Influence of Glide Path Preparation on the Canal Shaping Times of Wave One Gold in Curved Mandibular Molar Canals

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Highlights

- A comparative study on the effect of 3 different glide path techniques on the final canal shaping times with WaveOne Gold.
- WaveOne Gold Glider resulted in statistically significantly faster glide path preparation than K-files or PathFiles.
- Final preparation with WaveOne Gold took statistically significantly longer in canals in which no prior glide paths were prepared.
- There was no statistically significant difference in the mean final canal preparation times between the K-file, PathFiles, and WaveOne Gold Glider groups.

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Abstract

Introduction: The aim of this study was to compare the glide path preparation times of stainless steel hand files, PathFiles and the WaveOne Gold Glider, as well as the total time for root canal shaping with the Primary WaveOne Gold instrument in extracted human molar teeth with and without glide path preparation. **Methods:** Mesial canals of 60 mandibular molars (curvatures angles between 25° and 35°) were selected and randomly divided into 4 groups with 15 canals each. Canals were negotiated to patency with a #8 K-file. Canal preparations were performed by an endodontist using: pre-curved #10-15-20 stainless steel manual K-files (group KF); #10 stainless steel manual K-file followed by PathFiles #1-3 (group PF); and #10 stainless steel manual K-file followed by WaveOne Gold Glider (group WOGG). Total glide path and final preparation times were recorded. **Results:** No statistically significant difference in mean final preparation times was found between the WOGG (23.12 ± 6.03), PF (24.43 ± 4.94) and KF groups (27.22 ± 9.53). All 3 groups were statistically significantly faster than the NG group (35.37 ± 10.16) using ANOVA (P = 0.0004) and Kruskal-Wallis tests (P = 0.0010). Glide path enlargement was statistically significantly fastest with the WOGG group (19.73 ± 5.60) followed by the PF group (40.97 ± 6.84) and then the KF group (81.20 ± 26.32) using ANOVA and Kruskal-Wallis tests ($P < 0.0001$). **Conclusion:** Preparation time with the Primary WaveOne Gold file was statistically significantly reduced when the file was used in combination with any of the glide path preparation techniques. The WaveOne Gold Glider performed statistically significantly faster in glide path preparation time than the other glide path preparation techniques.

Keywords: Glide path preparation time, stainless steel K-files, PathFiles, WaveOne Gold Glider, WaveOne Gold

Introduction

A glide path is a smooth radicular tunnel extending from the canal orifice to the radiographic canal terminus or exit as determined by an electronic apex locator (1). Glide path preparation allows for an understanding and appreciation of the original canal anatomy, renders the canal patent to receive rotary files and, therefore, permits a more effective and safer action during root canal shaping (2, 3).

Once established, a successful glide path preparation can reduce torsional stresses and increase the lifespan of a rotary instrument by up to six times (3). A study by Patiño et al. demonstrated that the incidence of instrument separation was significantly reduced in canals where preparation was preceded by proper glide path preparation (4). A separate study showed a higher incidence of distortion and separation of nickel-titanium (NiTi) files in the absence of initial glide path preparation (5).

Various glide path preparation techniques are described in the literature. Manual glide path preparation with K-files (2% taper) have been recommended by a number of authors (1,3,6,7). NiTi rotary PathFiles (Dentsply Sirona, Ballaigues, Switzerland) were introduced in 2009 to facilitate glide path preparation. A study by Cantatore, Berutti and Castellucci showed that PathFiles can prepare a glide path with fewer irregularities and better conservation of original canal anatomy – even after canal preparation by inexperienced users (8). In recent years, single-file rotary glide path preparation systems like the ProGlider (Dentsply Sirona) and One G (Micro-Mega) have been introduced.

Several studies have demonstrated that the time taken for manual glide path preparation using stainless steel K-files exceeds that of rotary glide path preparation in both Endo-Training Blocks and on extracted mandibular molar root canals (8–10).

The use of NiTi shaping files in a reciprocating motion is a recent innovation with manufacturers claiming increased resistance to instrument separation (11). One such system, WaveOne (Dentsply Sirona), has demonstrated increased resistance to file fracture in a number of studies (12, 13). In reciprocating systems, the use of a single instrument is recommended for the complete shaping of root canals (14). A study examining the influence of glide path preparation on the failure rate of WaveOne reciprocating instruments demonstrated that the total canal preparation time with the use of the Primary WaveOne 25/08 reciprocating instrument on simulated canals was influenced by the method of glide path preparation. The results of this study showed that the total mean time to prepare simulated canals was significantly shorter when initial glide paths were prepared with PathFiles compared to glide path preparation with hand files or when no glide paths were prepared at all (9).

Gold-Wire is a new super-metal manufactured from a metal produced at the phase-transition point between martensite and austenite phases. This super-metal is completed by thermal processing and post-machining procedures (15). WaveOne Gold (Dentsply Sirona), according to the manufacturer, is 80% more flexible, 50% more resistant to cyclic fatigue, and 23% more efficient than its predecessor, WaveOne, manufactured from M-Wire (16). Recently, the WaveOne Gold Glider (Dentsply Sirona) – a single reciprocating file designed for glide path preparation prior to shaping canals with WaveOne Gold files – was launched. The file tip of the WaveOne Glider at D0 has an ISO 0.15 tip size with a 2% taper that progressively increase up to 6% at D16. The file has a semi-active tip and a parallelogram-shaped cross-section.

The aim of this study was to compare the glide path preparation times of stainless-steel hand files, PathFiles and the WaveOne Gold Glider, as well as the total time for root canal shaping with the Primary WaveOne Gold instrument in extracted human molar teeth with and without after glide path preparation.

Materials and Methods

Sixty extracted mandibular first molars with two mesial canals and two separate mesial apical foramina were selected. Root canals had to be visible on pre-preparation radiographs and had to be previously untreated. Only first mandibular molars with mesial root canal curvatures between 25 and 35 degrees were used. The Schneider method was used to evaluate each canal curvature with the use of a size 0.8 Kerr K-Flex file (Sybron Endo, California, USA) (17). With the use of a surgical microscope (Zumax Medical Co. Ltd) and after access cavity preparation with an Endo-Access bur (Dentsply Sirona), working length was determined by subtracting 0.5 mm from the length of the canal measured to the major apical terminus under 10 times magnification, The mesial canals were explored with a size 0.8 K-file and canals were negotiated to patency.

The specimens were coded and randomly divided into four equal experimental groups (n=15).

Glide Path Preparation

Glide path preparation was performed by a single operator in strict accordance with the manufacturer's recommendations for each system. All rotary or reciprocating files were operated by a 16:1 gear reduction hand piece powered by the X.Smart IQ (Dentsply Sirona) cordless motor. RC Prep (Premier, Pennsylvania, USA) was used as a lubricating agent and 3% sodium hypochlorite (NaOCl) as canal irrigation

KF group:

In each of the 15 canals, an initial reproducible glide path was prepared using pre-curved size 0.10, 0.15 and 0.20 stainless steel K-files. A final reproducible glide path to an ISO size 0.20 was confirmed when the stainless steel size 0.20 K-file could be placed at working length, pulled backwards for 4 mm and pushed back with light finger pressure to full working length without any interference or obstruction.

PF group

For each canal in this group (n=15) a pre-curved stainless steel size 0.10 K-file was negotiated to working length with increasing amplitudes of 1–3 mm to ensure an initial manually reproducible glide path. PathFiles no.1-3 was used to enlarge each canal in this group.

WOGG group

In each of the 15 canals a pre-curved stainless steel size 0.10 K-file was negotiated to working length with increasing amplitudes of 1–3 mm to ensure an initial manually reproducible glide path. The WaveOne Gold Glider was then used to enlarge each canal in this group.

NG group: No glide path preparation (n=15)

Each file in all of the glide path preparation groups was used only once. Preparation times were recorded with an electronic stopwatch. The time taken to change instruments was not taken into account. After glide path preparation, all 60 canals were shaped and prepared using WaveOne Gold Primary reciprocating files up to working length according to the manufacturer's instructions, using the X.Smart IQ (Dentsply Sirona) cordless motor. Throughout the instrumentation process RC Prep

was used as a lubricant and 5 ml of 3% sodium hypochlorite was used as irrigation solution. Each reciprocating file was only used to prepare one canal before being discarded. Preparation times were recorded with an electronic stopwatch.

Statistical Analysis

Mean and standard deviations were determined for each group and analysis of variance was used to statistically compare the mean glide path preparation times for the three groups, and final shaping times for the four groups. Statistical procedures were performed on SAS Release 9.3 (SAS Institute Inc, Cary, NC) running under Microsoft Windows (Microsoft Corp, Redmond, WA) for a personal computer.

Results

The mean and standard deviation values for the glide path preparation times and the total canal shaping times using WaveOne Gold Primary file are presented in Tables 1 and 2, respectively.

Table 1. Glide path preparation time (sec) for the three different glide path preparation groups

Preparation method	Number	Mean	Standard deviation	Minimum value	Maximum value
K-file	15	81.20 [c]	26.32	27.20	120.30
PathFiles	15	40.97 [b]	6.84	31.94	51.77
WaveOne Gold Glider	15	19.73 [a]	5.60	12.20	32.30

Mean values with the same superscript letters were not statistically different at $P < 0.05$.

Table 2. Final shaping times (sec) for WaveOne Gold in combination with four different glide path groups

Glide path technique	Number	Mean	Standard deviation	Minimum value	Maximum value
K-file	15	27.22 [a]	9.53	14.11	45.21
PathFiles	15	24.43 [a]	4.94	18.22	35.34
WaveOne Gold Glider	15	23.12 [a]	6.03	13.02	35.42
No glide path preparation	15	35.37 [b]	10.16	23.03	65.10

Mean values with the same superscript letters were not statistically different at $p<0.05$.

Glide Path Preparation Times

The WOGG group showed statistically significantly faster glide path preparation times compared to the PF and KF groups. The PF group in return showed statistically significantly faster preparation times compared to the KF group.

Canal Shaping Times

By means of analysis of variance (ANOVA) ($p < 0.05$), prior glide path preparation with the WOGG PF and KF groups statistically significantly reduced the final canal shaping time when the Primary WaveOne Gold file was used compared to the NG group.

Discussion

In this study, shaping times of WaveOne Gold used in curved mandibular molar canals were recorded following either no glide path preparation or one of three glide path techniques. The different glide path preparation technique times, prior to final instrumentation, were also recorded. Glide path preparation was done using conventional stainless steel hand K-files, rotary NiTi PathFiles and a single-file

reciprocating WaveOne Gold Glider. Human extracted mandibular curved canals were used to simulate clinically challenging canals.

This is the first study to compare the effect of four different glide path techniques on the final shaping time of canals prepared with WaveOne Gold. Final shaping of canals using WaveOne Gold in combination with all the glide path groups were statistically significantly faster compared to final instrumentation, where no glide path was prepared prior to final shaping of canals.

When one looks at glide path preparation times, PathFiles showed significantly shorter mean preparation times compared to stainless steel K-files. The WaveOne Gold Glider, however, showed statistically significant faster glide path preparation times compared to both the K-file and the PathFiles preparation groups. The statistically significant shorter glide path enlargement times of the WaveOne Gold Glider group can be explained by the fact that multiple instruments in each of the other two groups had to be used to prepare the glide path in comparison with the single WaveOne Gold Glider instrument. Paleker and van der Vyver evaluated three glide path techniques in a similar study with the use of K-files, G-files (Micro-Mega, France) and the ProGlider (Dentsply/Sirona) (10). These authors found that glide path preparation with G-files and the ProGlider file were statistically significantly faster than preparation with stainless steel K-files. No statistically significant difference existed, however, between the mean preparations times of G-files and ProGlider files. Similar studies also found that glide path preparation times were longer if manual stainless steel K-files were used compared with NiTi rotary files (8). Final shaping times for WaveOne Gold were statistically similar after glide path preparation, regardless of the glide path preparation technique used. In the group where no prior glide path was created before final shaping with WaveOne Gold, the final shaping times were statistically significantly longer than in those groups where a prior glide path had been prepared.

Another study by Paleker and van der Vyver showed that NiTi files exhibit superior centering ability and preservation of original canal anatomy when compared to K-files, which might affect shaping outcomes (18). These centering and preserving qualities along with reduced preparation time render PathFiles and the WaveOne Gold

Glider potentially the instruments of choice for creating a glide path in curved canals prior to final instrumentation with WaveOne Gold

Conclusions

Within the limitation of the study it can be concluded that canal shaping with WaveOne Gold is statistically significantly reduced when used in combination with any of the glide path techniques mentioned in this study. The WaveOne Gold Glider performed statistically significantly faster in glide path preparation than the other glide path preparation techniques and had the added advantage of being a single-file system.

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