



## Evaluation of Canal Transportation Using Single File Rotary Systems, One Shape, Waveone GOLD and Reciproc in Simulated Curved Canals (in Vitro Study)

Eanas Ittihad Jellil <sup>(1)</sup>

### Abstract

Objectives maintaining root canal anatomy through minimal canal transportation by using Rotary single file systems: One Shape, Wave One Gold and Reciproc systems used in simulated artificial curved root canals. Materials and Methods 30 simulated curved root canals in clear resin blocks were used in this study and divided into three groups containing 10 samples each: group (1) represented canals instrumented with Rotary One Shape files, group (2) canals instrumented with reciprocating Wave One Gold files while Group (3) canals were prepared with Reciproc files. All canals were imaged pre- and post-instrumentation at three levels, 2,3 and 5 mm apically and compared using Adobe Photoshop software program. Amount of transportation were assessed. The three groups were compared with ANOVA and LSD statistic tests Results the mean transportation at 3mm level of the canal had no significant difference among all groups, all shown transportation. At 2mm, and 5mm levels there were significant difference between groups, G2 shown the least transportation among all groups. Conclusions Within the limits of this study, the canal preparation with Wave One Gold files showed lesser transportation than One Shape and Reciproc files.

**Key words:** Root canal, Rotary, curve.

### Introduction:

Success of root canal treatment depends on many factors; one of the predictive steps is the root canal shaping procedure, because it is the roll in other later steps. Adequate instrumentation (shaping) with good irrigation is important to achieve sufficient root canal treatment <sup>(1)</sup>. A continuous tapered preparation from crown to apex should be created to maintain the original canal shape <sup>(2)</sup>. The shape memory of the files to restore themselves to their original shape during canal preparation may lead to removal of dentin structure on the outside curve of the canal this would be called canal transportation <sup>(3)</sup>. Many mishaps may occur like ledge formation and perforation if would be used with stainless steel hand instrumentation <sup>(4)</sup>. The development in material used for fabrication of endodontic instrument was a great step for safety of root canal preparation, rotary

nickel titanium (Ni-Ti) instruments now a day used is one of these developments<sup>(5)</sup>. Because of the unique properties of the alloy, the morphological characteristics and safety of canal shaping are improved by these instruments <sup>(6)</sup> through maintaining the original shape of the canal with little transportation <sup>(7)</sup>. Instrumentation by rotary files requires using many instruments to create the desire shape of the canal with minimal errors, this procedure is time consuming <sup>(8)</sup>. Other challenge would be having if instrumentation done for curved canals with stainless steel files <sup>(9)</sup>. So rotary nickel titanium (Ni-Ti) instruments had been used in this study with single file concept for more safety and less time during instrumentation. Two concepts of file rotation had been used in this study for instrumentation of curved root canals, the first concept was continuous rotation which represented by One shape file. Another concept was the balanced force technique which includes the use of

1) Asst. Lec, Department of Operative, College of Dentistry, Al- Mustansiriya University.

clockwise and contra clockwise (reciprocation) movements represented by Wave One Gold and Reciproc systems ,the reciprocation known from 1985<sup>(10)</sup>.

## Materials and methods:

### Artificial canals preparation

Thirty standardized clear resin blocks (Dentsply-Maillefer, Switzerland) with simulated curved root canals were used for this study. Blocks had following criteria, foramen size of 0.1 mm, canal length mean of 16 mm and curvature of 40°. Each simulated canal was checked there was no blockage with 10 K-file and then colored with black ink injected using a disposable syringe of 27 gauge needle and a preoperative images were taken of each canal using Nikon2 digital camera with standardized technique using a holder made from hard teflon materials with a transparent paper 11 where the chosen three levels of measurements have been drawn on it. After the images have been captured, they stored in computer and named as a preoperative images Fig (1).

### Canals instrumentation

A glide path was established for all groups using Proglider rotary path file with size 16\ .02 which Made from M-Wire NiTi Alloy, also Glyde (Dentsply-Maillefer) was used as a lubricant during canals instrumentation. The blocks were divided into 3 groups of 10 canals for each.

- Group 1, (G1) One shape (OSH) (Micro-Mega, France) with 25/.06.
- Group 2, (G2) Waveone GOLD (WOG) primary (Dentsply-Maillefer, Switzerland) with 25/.07.
- Group 3, (G3) Reciproc R25 (REC) (VDW GmbH, Germany) with 25/.08.

Crown down technique had been used for Canals preparation according to manufacturer's recommendations of each instrument using X Smart Plus motor (Dentsply-Maillefer, Switzerland). Pecking motions had been used for Reciproc and Wave One Gold while one shape had been used with continuous

rotation, each file discarded after 2 uses and cleaning procedure of file flutes done by using 70% ethyl alcohol with Gauze.

### Assessment of canal preparation

Images of Pre- and post-instrumentation were superimposed using a computer software program (Adobe Photoshop 2013, USA). After obtaining the measurements, the following formula was used to obtain the transportation ( $\beta$ ):  $\beta = D1 - D2$ , where D1 represents the maximum extent of the canal movement on the inner curve, while D2 is the movement on the outer curve Fig. (2). The SPSS program version 15 was used for statistical analysis of data after obtaining measurements at 3 using one-way analysis of variance (ANOVA;  $\alpha = 0.05$ ) followed by LSD test.

## Results:

The mean transportation for Group 1 at 2 mm, 3 mm and 5 mm apically was 26.2  $\mu\text{m}$ , 26  $\mu\text{m}$  and 15  $\mu\text{m}$ , respectively. The mean transportation for Group 2 at 2 mm, 3 mm and 5 mm apically was 9.6  $\mu\text{m}$ , 39.8  $\mu\text{m}$  and 9.2  $\mu\text{m}$ , respectively. The mean transportation for Group 3 at 2 mm, 3 mm and 5 mm apically was 12.4  $\mu\text{m}$ , 34.8  $\mu\text{m}$  and 25.2  $\mu\text{m}$ , respectively shown in Table (1) (Descriptive Statistics). At the level B (crest of curvature) there was no significant difference among all groups, all shown transportation. While at the level A (coronal to the curvature) there was significant difference between G2 and G3, G2 shown the least transportation among all groups. Also at level C (apical to curvature) there was significant difference between G1 and G2, G2 shown the least transportation among all groups. Table (2) (ANOVA test), Table (3) (LSD test).

## Discussion:

The preparation of curved root has many complications, one of them is canal transportation. The complication comes from leaving some area in the canals unprepared with some necrotic tissue where the bacteria hosted, lead to failure of endodontic treatment with poor apical

seal of the canals <sup>(12)</sup>. Standardization of the samples is required in the study to give more credible results, therefore clear resin blocks with standardized shape, size, taper, and curvature had been used which was validated by Dummer et al<sup>(13)</sup>. This study evaluates the canal transportation of three different Rotary Single file systems, which are, One Shape system, Wave One Gold system and Reciproc system. The results obtained suggested that all the three systems used in this study for canal transportation shown no significant variations at the curvature level. Even though One shape system showed the least mean of transportation among all. This result may be obtained from that One Shape system has three different zones of cross section along the blade in addition to variable cutting edge designs and numbers, the first zone has a variable 3-cutting edge, second zone has subsequently changes from 3 to 2 cutting edges and the last zone has 2 cutting edges<sup>(9)</sup>. In addition to electro polishing and flexibility may result in good apical progression with minimal fatigue and fracture. It has been highlighted from various literatures that the canal transportation is better within instruments with less cross-sectional area (0.06 taper

for Oneshape) and instruments with non-cutting tips <sup>(14)</sup>. At the other levels of the canal (coronal and apical to curvature) A and C levels results suggested that, G2 (Wave One Gold system) shown the least mean of transportation among all groups with significant variation. Many causes may encounter for this result, one of them is reciprocation technique (wave one Gold move 150 counter-clockwise (CCW) and 30 clockwise (CW) direction) which allows maintaining the original shape of the canal in curved root during the preparation <sup>(15)</sup>. Other cause may be the material of the wire which is commercially termed Gold wire produces more clinically optimal metal than NiTi, itself, through phase-transition point which have been identified between martensite and austenite that produces the Primary WaveOne Gold file which is more flexible and more resistant to cyclic fatigue <sup>(16)</sup>. In addition, the new cross-section (parallelogram with two 85-degree cutting edges) Fig. (3) Which alternate in one or two contact point to canal wall with new metal of Wave One Gold improve shaping results in maintaining apical curved canals, while decreasing the potential for iatrogenic events <sup>(17)</sup>.



Fig. (1): Resin block in a Teflon holder.

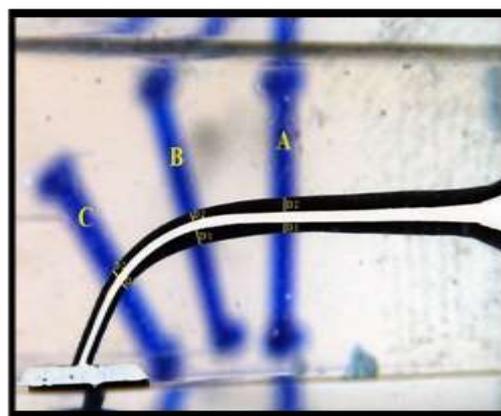


Fig. (2): Pre- and post-instrumentation images with Measuring levels

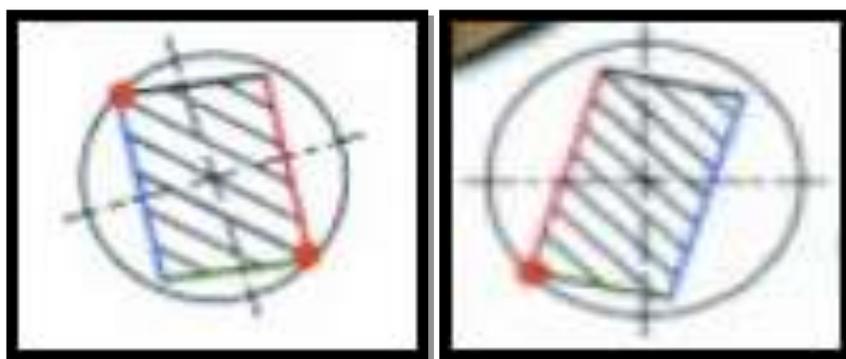


Fig. (3): Parallelogram Cross section of waveone GOLD with 1 and 2 alternate cutting edges.

Table (1): Show minimum , maximum , mean and stander deviation of all group at three level

Levels	Groups	N	Minimum	Maximum	Mean	Std. Deviation
<b>A</b>	G1 (OSH)	10	11	24	15	5.196
	G2 (WOG)	10	1	16	9.2	5.585
	G3 (REC 25)	10	15	43	25.2	11.054
<b>B</b>	G1 (OSH)	10	3	57	26	20.371
	G2 (WOG)	10	31	48	39.8	7.362
	G3 (REC 25)	10	16	64	34.8	19.879
<b>C</b>	G1 (OSH)	10	12	49	26.2	15.401
	G2 (WOG)	10	0	18	9.6	8.443
	G3 (REC 25)	10	4	23	12.4	6.804

Table (2): ANOVA test

Levels		Sum of Squares	Df	Mean Square	F	Sig.
<b>A</b>	Between Groups	656.133	2	328.067	5.456	.021
	Within Groups	721.600	27	60.133		
	Total	1377.733	29			
<b>B</b>	Between Groups	488.133	2	244.067	.847	.453
	Within Groups	3457.600	27	288.133		
	Total	3945.733	29			
<b>C</b>	Between Groups	789.733	2	394.867	3.339	.070
	Within Groups	1419.200	27	118.267		
	Total	2208.933	29			

Table (3): (LSD test)

Levels	Groups		Mean Difference	P- value
<b>A</b>	G1	G2	5.800	.260
	G1	G3	-10.200	.060
	G2	G3	-16.000	.007
<b>B</b>	G1	G2	-13.800	.223
	G1	G3	-8.800	.428
	G2	G3	5.000	.650
<b>C</b>	G1	G2	16.600	.033
	G1	G3	13.800	.068
	G2	G3	-2.800	.691

\* The mean difference is significant at  $P \leq .05$  level

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