Effects of Different Glide Path Files on Apical Debris Extrusion in Curved Root Canals

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Abstract

Introduction: Creating a glide path before root canal preparation with nickel-titanium rotary files is essential to prevent the file fracture and to maintain the original root canal configuration. Both rotary glide path files and manual K-files are used to create a glide path. The aim of this study was to compare the amount of apically extruded debris after using different glide path files before preparing curved root canals with the WaveOne Gold single-file reciprocating system (Dentsply Maillefer, Ballaigues, Switzerland). **Methods:** Sixty extracted mandibular first molar teeth with curved mesial roots were selected for this study. The mesial roots of the teeth were removed from the cementoenamel junction. Cone-beam computed tomographic imaging was used to evaluate the curvature of the mesial root canals. Specimens were randomly divided into 6 experimental groups according to the root canal preparation (n = 10): group G-File, a glide path with G-Files (Micro-Mega, Besancon, France) + WaveOne Gold preparation; group One G, a glide path with One G (Micro-Mega, Besancon, France) + WaveOne Gold preparation; group ProGlider, a glide path with ProGlider (Dentsply Maillefer) + WaveOne Gold preparation; group PathFile, a glide path with PathFiles (Dentsply Maillefer) + WaveOne Gold; group K-files, a glide path with a K-file + WaveOne Gold preparation; and group without a glide path, WaveOne Gold preparation without a glide path file. Roots were attached to preweighed Eppendorf tubes. All instruments were used according to the manufacturers' instructions. During root canal preparation, a total of 8 mL distilled water was used for each specimen. Apically extruded debris was collected in Eppendorf tubes. After the completion of root canal preparation, Eppendorf tubes were removed from the specimens and stored in an incubator at 68°C for 5 days. Eppendorf tubes were weighed after evaporation to calculate the amount of extruded debris. The data were statistically analyzed with 1-way analysis of variance and post hoc Tukey honest significant difference tests (P = .05). **Results:** A statistically significant difference was observed between the One G and K-File groups. The One G group was associated with significantly less debris extrusion than the K-file group. There was no statistically significant difference between K-files and ProGlider, G-Files, PathFiles, and WaveOne Gold without a glide path, and also there was no statistically significant difference between One G and ProGlider, G-Files, PathFiles, and WaveOne Gold without a glide path. All experimental groups caused apical debris extrusion. **Conclusions:** Under the conditions of this *in vitro* study, all rotary path file systems were associated with similar apical debris extrusion before preparing root canals with the WaveOne Gold single-file reciprocating system. K-files caused more apically extruded debris than the One G files. *(J Endod 2018;■:1–4)*

Key Words

Debris extrusion, glide path, reciprocating files

Significance

Apically extruded necrotic debris might cause flare-ups and decrease the success rate of treatment. The file design, irrigation protocols, and preparation technique may affect the amount of apically extruded debris. According to the results of this study, manual K-files caused more apical debris extrusion than One G rotary glide path files.

Cleaning and shaping of the root canal system are achieved by chemomechanical preparation with endodontic files and irrigation solutions (1, 2). Stainless steel hand instruments were used for mechanical preparation for many years but have various disadvantages, including the potential to give rise to zip formation, perforation, and canal transportation, especially in curved root canals (1). The development of nickel-titanium (NiTi) rotary files resulted in less operator fatigue and well-tapered and centered root canal preparation in a shorter time (3).

Despite the advantages of NiTi rotary instruments, there is an increased risk of file fracture mainly because of excessive torsional and flexural stresses (4). Torsional stresses increase with excessive apical pressure during instrumentation and locking of the file tip in the root canal while the handpiece continues to turn (the taper lock effect) (5). Taper lock, torsional fracture risk, and shaping aberrations might be prevented by performing coronal enlargement and preflaring of the root canal to create a glide path before performing mechanical preparation with NiTi rotary files (6, 7).

West (8) defined the glide path as a smooth radicular patency from the root canal orifice to the apical construction. Files with a small taper (.02) and sizes of 0.15 or 0.20 are recommended to prevent taper lock and file fracture (6). Glide path preparation might be achieved using hand files or rotary glide path files (5). Stainless steel K-files have been recommended for manual glide path preparation to reduce the fracture rate of NiTi instruments (9). However, using stainless steel hand files during glide path preparation can be time-consuming and difficult, especially in severely curved or multiple narrow root canals (10). Therefore, the use of NiTi rotary glide path files has been

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suggested for safer and faster glide path preparation (11). NiTi rotary glide path preparation after using a small-size stainless steel K-file for initial canal negotiation is a less invasive and safer method for glide path enlargement (10). Glide path preparation with K-files leads to more postoperative pain than preparation with rotary NiTi glide path files (12).

Recently, several companies have manufactured different rotary pathfinding systems for creating a glide path. ProGlider (Dentsply Maillefer, Ballaigues, Switzerland) and One G (Micro-Mega, Besancon, France) are single-file systems produced for glide path preparation. The tip diameter of One G is 0.14 mm, and the taper of the file is 3%. The file design has 3 cutting edges, ensuring better debris elimination. ProGlider is manufactured using M-Wire NiTi technology, which increases the flexibility and cyclic fatigue resistance of the file (13). The ProGlider file has a square cross section and a 0.16-mm tip diameter. The taper of the file progressively changes from .02 to .08 over the cutting surface. The progressive taper of the file allows smoother glide path preparation and preflaring of the coronal and middle parts of the root canal (14).

The G-File (Micro-Mega, Besancon, France) NiTi rotary glide path system has 2 files with a .03 taper. G1 has a 0.12 tip diameter, and G2 has a 0.17 tip diameter. These files have 3 cutting edges with 3 different radii to improve the elimination of debris and cutting efficiency. The PathFile rotary glide path system (Dentsply Maillefer), which is manufactured from NiTi, has a square cross section and a .02 taper. The system consists of 3 files with 0.13, 0.16, and 0.19 tip diameters.

During the cleaning and shaping of root canals, dentin chips, microorganisms, irrigation solutions, and pulp tissue may be transported apically and extruded beyond the apical foramen (15). Apically extruded materials may potentially cause postoperative complications such as flare-ups and postoperative periapical inflammation (16, 17). Although all root canal preparation procedures seem to push the dentinal debris into the periapical tissues, the preparation or irrigation technique and instrument design may affect the amount of apically extruded debris (18–20).

The objective of this *ex vivo* study was to compare the effects of different glide path systems on apical debris extrusion while preparing root canals with a single reciprocating file. The null hypothesis was that there would be no difference in the amount of apically extruded debris after using different glide path files while preparing root canals with a WaveOne Gold file (Dentsply Maillefer).

Materials and Methods

Human mandibular molar teeth extracted for periodontal reasons were collected and stored in saline solution. Eighty teeth with a mature apex and curved mesial root canals were used in this *in vitro* study. The teeth were embedded into polyvinyl siloxane impression material, and cone-beam computed tomographic images were obtained. These images were used to evaluate the curvature of the root canals and the presence of 2 separate root canals in the mesial roots. The degree of root canal curvature was measured according to Schneider's method (21). Root canals with a curvature between 25° and 35° were selected. The mesial roots of the remaining 67 teeth were removed from the cementoenamel junction using a high-speed fissure bur under water cooling to obtain a 13-mm root length. A precurved #08 K-file (VDW GmbH, Munich, Germany) was inserted into the root canal until the tip of the file was visible at the apical foramen, and the working length was determined after subtracting 1 mm from this length under a stereomicroscope. Seven teeth were discarded because the #08 K-file could not reach the apical foramen; the curved root canals of the remaining 60 roots were used for the experiment.

Separate Eppendorf tubes were used for each specimen. Electronic scales (Mettler-Toledo AG, Greifensee, Switzerland) with an accuracy of 10^{-5} g were used to measure the weight of each tube. Three consecutive measurements were obtained, and the average weight was calculated for each tube.

Debris Collection

The experimental design described by Myers and Montgomery (22) was used to collect the apically extruded debris during root canal preparation. The Eppendorf tubes were inserted into the glass vials. A round hole was created in the silicone rubber cap of the vial. Teeth were inserted into the silicone rubber cap up to the cementoenamel junction and fixed with cyanoacrylate to prevent the leakage of irrigation solution through the external surface. A 27-G needle was inserted alongside the rubber cap as a drainage cannula to balance the internal and external air pressures. Each rubber cap with the needle and tooth was placed in its own Eppendorf tube. A rubber dam sheet was used to prevent the operator from seeing the root apex. The experimental model is shown in Figure 1.

Preparation of Root Canals

Sixty teeth were randomly divided into 6 experimental groups, and the curved root canal of each specimen was prepared as follows in each group:

1. Group G-File (n = 10): G1 (#0.12) and G2 (#0.17) rotary files were used to create a glide path, and a WaveOne Gold Primary (Dentsply Maillefer) reciprocation file was used to finish the root canal preparation.
2. Group One G (n = 10): a One G (#0.14) rotary file was used to prepare the glide path, and the root canal preparation was finished with a WaveOne Gold Primary reciprocation file.
3. Group ProGlider (n = 10): glide path preparation was performed with a ProGlider (#0.16) rotary file, and a WaveOne Gold Primary reciprocation file was used for root canal enlargement.

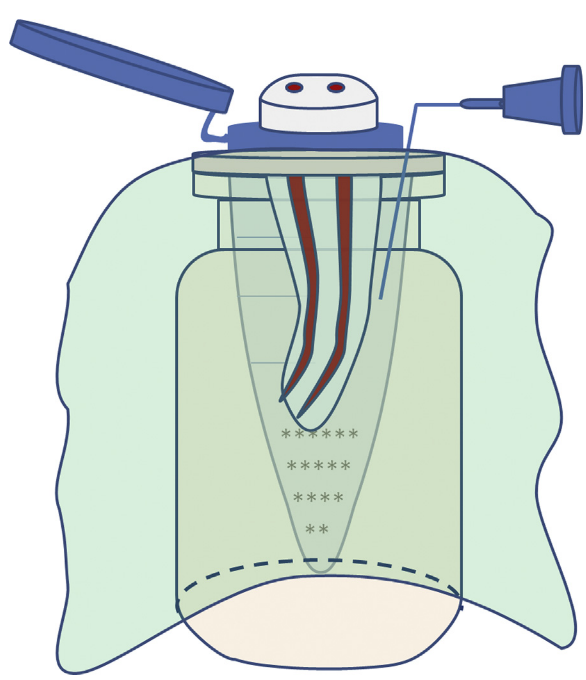

Figure 1. A schematic illustration of the experimental model.