Original Article

Shaping Ability of 2Shape and WaveOne Gold Files Using Cone-Beam Computed Tomography

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ABSTRACT

Aim and Objective: The aim of this study is to evaluate the apical transportation, centering ability, and volume of removed dentin of WaveOne Gold (WOG) and 2Shape with the use of cone-beam computed tomography.

Materials and Methods: Freshly extracted mandibular teeth with sample size of thirty were carefully chosen and instrumented using the 2Shape and WOG rotary files. Preoperative and postinstrumentation cone-beam computed tomographic scans were done to accomplish mesial and distal dentin walls' measurements and volume of removed dentin calculations, apical transportation, and centering ratio. Statistical analysis was performed and confirmed by independent *t*-test. Statistical significance was set at 5%.

Results: When shaping ability of 2Shape and WOG was evaluated, it was reported that there was no statistically significant differences noted among the groups in relation to the total volume of removed dentin, apical transportation, and centering ratio.

Conclusion: It can be concluded that 2Shape and WOG preserved the original canal anatomy well and did not eliminate excess dentin during shaping and cleaning. Rotary nickel–titanium files which work on the principle of rotary movement attained an outcome analogous to that of the rotary files working on reciprocating motion in relation to alteration in angle.

Keywords: *Apical transportation, centering ratio, G-wire-reciprocating motion-WaveOne Gold, T-wire-2shape, volume of removed dentin*

Introduction

The foremost aim of root canal treatment is to promote the shaping followed by amended cleaning of the root canal, to attribute a conical shape and to preserve the originally existing root canal curvature. Nevertheless, throughout chemomechanical preparation, deviations from the original root canal curvature may occur.[1] These changes could have a pessimistic influence on the superiority of obturation and subsequently on the success of the root canal treatment.[2]

Currently, there are no instruments available which are capable of symmetrically shaping the root canal walls;[3] however, nickel–titanium (NiTi) rotary instruments when compared to stainless steel instruments produce more centralized preparations with a lower transportation.[4]

Recently introduced, 2Shape (2S) NiTi rotary file is made of NiTi-alloy called T-wire. 2Shape has a sequence with two instruments: TS1 (#25, 0.04) and TS2 (#25, 0.06).[5]

Yared proposed a new technique employing reciprocating movements using just one instrument;[6] biomechanical preparation with reciprocating motion has been claimed to lessen the likelihood of unforeseen file fractures. WaveOne Gold (WOG) G-wire technology is available in 4 sizes: small (#20, 0.07), primary (#25, 0.07), medium (#35, 0.06), and large (#45, 0.05).[7]

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There is a paucity of literature comparing the shaping ability of 2Shape and WOG. Therefore, this study was planned. Null hypothesis tested as new manufacturing methods and type of rotary motion will not have any effect on their shaping ability of root canals.

Materials and Methods

Sample size was calculated, and thirty freshly extracted mandibular molars were selected, which on radiographic evaluation had canal curvature of 25°–30°, and samples were stored in normal saline till use. Cone-beam computed tomographic scanning was done before instrumentation.

Teeth were accessed with the aid of Endo-Access bur (Dentsply Maillefer) in a high-speed airotor. Through the mesiobuccal canals (MB), 10 K size files (Dentsply Maillefer) were inserted, and the curvature of the canal was evaluated according to Schneider's method. Canals with curvatures of 25°–30° were included for shaping and cleaning. Distal roots were sectioned using low-speed diamond disc with the respective part of the crown from the furcation level and discarded, and only the mesial roots were used for the study. The determination of the working length was established by inserting size 10 K-file to root canal terminus and subtracting 1 mm from this measurement which was then confirmed using electronic apex locator. The teeth were marked from 1 to 30 and divided randomly into two groups of 15 each after randomization of the sample.

Group 1 (2S, n = 15): Instrumented with 2Shape (MicroMega, France) in the sequence TS1>TS2 (6%/#25) as it can be considered as standard control preparation in continuous rotation in pecking motion according to manufacturer's recommendations.

Group 2 (WOG, n = 15): Instrumented with primary file (7%/#25) WOG (Dentsply Maillefer, Switzerland) in reciprocating motion (clockwise – 140° and counterclockwise – 45°).

Root canal shaping

A single operator performed the root canal procedure according to the manufacturer's instructions for each NiTi rotary system. Electric motor (X-Smart plus; Dentsply Maillefer) with a 16:1 reduction handpiece was used for mechanical instrumentation with NiTi rotary files. As a lubricating agent during instrumentation, Glyde (Dentsply Maillefer) was used. A glide path was performed using ProGlider (Dentsply Maillefer; size 16, 0.02 taper) file to the working length. Apical preparation was completed with a size 25 file using the file order specified by the manufacturer. During instrumentation, irrigation of the canals was done with 2 mL 5% NaOCl. After instrumentation, 1 mL of 17% ethylenediaminetetraacetic acid was applied for 3 min followed by final irrigation with 3 mL of NaOCl. Each instrument was used to prepare three canals and then discarded.

Cone-beam computed tomography analysis

Custom-made specimen holders were used for placement of sectioned tooth in which each root could be positioned in the same place before and after instrumentation. Pre- and post-instrumentation measurements of MB canals were achieved. The volume of removed dentine was measured in mm3 for each root canal by subtracting the uninstrumented canal volume from the instrumented canal volume [Figure 1]. Canal transportation and centering ratio were calculated at three cross-section levels, i.e., 3, 5, and 7 mm from the apical end of the root using the following equation:

Degree of canal transportation: Mesiodistally = $(m_1 - m_2) - (d_1 - d_2)$.

Canal centering ratio = $(m_1 - m_2)/(d_1 - d_2)$ or $(d_1 - d_2)/(m_1 - m_2)$.

Statistical analysis

A statistical analysis (SPSS 15.0; SPSS Inc., Chicago, IL, USA) of the data was performed, each set of measurements were analyzed using the Kolmogorov–Smirnov test. Statistical significance level was set at $P < 0.05$.

Results

Volume of removed dentine

Table 1 shows the mean ± standard deviation of volume of removed dentine (mm) for tested groups and statistical analysis. There is no significant difference between the two tested groups ($P > 0.05$).

Table 1: Mean and standard deviation values for volume of removed dentin detected at 3 different levels (mm)

	Inner measurements			Outer measurements		
	2 Shape	WaveOne Gold	*P*	2Shape	WaveOne Gold	*P*
Level 1 3 mm	0.07±0.01	0.09±0.03	0.655	0.13±0.03	0.18±0.09	0.201
Level 2 5 mm	0.22±0.04	0.25±0.06	0.317	0.19±0.08	0.22±0.04	0.362
Level 3 7 mm	0.26±0.06	0.28±0.03	0.449	0.21±0.03	0.26±0.07	0.391

Canal transportation

There is no statistically significant difference reported as shown in Table 2 for degree of canal transportation mesiodistally for tested groups ($P > 0.05$). Graphical representation of canal transportation is shown in Graph 1.

Centering ratio

No statistically significant difference between the two tested groups is noticed ($P > 0.05$), as shown in Table 3. Graphical representation of canal transportation is shown in Graph 2.

Table 2 shows the mean and standard deviation values of the canal transportation at the three studied levels (3, 5, and 7 mm) for each tested group. Both the tested groups showed similar results when compared.

Table 3 shows the mean and standard deviation values of the centering ratio at the three studied levels (3, 5, and 7 mm) for each tested group. Both the tested groups showed similar results when compared.

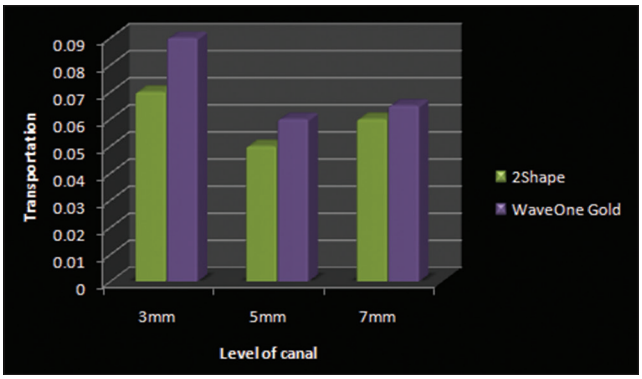
Discussion

The purpose of this study is to compare the shaping ability of two recently introduced NiTi rotary instruments recommended for the preparation of curved root canals, one of which is activated by reciprocating movement and one by continuous rotary movement. The following parameters were evaluated: volume of removed dentin, apical transportation, and centering ratio.

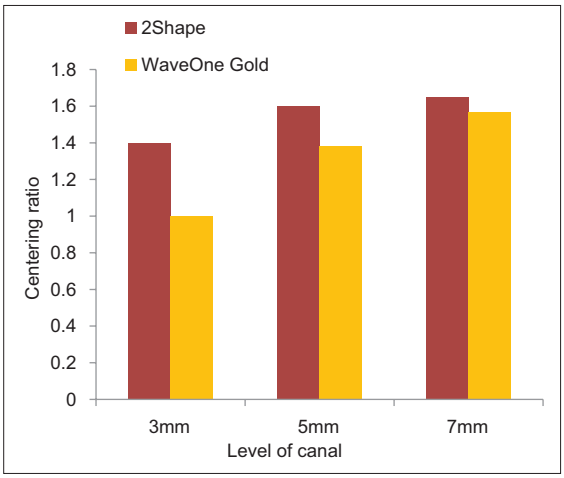
Crowns corresponding to the mesial roots were retained to mimic the clinical conditions where the tension is produced during canal instrumentation by file, due to the interference of cervical dentine projections.[8]

For assessment of shaping ability, cone-beam computed tomography imaging technique was used as it provides a specific, reproducible, and three-dimensional assessment of dentine thickness and root canal volume alteration before and after preparation without damaging the specimens.[9]

The angle of curvature at 25°–30° was preferred as it is considered as moderate curvature according to American Association of Endodontists Endodontic Case Difficulty



Graph 1: Degree of canal transportation mesiodistally for tested groups



Graph 2: Centering ratio for tested groups

Table 2: Mean and standard deviation values for the amount of canal transportation irrespective of the direction at 3 measurement levels (mm)

	2Shape	WaveOne Gold	*P*
Level 1: 3 mm	0.07±0.032	0.09±0.02	0.376
Level 2: 5 mm	0.06±0.03	0.06±0.015	0.293
Level 3: 7 mm	0.05±0.035	0.065±0.018	0.501

Table 3: Centering ratio means and standard deviations detected at 3 different levels (mm)

	2Shape	WaveOne Gold	*P*
Level 1: 3 mm	1.4±0.13	1.0±0.15	0.596
Level 2: 5 mm	1.6±0.15	1.35±0.14	0.733
Level 3: 7 mm	1.67±0.13	1.55±0.15	0.610

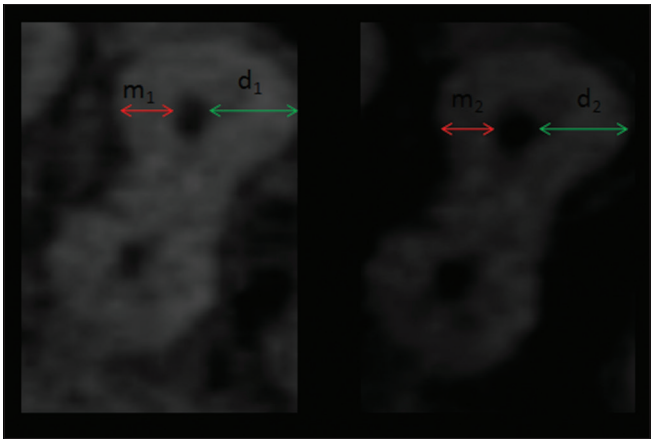


Figure 1: Pre- and post-instrumentation cone-beam computed tomography images

Assessment to obtain results that cover a large scale of cases.[10]

Curvatures with high susceptibility to iatrogenic mishaps usually exist at these three levels: 3, 5, and 7 mm, which represent the apical, middle, and coronal thirds of the root canals, respectively; hence, they were chosen for evaluation in the study.[11]

In this study, there was no statistically significant difference reported between 2Shape and WOG systems when the volume of removed dentin was evaluated, as shown in Graph 1 ($P > 0.05$).

There was no statistically significant difference noted between 2Shape and WOG systems ($P > 0.05$) while assessing the canal transportation (Graph 2) and centering ratio (Graph 3) at all the levels 3 mm, 5 mm, 7 mm. The probable reason could be the tip design, metallurgy, file cross-section, and principle working motion of each file system.

2Shape (2S) NiTi rotary file works on rotating motion and is made of NiTi-alloy called T-wire which is a method which allows for an increased resistance to cyclic fatigue (+40%) and a better negotiation of curvatures. The two instruments – TS1 (0.25/0.04) and TS2 (0.25/0.06) return to their original shape after each use. A latest generation of cross-section with tripe helix: two primary cutting edges and 1 secondary cutting-edge aids in the perfect compromise between cutting efficiency and debris removal.[5]

WOG works on the principle of reciprocating motion and is claimed to be able to completely shape and clean root canals with only one single use instrument. These files are made of a special NiTi-alloy called G-Wire which is created by an innovative thermal treatment process. The benefits of this G-Wire NiTi are increased flexibility of the instruments and improved resistance to cyclic fatigue. Reverse helix, semi-active and modified guiding tip, and offset parallelogram-shaped cross-section limit the engagement zone. Reciprocating movement minimizes torsional and flexural stresses, increases the centering ability of canal, and reduces the taper lock of the instrument within the canal.[12-15]

An *in-vitro* study on shaping ability of Reciproc, WOG, and HyFlex EDM Single-file Systems in Simulated S-shaped Canals was conducted by Ozyurek *et al.* in the year 2017; it was concluded that all the NiTi files produced various levels of removal of resin.[12] However, the lower level of resin removal was reported with the use of WOG and HEDM NiTi files as compared to the RPC NiTi files. The results for WOG were in accordance with our study stating less volume of removed dentin.[16]

Similarly, the results of the study done by Abdullah *et al*. in 2018 comparing the shaping ability of ProTaper Gold and WOG system in simulated S- and L-shaped canals revealed that there was a highly significant difference noted in preparation, and it was concluded that WOG showed better shaping ability with less canal aberrations and faster canal preparation as compared to ProTaper Gold.[17] Hence, it is supporting the results of the current study that WOG respects the canal anatomy better when used for chemomechanical preparation. Simone Staffoli *et al*. in 2018 conducted the study to compare the centering ability of ProTaper Next and 2Shape file system on simulated teeth with severe curvature; it was reported that there was no significant difference in centering ability of ProTaper Next and 2Shape. Both the file systems showed some degree of canal transportation, especially in the apical third.[18,19]

The 2Shape and WOG NiTi rotary systems revealed comparable volume of removed dentine, canal transportation, and centering ratio. There is a paucity of literature on shaping ability of 2Shape system; hence, the file system was selected for the study. Further investigations to the metallurgy and mechanical properties of these recent systems are required to gain insight on how the proprietary advanced metallurgy processing of these affects its properties. In addition, evaluations of the clinical performance of these systems *in vivo* are needed to provide reliable recommendations for endodontists.

Conclusion

Within the limitations of this *in-vitro* study, both 2Shape and WGO rotary systems performed similarly with regard to volume of removed dentin, canal transportation, and centering ratio and were able to maintain the original canal curvature in mesial canals of mandibular molars.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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