary groups. But the difference was nonsignificant among all rotary systems used in this study. Results showed that nonsignificant differences were present for the presence of dentinal defects.

Wilcox et al.[12] claimed that the amount of tooth structure removed was associated with vertical root fractures. A previous study[13] 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.[14] 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 Kader[15] 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.[13] 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.

tainless steel hand instruments clean the canals superficially and have also been shown to create canal aberrations, such as ledges, perforations, zips, and elbows.[6] But hand instrumentation does not appear to induce much damage to root canal wall. As in this study, instrumentation with hand files did not demonstrate damage to the root canal wall. This is in agreement with several other studies given by Yoldas et al.,[5] Hin et al.[16] and could be attributed to the less aggressive movements of the hand files in the canal compared with engine-operated files and less taper (0.02) as compared to rotary Ni-Ti instruments.

Conclusion

Ni-Ti rotary devices can cause varying degrees of dentinal damage during root canal preparation, despite the fact that they have many advantages over hand instruments. The higher taper, more rotations, and aggressive cutting may be the causes because they can increase the pressures on the dentin wall and lead to the development of dentinal abnormalities. According to this study, the ProTaper rotary system damages the dentin more than other rotary systems (K3, Easy RaCe).

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