

Comparison of different rotary files system during root canal preparation seen under stereomicroscope

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Abstract

Background: To compare different rotary files system during root canal preparation seen under stereomicroscope.

Materials & Methods: A total of 45 premolars from the maxillary and mandibular regions, extracted for orthodontic purposes, were included in the study, with two contralateral teeth from each individual. This study was done in GDCRI, Ballari. The specimens were divided into three groups, each consisting of 15 canals. These replicas were then evaluated under a stereomicroscope. Chi-square test was done. The results were analysed using SPSS software.

Results: The measurement of canal preparation time, revealed a mean time of 10.22 minutes for hand K-files preparations and a mean time of 8.15 minutes for rotary Profile preparations. This difference was found to be statistically significant with a p-value of 0.03.

Conclusion: Rotary instruments appear to present significant advantages in terms of efficiency and operational integrity.

Keywords: Rotary files, K-file, root canal.

Introduction

The technical demands and level of precision required for successful performance of endodontic procedures have traditionally been achieved by careful manipulation of hand instruments within the root canal space and by strict adherence to the biologic and surgical principles, essential for disinfection and healing.¹ To improve the speed and efficiency of the treatment stainless steel instruments have been used in a variety of preparation techniques, in an attempt to produce the appropriate canal shape. However, studies have shown that procedural incidents occur commonly, producing aberrations such as formation of hourglass-shaped canals, zips, elbows and canal transportation.²⁻⁴ Nickel-Titanium (NiTi) rotary instruments are thought to reduce such aberrations. Endodontic instruments have come a long way since their inception. In the middle of the 1800s, dentist Edward Maynard developed the first endodontic file.⁵ The ease of the material's composition is a major selling point. Hand instrumentation, once a hallmark of endodontic practice but now mostly forgotten, is nonetheless an essential aspect of the canal preparation process.

Nickel-titanium (NiTi) instruments were made because stainless steel instruments only clean the root canal system on the surface and can cause problems like ledges, zips, etc.⁶ Human dentin is viscoelastic, and during root canal preparations, NiTi rotary instruments on the canals apply rotational forces to the dentin.⁷ These rotating files must contact and plane the canal walls to debride the canal. These contacts cause a lot of short-term stress concentrations in the root dentin, which leads to craze lines or tiny cracks. During root canal preparation, stresses are made inside the root canal. These stresses are sent through the root to the surface, where they break the bonds that hold the dentin together. Later could these tiny cracks get bigger and cause a vertical root fracture. This depends on a number of factors, such as the thickness of the root dentine, the strain on the obturation, and the placement of the post.⁸ Stainless steel root canal instruments clean the canal superficially and can create canal aberrations such as ledges, zips, and elbows.⁹ 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.¹⁰ Rotary instrumentation also requires less time to prepare canals as compared to hand instrumentation.¹¹ Hence, this study was conducted to compare different rotary files system during root canal preparation seen under stereomicroscope.

Materials & Methods:

A total of 45 premolars from the maxillary and mandibular regions, extracted for orthodontic purposes, were included in the study, with two contralateral teeth from each individual. This study was done in GDCRI, Ballari. The specimens were divided into three groups, each consisting of 15 canals. The first group underwent preparation using stainless steel hand K-files, while the second group was prepared using profile 0.04 taper series 29 rotary files and third group was Easy Ra Ce system. The

Table1: comparison of the mean preparation times for canals using K-files versus rotary instruments

| Files | Time (min.) |
|-------------------|-------------|
| Hand K –file | 10.22 |
| Rotary profile | 8.15 |
| Easy RaCe- Rotary | 9.08 |

Table2: Canal blockage with debris following instrumentations in k file and rotary groups

| Canals | K -file | Rotary files |
|---------|------------|--------------|
| Blocked | 2 (13.4%) | 0 |
| Patent | 13 (86.6%) | 30 (100%) |
| Total | 15 | 30 |

Discussion:

Bilaterally extracted humans first permanent premolars were used in this study. Previous studies used simulated canals constructed in clear resin block with standardization of degree, location and radius of root canal curvature, this guaranteed high degree of reproducibility and standardization of the experimental design in assessment of with K-files and Profiles prepared canals preparation procedures and instruments performance. However, regarding micro-hardness and abrasiveness of acrylic resin when compared to dentin, it has been expressed that dentin usually requires double the preparation forces.^{12,13} Hence, this study was conducted to compare different rotary files system during root canal preparation seen under stereomicroscope. In the present study, the measurement of canal preparation time, revealed a mean time of 10.22 minutes for hand K-files preparations and a mean time of 8.15 minutes and 9.08 for rotary Profile preparations and Easy Ra

Ce rotary preparations. This difference was found to be statistically significant with a p-value of 0.03. A study by A Dafalla A et al, a total of 46 maxillary and mandibular first premolars extracted for orthodontic purposes were collected (two contralateral teeth from each individual). The samples were divided into two groups of 34 canals each. Teeth in the first group were prepared with stainless steel hand K-files while the second groups were prepared with profile 0.04 taper series 29 rotary files. Results showed significantly shorter preparation time for Profile than K-file. 8.8% of the canals prepared with K-files showed canal blockage, while all canals prepared with Profile remained patent. Alterations in working length working distance appeared in 23.5% of canals prepared with K-file and 11.7% in canals prepared with Profile. Failed instruments in K-files were significantly higher, mostly deformation (P<0.001). Profiles failed instruments were in the form of fracture and no deformation was detected. Both

Results:

The measurement of canal preparation time, revealed a mean time of 10.22 minutes for hand K-files preparations and a mean time of 8.15 minutes and 9.08 for rotary Profile preparations and Easy RaCe rotary preparations. This difference was found to be statistically significant with a p-value of 0.03. For hand-prepared canals using K-files, the results indicated that 2 canals (13.4%) experienced blockage due to debris. In contrast, after rotary instrumentation with the Profile system and Easy RaCe system, all 30 canals remained patent. The difference in blockage rates between the two methods was not found to be statistically significant, with a p-value of 0.2.

systems showed unsatisfactory walls smoothness and flow. Within the limitation of the study it was concluded that Profile 0.04 taper series 29 rotary systems prepare canals more rapidly, and have lower incidences of fracture and blockages, and only limited loss of working length. Canal preparation with K-file was time consuming and showed higher incidence of deformed instruments; overall, rotary instruments seem to offer greater advantages.¹⁴In the present study, for hand-prepared canals using K-files, the results indicated that 2 canals (13.4%) experienced blockage due to debris. In contrast, after rotary instrumentation with the Profile system, all 30 canals remained patent. The difference in blockage rates between the two methods was not found to be statistically significant, with a p-value of 0.2. Another study by Ferraz CC et al, evaluated the weight of debris and irrigant volume extruded apically from extracted teeth in vitro after endodontic instrumentation using the balanced force technique, a hybrid hand instrumentation technique, and three engine-driven techniques utilizing nickel-titanium instruments (ProFile .04, Quantec 2000 and Pow-R). Five groups of 20 extracted human teeth with single canals were instrumented using one or other of five techniques: balanced force, hybrid, Quantec 2000, ProFile .04, or Pow-R. Debris extruded from the apical foramen during instrumentation were collected into preweighed 1.5 mL tubes. Following instrumentation, the volume of extruded irrigant fluid was determined by visual comparison to control centrifuge tubes filled with 0.25 mL increments of distilled water. The weight of dry extruded dentine debris was also established. Overall, the engine-driven techniques extruded less debris than the manual ones. However, there was no statistical difference between the balanced force technique and the engine-driven methods. The volume of irrigant extruded through the apex was directly associated with the weight of extruded debris, except within the ProFile group. The hybrid technique was associated with the greatest extrusion of both debris and irrigant. Overall, the engine-driven nickel-titanium systems were associated with less apical extrusion.¹⁵ Hulsman M et al, compared several parameters of root canal preparation using two different rotary nickel-titanium (Ni-Ti) instruments: Flex Master (VDW, Munich, Germany) and HERO 642 (Micro-Mega, Besançon, France). Fifty extracted human mandibular molars with root canal curvatures between 20 and 40 degrees were embedded into a muffle system. All root canals were prepared to size 45 using a high-torque motor with two different Ni-Ti instruments, Flex Master and HERO 642. In both groups, irrigation was performed with 2 mL NaOCl (3%) after each instrument size. RC-Prep (Premier,

Philadelphia, USA) was used as a chelating agent with each instrument. Both Ni-Ti systems maintained the curvature well: the mean degree of straightening was 0.6 degrees for Flex Master and 0.5 degrees for HERO 642. One file was fractured with the Flex Master system, but further procedural incidents were not recorded. Following preparation with Flex Master, 18% of the root canals had a round diameter, 53% an oval diameter and 29% an irregular diameter; HERO 642 preparations resulted in a round diameter in 25%, oval shape in 47% and irregular cross-sections in 28% of the cases. Mean working time was shorter for HERO 642 (66.0 s) than for Flex Master (71.1 s). Cleanliness of the root canal walls was investigated under the SEM using 5-score indices for debris and smear layer. For debris, HERO 642 and Flex Master achieved 73 and 70% scores of 1 and 2, respectively. The results for smear layer were similar: HERO 642 and Flex Master achieved 33 and 26% scores of 1 and 2, respectively. Significant differences between the two systems were not detected for any of the parameters evaluated. Both systems respected original root canal curvature well and were safe. Both systems failed to remove debris and smear layer in the majority of the cases.¹³ Schafer E et al, determine the cleaning effectiveness and the shaping ability of K3 nickel-titanium rotary instruments and stainless steel hand K-Flexofiles during the preparation of curved root canals in extracted human teeth. A total of 60 root canals of mandibular and maxillary molars with curvatures ranging between 25 degrees and 35 degrees were divided into two groups of 30 canals. Based on radiographs taken prior to instrumentation with the initial instrument inserted into the canal, the groups were balanced with respect to the angle and the radius of canal curvature. Canals were prepared by K3 instruments using a crown-down preparation technique or by K-Flexofiles using a reaming motion up to size 35. For debris removal, K-Flexofiles achieved significantly better results ($P < 0.001$) than K3 instruments. The results for remaining smear layer were similar ($P > 0.05$). K3 instruments maintained the original canal curvature significantly better ($P < 0.0001$) than K-Flexofiles. No significant differences were detected between the instruments ($P > 0.05$) for the time taken to prepare the canals. K-Flexofiles allowed significantly better removal of debris than K3 instruments. K3 files maintained the original curvature significantly better. A number of K3 instruments fractured.¹⁶

Conclusion:

The rotary systems of Profile 0.04 taper series 29 demonstrate a faster canal preparation process with reduced occurrences of blockages. In contrast, canal

preparation using K-files was found to be time-consuming and associated with a higher incidence of deformed instruments. Overall, rotary instruments appear to present significant advantages in terms of efficiency and operational integrity.

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