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Research Article

# The Influence of Glide Path on Risk Fracture of Reciproc and WaveOne (25.08) Endodontic Instruments

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## Abstract

**Purpose:** The aim of this investigation was to evaluate the necessity of performing a glide path to decrease the risk of file separation using Reciproc and WaveOne 25.08 instruments.

**Materials and Methods:** 20 Reciproc files (25.08) and 20 WaveOne files (25.08) were used during the investigation. 10 files of each system were used to prepare root canals with previous glide path and the other 10 without a glidepath preparation. The instrumentation was performed on extracted molars, type IV Vertucci´s classification on mesial canals. All specimens were standardized to a radicular length ratio between 19.5 – 20 mm. with less than 25 degrees of radicular curvature. During the instrumentation data about the number of canals prepared prior to fracture was recorded on each group. Comparisons between groups was made using Kruskal-Wallis and Mann Whitney statistics tests.

**Results:** No statistically significant differences were found on the number of canals instrumented prior to Reciproc and WaveOne 25.08 separation with or without glidepath.

**Conclusion:** The creation of glidepath before to canal instrumentation has no influence on the fracture risk of Reciproc and WaveOne 25.08.

***Keywords:*** *Glidepath; Pathfile; WaveOne; Reciproc; Reciprocating Motion; File; Separation; Fracture*

## Introduction

The introduction on the market of NiTi instruments caused a revolution on the endodontic field [1], however, 360 degrees' continuous rotation increases the risk of files structural fatigue that leads to instrument separation inside of the canal [2,3]; Torsional and cyclic fatigue are the main causes of file separation [4-6]. It has been demonstrated that a reliable way of reducing the fracture risk is creating a permeable and reproducible way inside the canal [7]. This can be achieved by hand or rotary files, smaller than the first file of the rotary system chosen by the clinician [8-10]. According to West, glide path could be defined as a smooth and reproducible radicular tunnel going from the canal entrance to the apical foramen [8].

Risk of file separation decreases using reciprocating motion thanks to the reciprocating angles that do not reach the elastic limit of the NiTi instruments, however, cyclic fatigue could not be avoided, although it can be decreased on magnitude [11-13]. Based on the previous

fact, manufacturers of instrumentation systems using that kind of cinematic motion declare that it is not necessary to create a glide path before working [6,14]. Nevertheless, actual evidence on the behavior of the instruments inside of natural root canals still is very limited.

The aim of this study was to evaluate the necessity of performing a glide path to decrease the risk of file separation using Reciproc and WaveOne 25.08 instruments.

Based on the previous studies reporting the advantages of glide path, the hypothesis established on the present study was "glide path is necessary to reduce the separation risk of Reciproc and WaveOne 25.08 during root canal instrumentation".

## Materials and Methods

During the execution of this study, were instrumented 226 first mandibular molars corresponding to Vertucci's type IV classification on mesial canals. To facilitate the radiographic analysis the distal root was removed on every single molar. All molars included on this investigation were standardized to a radicular length ratio between 19.5 – 20 mm with less than 25 degrees of radicular curvature. The measurement of radicular curvature angle was performed by Schilder´s method, using the program Meazure 2.0 to stablish the angles on buccal and mesial views.

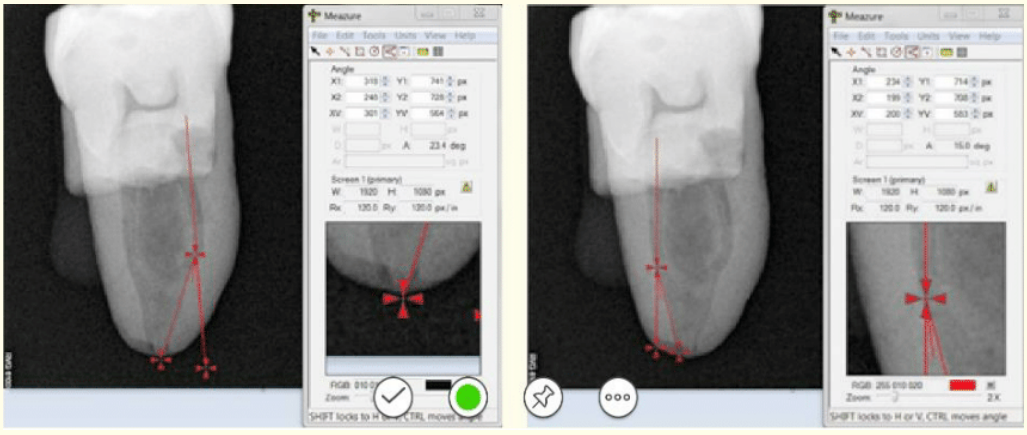

***Figure 1:*** *Curvature angles measurement on first mandibular molars medial canals using the program Meazure 2.0.*

Inferior molars matching inclusion criteria (radicular length between 19.5 – 20 mm, type IV Vertucci´s classification and less than 25 curvature degrees) were instrumented with Reciproc and WaveOne 25.08. One molar for each reciprocating system, one canal with glide path and the other one without. On this way, four groups were established: Group No. 1: Reciproc with glide path, Group No. 2: Reciproc Without glide path, Group No. 3: WaveOne with glide path, Group No. 4: WaveOne without glide path. The instrumentation system for each molar and the decision of what canal was instrumented with or without glide path was done completely randomized.

The instrumentation protocol was as follows: Two new Reciproc or WaveOne(depending on a random assignment) files were selected, one of them used to work on canals with glide path and the other one to instrument without glide path; mesial canals of mandibular first molars was prepared until a separation of the instrument occurs inside of the root, when separation occurs, buccal and mesial radiographs were taken; data regarding on the number of canals prepared before breakage of the file and the quantity of instrumentation cycles needed to reach working length on each molar were recorded. An instrumentation cycle is defined as three apical movements of approximately 1 mm each. After an instrumentation cycle the file was took out of the canal, cleaned with a gauze moistened with 5.25% sodium hypochlorite, then the root canal was irrigated with 2 ml. 5.25% sodium hypochlorite with the positive pressure technique. The pulp chamber was full of irrigant during the whole instrumentation protocol. To facilitate the procedure and to reduce external variables

that could influence on the results, each molar was placed on a silicone block mounted on a metallic holder to keep it tight and steady during all the procedure.

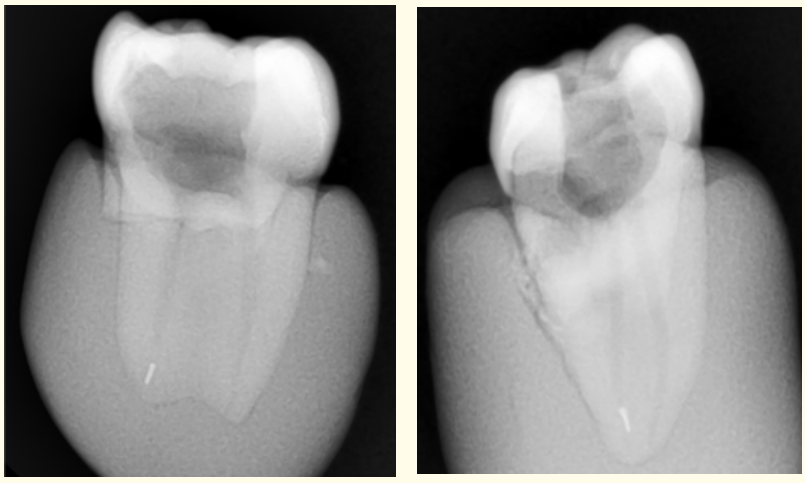

***Figure 2:*** *Radiograph of fractured instruments on fist mandibular molars mesial canals apical third. Reciproc – Left, WaveOne – right.*

It´s important to mention the fact that, whenever it was possible to prepare 10 entire root canals with one file without separation, the file was declared as anon-fractured instrument. A total of 20 Reciproc 25.08 and 20 WaveOne 25.08 were used; 10 of each system to work with glide path and the other 10 without glidepath. The endodontic motor used during the whole procedure was the X-Smart Plus.

Manual K-files No. 08.02 were used to established working length, the file was inserted on the canal until it was possible to see it at the mayor foramen with an operative microscope 12X magnification, 1 mm was subtracted to that length to determine the apical limit of the instrumentation protocol. Glide path was performed on the corresponding canals with rotary Path Files 13.02 at 300 RPM and 0.3 N/cm torque using the X-Smart Plus endodontic motor.

Statistical analysis was made using the SPSS Statistics 19.0. program; Central tendency, Dispersion and Kolmogorov-Smirnov measures were applied to all recollected data on each group. To determine the existence of statically significant differences between groups, Student t test, Mann Whitney, krusdal-Wallis and ANOVA were applied.

Economical support to developed the Study, materials, equipment and laboratory installations were provided by the Universidad de San Carlos de Guatemala (USAC) Dental School and the Guatemalan Science and Technology Institute (CONCYT). The investigation is registered on the CONCYT records by the registry number 026-2013, Principal investigator on charge: Jenner Oscarly Argueta Zepeda D.D.S. – M.Sc. Investigator ID Number: 2606.

## Results

At the end of the study, 8 of the 20 Reciproc instruments suffer fracture inside of the canals, 2 from the group worked with glide path and 6 belonging to the group without glide path. On the other side, from the total of 20 WaveOne files, 19 were separated, 9 from the group worked with glide path and 10 belonging to the instrumentation group without glide path. Comparisons between groups, number of canals instrumented and the quantity of instrumentation cycles needed to reach working length are presented on the following graphics.

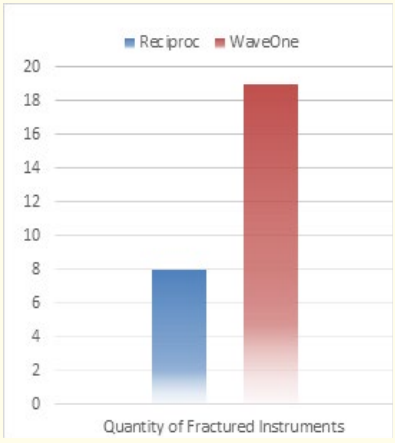


***Figure 3:*** *Quantity of fractured reciproc and waveone files during root canal instrumentation. WaveOne twice the number of Reciproc separate files during the study.*

| | Mean | Median | Minimum | Maximum | Kruskal-Wallis |
|---|---|---|---|---|---|
| Reciproc® without glide path | 9.10 | 9.00 | 8.00 | 10.00 | p = 0.000 |
| Reciproc® with glide path | 9.80 | 10.00 | 9.00 | 10.00 | |
| WaveOne® without glide path | 6.50 | 6.50 | 5.00 | 9.00 | |
| WaveOne® with glide path | 7.70 | 7.50 | 5.00 | 10.00 | |
| Reciproc® with gp Vs Reciproc® without gp | | | | Mann-Whitney | p = 0.112 |
| WaveOne® with gp Vs WaveOne® without gp | | | | | p = 0.089 |
| Reciproc® with gp Vs WaveOne® with gp | | | | | p = 0.001 |
| Reciproc® without gp Vs WaveOne® without gp | | | | | p = 0.008 |

***Table 1:*** *Quantity of canals instrumented before file separation using reciproc and waveone.*

*No statistically significant differences were found on the groups comparing the number of canals instrumented with and without glide path, on the other hand, statistically significant differences were found on the groups comparing quantity of canals instrumented prior to fracture using Reciproc Vs WaveOne.*

| | Mean | Median | Minimum | Maximum | ANOVA |
|---|---|---|---|---|---|
| Reciproc® without glide path | 3.44 | 3.36 | 3.00 | 4.22 | p = 0.064 |
| Reciproc® with glide path | 3.10 | 3.05 | 2.70 | 3.70 | |
| WaveOne® without glide path | 2.97 | 2.90 | 2.57 | 3.50 | |
| WaveOne® with glide path | 3.33 | 3.20 | 2.71 | 4.16 | |

***Table 2:*** *Quantity of instrumentation circles needed to reach working length using reciproc and waveOne.*

*No statistically significant differences were found on the groups comparing the number of instrumentation cycles needed to reach working length with and without glide path and between group of different files (Reciproc Vs WaveOne).*

| | Mean | Median | Minimum | Maximum | ANOVA |
|---|---|---|---|---|---|
| Reciproc® without glide path | 32.80 | 32.50 | 24.00 | 40.00 | p = 0.000 |
| Reciproc® with glide path | 30.40 | 30.00 | 27.00 | 37.00 | |
| WaveOne® without glide path | 23.30 | 22.00 | 14.00 | 35.00 | |
| WaveOne® with glide path | 21.50 | 21.50 | 14.00 | 28.00 | |
| Reciproc® with gp Vs Reciproc® without gp | | | | Tukey | p = 0.729 |
| WaveOne® with gp Vs WaveOne® without gp | | | | | p = 0.864 |
| Reciproc® with gp Vs WaveOne® with gp | | | | | p = 0.000 |
| Reciproc® without gp Vs WaveOne® without gp | | | | | p = 0.020 |

***Table 3:*** *Quantity of instrumentation circles performed before file separation using reciproc and waveOne.*

*No statistically significant differences were found on the groups comparing the number of instrumentation cycles performed before file separation with and without glide path, on the other hand, statistically significant differences were found on the groups comparing quantity of instrumentation cycles performed before file separation between group of different files (Reciproc Vs WaveOne).*

## Discussion

The aim of the present study was to evaluate the necessity on performing a glide path to decrease the risk of file separation using Reciproc and WaveOne 25.08 instruments on first mandibular molars mesial canals with a working length ratio between 19.5 – 20 mm and less than 25 curvature degrees. Standardization regarding to working length and radicular curvature was verify using Mann-Whitney and the Student T test respectively; being 0.413 the P value for Mann-Whitney and 0.332 for the Student T test, both with 95% of confidence value; previous results indicate no statistically significant differences on the working length and radicular curvature degrees on all the four groups.

Standardization mentioned on the previous paragraph is crucial, keeping in mind that root canal curvature is one of the mayor risk factors for cyclic fatigue and file separation [3,15].

Although Reciproc and WaveOne instruments are commercialized as single use files, in case of treating multi-rooted teeth, each file could work even on 3 – 4 canals at least, this multiple use of the same file can cause accumulation of cyclic fatigue as the clinician works from one canal to other [16,17]. It is highly recommended for the clinician to know the behavior of this instruments when they are used several times.

Berrutti., *et al.* in 2012 [3] demonstrated that WaveOne files caused less modifications on the original root canal curvature when glide path was performed compared with the instrumentation without glide path. They also found that much more instrumentation cycles were needed to reach working length when the instrumentation protocol was performed without glide path; previous results does no match with the findings on this investigation because our results show no statistically significant differences between groups on the number of instrumentation cycles needed to reach working length.

On the other hand, when comparisons were made between the groups: Reciproc with glide path vs WaveOne with glide path, and Reciproc without glide path vs WaveOne without glide path; statistically significant differences were found, 0.008 and 0.001 P value respectively. It was possible to instrument a larger number of radicular canals with Reciproc than with WaveOne; these results match with the ones reported by Argueta A. in 2012,on a Study performed on artificial canal on resin blocks, using Reciproc and WaveOne as well [15].

Grande., *et al*. [18] proved that big metallic core on a file, at the point of maximum stress has a negative influence on the cyclic fatigue resistance; the authors of the study demonstrated that instruments with smaller metallic core (Mtwo) have higher resistance to cyclic fatigue than the ones with a bigger metallic core (Protaper) [18]. The results mentioned above match with the data obtained on the present

investigation and with the ones reported by Plotino G., *et al.* in 2012, whom evaluated cyclic fatigue resistance of Reciproc and WaveOne [19,20], Reciproc has a higher cyclic fatigue resistance that could be attributed to its transversal cross section, despite the fact they are made from the same alloy of WaveOne. Reciprocating angles also could have influence on fracture resistance behavior of the files.

## Conclusion

Within the limitations of the study we can conclude that performing a glide path before to reciprocating instrumentation has no influence on reducing the risk of fracture of Reciproc and WaveOne 25.08 during the instrumentation on first mandibular molars mesial canals with less than 25 curvature degrees.

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