



ORIGINAL RESEARCH PAPER

Endodontic

SHAPING ABILITY OF WAVEONE, UNICONE IN REVERSE RECIPROCATING (RR) AND UNICONE IN FORWARD RECIPROCATING (FR)

KEY WORDS:Endodontics, Reciprocating Motion, Canal Shaping, Apical Transportation, Instrument Fracture

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ABSTRACT

Study Focus: This study aimed to compare manipulation time, centering ability, apical transportation and fracture of the UnicOne instrument in two reciprocating mode and compared with WaveOne Gold on human teeth. **Methods:** Sixty extracted maxillary central incisors were divided into 3 groups according to each instrumental dynamic WaveOne Gold using the preset program "WaveOne ALL » (170° CCW, 50° CW), Unicone in "FR"(30CCW, 90CW) and Unicone in "RR"(90CCW, 30CW). After canal shaping, the centering and apical transportation were evaluated by a double-digital radiographic technique, however the manipulation time was calculated using a stopwatch. **Results:** Our study revealed that WaveOne Gold presented significantly lower working time than the other tested systems and no statistically significant difference working time between the two modes, on the other hand the "FR" mode was more efficient in centering than the "RR" mode, and no instrument was fractured during this experiment. **Conclusion:** It was concluded that, the "FR" mode allowed preservation and reproducibility of the initial canal and also better handling than the "RR" mode.

INTRODUCTION

The main objective of endodontic treatment is to clean the root canal, giving it a conical shape in the direction of crown to apex, preserving the original curvature; however, during instrumentation divergences from its original shape may occur at some point.^[1]

The use of rotary instruments has revolutionized endodontic treatment, reducing operator fatigue and treatment time and minimizing errors associated with the use of stainless-steel instruments.^[2]

Despite the increasing use of NiTi rotary systems worldwide, their cost, possibility of cross-contamination and unexpected separation by fatigue after extended clinical life span are notable disadvantages.^[3-4-5]

Reciprocating motion (RM) is a recent innovation in nickel-titanium (NiTi) instrumentation systems in which instrument travels a shorter angular distance than a rotary instrument, which subjects the instrument to lower stress values. Consequently, an instrument should have an extended fatigue life.^[6-7] The instrument works when rotation is in the reverse direction as opposed to the more frequent direction. Manufacturers claim that the M-Wire NiTi alloy enhances the flexibility and fatigue resistance by using a single NiTi instrument to prepare the entire root canal.^[8-9]

At the present time, different reciprocating, single-use instruments have been introduced in the market.

The objective of this study was to evaluate the shaping ability, manipulation time and instrument separation resist, as well as the transportation of the apical foramen using the new file (UnicOne, Medin, Czech Republic) in two instrumental dynamics: forward reciprocating and reverse reciprocating and compared to WaveOne Gold.

1-Material and Method

1.1-The study samples:

Sixty freshly extracted human maxillary central incisors were randomly divided into three groups:

- Group 1 (n=20): prepared using WaveOne Gold with the preset program WaveOne ALL
- Group 2 (n=20): prepared using UnicOne (UnO) in Forwardreciprocating (FR) with a speed of 350 rpm and a torque of 2 Ncm.
- Group 3 (n=20): prepared using UnicOne (UnO) in reversereciprocating (RR) with a speed of 350 rpm and a torque of 2 Ncm.

The samples excluded from this study were teeth with significant coronary decay, calcified roots, immature apexes and roots with internal or external resorption.

1.2- Fabrication of the bases:

In order to have identical bases in both shape and size, we made a silicone mold. A box with a negative shape of the mold in question was manufactured.

This box contains 12 equal glass cubes of 30mm diameter each, spaced 10mm apart and glued on a 16cm long and 13cm wide plexiglass plate. This plate is put in the box which has the same dimensions with a depth of 10cm, the whole is covered with Vaseline and therefore ready for the formwork.

After removing the silicone, we disintegrated the mold, covered the teeth at their apex with red wax for better radiographic visibility, then mixed zeta silicone plus with its catalyst until it reached the right consistency, it is poured on the mold, until cured.

1.3. Pre-operative radiography: A fixation system was developed and divided into three parts: the first part to fix the X-ray cone, the second to place the sample, and the third to fix the radiographic sensor.

1.4. Access cavity preparation: Access cavity is triangular with the base towards the incisal edge and the apex towards the cingulum.

1.5 Instrumentation of the Root Canals: The working length (WL) was determined when the tip of the #15 file (Dentsply/Mailfefer, Ballaigues, Switzerland) was visualized

at the canal terminus, then it was withdrawn 1 mm. After that, pre-operative radiographs were taken with a K015 file at 5mm beyond the apex.

All canals were instrumented by the same operator, specialist in endodontics.

The canals were irrigated with sodium hypochlorite 2.5% with a 2.5 cc syringe and a 21G (40 mm long and 0.8 mm wide).

The instrumentation was finished when the instrument reached the WL and all instruments were reciprocated following the manufacturers instructions.

The preparation of the canal is checked by introducing a gutta cone, corresponding to the taper of the instrument, to the apex of all teeth.

1.6. Recording of root canal preparation time: For each instrument, time in seconds was recorded by the same operator with a chronometer, from the start of rotation of the instrument until it reaches the WL.

All data were recorded and subjected to statistical evaluation.

1.7. Post-operative radiograph file in place: with the same K015, file exceeded by 5mm.

1.8. Measurement of apical deviation: Measurement of apical deviation on superimposed preoperative and postoperative digitized images of root canals, was made with software Adobe Photoshop CC 2019 (figure 1). Specific ImageJava software was used to measure the angle formed by the lines that joined first file preoperative and postoperative file.

1.9. Statistical Analysis: Statistical analysis was performed using JASP software.

Means, variances and standard deviation were calculated for each group.

Paired t-test was used to analyze the differences, compare the working time to shape the canals in WaveOne Gold and Unicone in "FR" and "RR" as well as the apical transportation. The level of statistical significance was set at $p < 0.05$.

2-Results:

WaveOne Gold presented significant lower working time than the other tested systems ($P < .05$), whereas no differences were observed between the two Unicone modes "FR" and "RR" ($P > .05$). In fact, the group 1 WaveOne Gold has an average working time of $6.309 \pm 1.603s$, while the average working time of Unicone in mode « FR » and « RR » are $12.34 \pm 7.135s$ and $13.92 \pm 6.340s$ respectively (table 1).

Group 2 Unicone in "FR" mode has an average angle of $3,576 \pm 3,100^\circ$, which is significantly lower than the group 3 Unicone average in "RR" mode, which is $5,989 \pm 3,673^\circ$ ($P=0.012 < 0.05$) (table 2).

However, there is no statistically significant difference in the angle α between the WaveOne Gold and Unicone groups.

Table 1: descriptive analysis of means and standard deviations of working time and α angle of the three groups

	T*W	A*W	TFR	A FR	T RR	A RR
Valid	20	20	20	20	20	20
Missing	0	0	0	0	0	0
Mean	6.309	4.244	12.34	3.576	13.92	5.989
Std. Deviation	1.603	4.132	7.135	3.100	6.340	3.673
Minimum	3.540	0.000	4.800	0.000	3.540	0.000
Maximum	9.330	10.89	33.00	8.600	23.87	12.38

Note:T*Time,A* α angle

Table 2: Paired Samples of working time and α angle of the three groups (T-Test)

		t	df	P
A W	A FR	0.517	19	0.611
A W	A RR	-1.360	19	0.190
A FR	A RR	-2.771	19	0.012
Tps W	Tps FR	-3.591	19	0.002
Tps W	Tps RR	-5.180	19	< .001
Tps FR	Tps RR	-0.862	19	0.399

3-DISCUSSION

Single-file reciprocation, alternating clockwise and counter-clockwise movements, aims to simplify operating procedures and overcome the limits of continuous rotation, namely the instrumental fracture and the preparation time.^[10]

The systematic literature review published by G. Plotino 2015^[11], showed that reciprocating motion improves the quality of canal shaping compared to rotation motion and increases the instruments lifetime by reducing their cyclic fatigue.

K. Bane et al. 2015^[12], compared the file separation and working time of WaveOne and Reciproc, in reciprocating motion with the Protaper in rotation motion on 120 mandibular molars divided into 3 groups and showed that reciprocating instruments perform better with less working time.

Recent literature shows that reciprocating motion can extend the cyclic fatigue life in comparison with continuous rotation^[13-14]. The term reciprocating motion includes several possible movements and angles, each of which may influence the performance and resistance to failure of NiTi instruments.

In our study, we compared Unicone in "FR" mode (30° CCW, 90° CW) and in "RR" mode with (90° CCW, 30° CW) to WaveOne Gold used in the "WAVEONE ALL" program (170° CCW, 50° CW), and considered as a reference. WaveOne GOLD files with a reverse cutting helix, engage and cut dentine in a 170-degree counter-clockwise (CCW) direction and then, before the instrument has a chance to taper lock, disengages 50 degrees in a clockwise (CW) direction. The net file movement is a cutting cycle of 120 degrees and therefore after three cycles the file will have made a reverse rotation of 360 degrees. The same principle is used to Unicone in "FR" mode with a 30-degree counter-clockwise (CCW) and 90 degrees in a clockwise (CW) direction, versus "RR" mode with a 90-degree counter-clockwise (CCW) and 30 degrees in a clockwise (CW) direction.^[15]

Our study was carried out on natural teeth and not on artificial resin canals. The artificial canals made of resin have the advantage of being able to compare the instruments behavior towards the calibrated canals. But they don't respect the real action of the instruments in a root canal of human tooth, because of their differences in hardness and texture. Indeed, the properties of the resin used to sink the learning blocks were studied: The micro hardness of the resin is about $20 \pm 6kg / mm^2$, and the minimum force to be exerted on a K-file with $25 / 100^b$ diameter to scratch the resin is about 90g. On the other hand, in order to scratch the dentine, it is necessary to exert on the same file a force of 190g, or about the double.^[16]

Instrument fracture :

E. Silva et al. 2016^[9], compared the cyclic fatigue of the Reciproc R25 instrument in the "ReciprocAll" mode (150°CCW, 30°CW), with the primary Waveone in the "Waveone All" mode (170°CCW, 50°CW) and the Unicone (25.6%) in the "Waveone All" and "Reciproc All" modes, on 70 artificial canals of 60° curvature. The results showed that Reciproc fractures less followed by Waveone and then Unicone.

Reciprocating motion presented different angles of rotation and speed. This situation might also influence the cyclic fatigue resistance of reciprocating files.

During our experimental study, no instruments were fractured in all three compared groups.

H. Arslan in 2016^[17], who evaluated the cyclic fatigue of the Reciproc instrument in (150CCW, 30CW), then in (270CCW, 30CW) and (360CCW, 30CW), concluded that the instrument fractures more as the counter-clockwise rotation increases^[17]. Same results by G. Gambarini 2012^[14], who evaluated the fracture time of the K3XF in (90 CCW, 30CW), (150CCW, 30CW), (210CCW, 30CW) and (390CCW, 30CW).

• Canal centering and apical transportation:

The results of our study revealed less apical transport in "FR" mode (30CCW, 90CW), which is statistically significant compared to the group 3 Unicone average in "RR" mode.

This difference is less than group 1 Wave one gold (170° CCW, 50° CW) but no statistically significant with Unicone groups.

E. Matos et al. in 2015^[18], compared root canal shaping and apical transport between Reciproc and Unicone in reciprocity with the Protaper Universal in continuous rotation, on 30 artificial resin blocks with a 35° curvature. The results showed that Unicone in reciprocity mode has preserved the most curvature with less apical transport.

S. El Sadat et al. in 2013^[19], evaluated the apical transport performed by the Waveone instrument in several reciprocity modes (150°CCW, 30°CW), (120°CCW, 30°CW) and (90°CCW, 45°CW), he concluded that the more the counterclockwise angle increases, the more apical transport there is, therefore less than root canal centering, which confirms our results compared to the "RR" mode (90°CCW, 30°CW) with more apical transport.

This also agrees with the results of H. Arslan et al. in 2015^[17].

• The Working time of root canal instrumentation

Our results didn't show significant differences between the two Unicone modes "FR" and "RR" (P > .05), but WaveOne Gold presented a significant lower working time than the other tested systems.

K. Bane et al. 2015,^[22] compared working time of the Reciproc instruments in Reciproc All mode (150CCW, 30CW), Waveone in Waveone All mode (170CCW, 50CW) and the Protaper in rotation motion.

This comparison didn't show any statistically significant difference between Reciproc and Waveone, a single-file system, in reciprocating motion that have a lower working time compared to the multiple-file system Protaper in continuous rotation.

CONCLUSION

The single-use instrument systems, which have recently completed the panel of endodontic instruments, attract by their concept, the suggestion of a simplified, safe and fast protocol during the endodontic treatments.

In our study, we compared Unicone in "FR" mode (30° CCW, 90° CW) and in "RR" mode with (90° CCW, 30° CW) with WaveOne Gold used in the "WAVEONE ALL" program.

With the "FR" we had less apical transport with better preservation and reproducibility of the initial root canal anatomy.

The reciprocating motion in "RR" mode seems to be less efficient with file suction effect that can be a major difficulty

for the practitioner.

WaveOne Gold presented a significantly lower working time in comparison with the other tested systems, maybe due to the morphological characteristics of its instruments.

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