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An In-Vitro Evaluation of Apical Extrusion of Debris During Instrumentation with Two Different Rotary File System in Permanent Mandibular Teeth

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Abstract

Background: An inter appointment flare-up caused by inflammatory reactions is one of the most important side effects of apical extrusion. The preparation endpoint, irrigation fluid type and quantity, instrumentation size, technique, and instrument type are only a few of the variables that determine the amount of extruded debris.

Aim: The aim of this study was to evaluate the apical extrusion of debris during root canal instrumentation using two different rotary file system.

Material and Method: Protaper gold rotary Ni-Ti system and Neo Endo rotary Ni-Ti system were used to instrument the two groups of 40 freshly extracted mandibular premolars with straight roots. Before instrumentation, preweighed Eppendorf tubes are adapted for each tooth. A

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30-gauge needle and 1 mL of distilled water were used to irrigate the area after each instrument during instrumentation. After being taken out of the Eppendorf tubes, the tooth's tips were irrigated with 2 ml of distilled water. In each group, the total amount of irrigant was 8 ml. After 15 days of 68°C incubation, all tubes were weighed. Calculating the difference between the pre- and post-debris weights, statistical analysis was carried out using an independent t-test, with the threshold of significance set at 0.05.

Result: The difference between pre- and post-weights was significantly greater for the neoendo system

Conclusion: Although apical debris extrusion was induced by both rotary files, the protaper gold demonstrated noticeably less debris extrusion than the neoendo rotary file.

Keywords: Endodontic flare-up, Neo-endo, Protaper gold, Rotary files

Introduction: The periapical tissues may be exposed to pulp tissue, microbes, dentin chips, and irrigants. The patient experiences an endodontic flare-up as a result, which causes pain, inflammation, and delayed recovery. The most typical tissue, irrigants, and other microorganisms can all be found in root canals. Reduce the ejection of debris into the periradicular tissues by restricting the preparation to regions above the apical terminal. An apical extrusion of pulp and dentinal debris is one cause for this.[1] According to published research, even when the area of preparation does not reach the apical terminus, all current instrumentation procedures cause intracanal content to protrude into the periradicular tissues. However, the amount of extruded material varies depending on the instruments and file designs.[2-4]

An inflammatory response and postoperative discomfort could result from this extrusion.[5] The first researchers to measure the quantity of apical ejected debris during instrumentation were Vande Visse and Brilliant.[6]

At present, all preparation techniques and instruments are associated with extrusion of debris, even when the preparation is maintained short of the apical terminus. Several studies reported that instrumentation with an in-and-out motion tended to produce more apically extruded debris than instrumentation with rotational motion.[7] It is predicted that engine-driven rotary tools will result in less extrusion than hand tools. This may be because rotary instruments have a propensity to draw debris into their flutes, which causes the debris to exit the root canal coronally.[8] ProTaper offers a variety of rotary NiTi systems for root canal preparation. The common NiTi alloy used in universal instruments has a convex triangular cross-sectional shape,

a safety tip that does not cut, and a flute design that blends numerous tapers within the shaft. It is said that instruments with this cross-sectional shape can cut dentine more successfully.[9]

According to the manufacturer, the ProTaper Gold (PTG) system includes a convex triangle cross-section, variable progressive taper, and rotational action in addition to a continually tapered form for a more effective, adaptable, and safe cutting action.[10] Neoendo flex is a third-generation gold thermal-treated NiTi rotary file which has a triangular cross-sectional design with sharp cutting edges and a safety noncutting tip. It has increased flexibility to negotiate canals.[11] Present study was conducted to evaluate the apical extrusion of debris during root canal instrumentation using two different rotary file system i.e. protaper gold and neoendo rotary file.

Material and Method: Department of Conservative Dentistry and Endodontics' research committee gave its ethical approval before this study could be carried out. The investigation covered the single canal in the forty extracted (due to orthodontic purpose), non-carious mandibular premolar with fully developed apices and single roots. Excluded teeth included those that were broken, repaired, had developmental flaws, and were resorbing internally or externally.

40 teeth each were divided into two groups i.e. Protaper gold rotary file group and Neo Endo rotary file group. In distilled water, specimens were kept until they were needed. A round diamond disc and straight handpiece were used to decoronate all of the specimens off the cementoenamel junction (CEJ) level to produce sections with roots that were 15+/-1 mm long. By using a number 10 K file up to the root canal terminus, determining the working length, taking 1 mm off of it, and having it radiographically validated.

A comparable experimental setup to that described by Myers and Montgomery[12] was employed to assess debris extrusion. For each tooth, an Eppendorf tube was used. A heated instrument was used to make a hole in the tube cover. Each Eppendorf tube was weighed separately on an analytical scale. To prevent unintentional leaking of irrigating liquids throughout the experiment, each root was then inserted into the tube cap and attached on the lateral side using cyanoacrylate. All canal preparations were done by a single operator.

Group 1 Protaper gold: Protaper Gold file system was used with X-smart ™ (Dentsply). following sequence was used SX file (size 18, 0.10 taper), S1(size 18, 0.10 taper) and S2(size 20, 0.10 taper) files, F1 (size 20, 0.07 taper) file, and F2 (size 25, 0.08 taper) file till full working

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length. All the PTG instruments were used at 300 rpm with a torque of 3 Ncm for SX and S1 instruments, 1.5 Ncm for F1 instruments, and 2 Ncm for F2 instruments.

Group 2 Neoendo rotary file: Root canals were prepared using Neoendo Flex files attached to an endomotor (X-Smart, Dentsply) according to the manufacturer's instructions at speed of 350 rpm and a torque of 1.5 Ncm. Coronal flaring was done with (30/08) file. Apical shaping was done with 20/06 and 25/06 up to the full working length.

Irrigation during each root canal preparation was performed using a total of 8 ml distilled water. The irrigation needle was maintained at 3 mm from working length. After 15 days of 68°C incubation, all tubes were weighed. Calculating the difference between the pre- and post-debris weights, statistical analysis was carried out using an independent t-test, with the threshold of significance set at 0.05.

Result: Table 1 contains a summary of the independent t-test results. Protaper gold file system outperformed the other one in terms of performance and demonstrated the least amount of debris extrusion at the apex.

Group	*n*	Mean with std. deviation	P Value
Preweighted			
Protaper gold	20	2.02 ± 0.12	>0.05
Neo Endo	20	2.06 ± 0.10	
Postweighted			
Protaper gold	20	2.23 ± 0.12	>0.05
Neo Endo	20	2.85 ± 0.14	
Difference			
Protaper gold	20	0.21 ± 0.11	<0.05
Neo Endo	20	0.79 ± 0.10	

Discussion: Endodontic instrumentation aims to completely clean and disinfects the root canal system, as well as to shape the canals in a way that will result in a 3D obturation. To achieve these objectives, debris like dentinal shavings, necrotic pulp tissue, microorganisms and their metabolites, or irrigants may be extruded into the periradicular tissue. Extruded material has been referred to as a "worm" of necrotic waste and has been identified as a significant

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contributor to flare-ups during therapy.[13] According to studies, apical debris is produced to some degree by practically all instrumentation techniques.[14,15]

According to the findings, there is a correlation between the degree of preparation up to the apex,[12] the diameter of apical patency,[16] the amount of irrigant used,[6] the formation of a dentine plug,[17] the use of a step-back vs. crown-down technique, and the use of conventional hand filing vs. rotary motion.[12] These have led to the widespread beliefs in the endodontic literature that a linear filing action produces more debris as compared to rotating instruments, and that the crown-down approach extrudes less debris apically than the step-back technique.[18,19] The last ten years have seen a rise in the use of rotary nickel-titanium (Ni-Ti) equipment for root canal preparation. Modern instrument designs have been created recently to increase operating efficiency and safety, including noncutting tips, radial lands, various cross sections, and varied tapers. The amount of apically ejected debris may differ depending on the design of the instrument even though the manner of usage (i.e., rotating motion) is the same for these kinds of devices.[19]

The purpose of this study was to evaluate and compare the amount of apically extruded debris using two rotary file systems i.e. protaper gold and neoendo rotary file. To remove the interoperator variable from our investigation, a single operator prepared all of the canals. In order to reduce the number of variables and raise the likelihood that the amount of apically extruded debris was caused by instrumentation, a standard protocol was followed. Specifically chosen teeth for this investigation had a closed mature apex, a single canal, and foramina. The teeth were decorated at the CEJs, which made it easier to establish a stable and trustworthy reference point and a working length of about 15+/-1 mm. Prior to instrumentation, pulpal tissue was excised to ensure that the debris extruded was dentinal shaving and not pulpal remains. fixed amount of sterile water 8 mL was chosen as an irrigant for this study to reduce the chances that particulate matter indwelling in other irrigants might possibly skew the final values.[20]

In our study it was found that apical debris extrusion was induced by both rotary files, the protaper gold demonstrated noticeably less debris extrusion than the neoendo rotary file. Protaper gold is an upgrade from Protaper Universal. Protaper gold has the same philosophy as the first generation of Protaper (file sequence, file sizes, motor settings, obturation methods) with strong additional benefits like increased flexibility (24% on average) and greater resistance to cyclic fatigue.[21]

Smaller dimensions, an off centered mass, and a regressive taper are features of the protaper gold system. Protaper gold instruments' capacity to centre themselves may ensure that more dentin thickness is kept in the root canal and may help to eliminate more bacteria. The gradual taper and convex triangular cross section improve PTG's cutting efficiency while reducing rotating friction between the file blade and dentin. Blum asserts that the torsional resistance of Protaper gold is much lower. Each instrument's non-cutting tip design enables it to follow the secured section of the canal securely, and the tip's compact flat area improves its navigation through soft tissue and debris.[22,23]

Conclusion: According to the proposed methodology and results of this in vitro study, it was concluded that all systems extruded debris beyond the apical foramen. The protaper gold was found to be the least mean value of apically extruded debris.

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