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Original Research

Assessment of cyclic fatigue resistance of Ni-Ti reciprocating rotary files: Wave One Gold and Reciproc- An in-vitro study

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***ABSTRACT*:**

Background: Reciproc and Wave One Gold are a new generation single-file systems that have recently been introduced and used in the market. Both file systems have reciprocating motion. This study assessed the cyclic fatigue resistance of two different Ni-Ti reciprocating rotary files Wave One Gold and Reciproc. **Materials & Methods:** This in-vitro study was conducted in the department of Endodontics. Group I comprised of wave one gold files size 25 taper 0.07, and group II had reciproc files size 25 taper 0.04. Each file rotated continuously with 350 rpm speed and 2.5Ncm torque until the file was fractured. The time elapsed during rotation until fracture was recorded. **Results:** Group I comprised of wave one gold files and group II had reciproc files. The time required fracturing file system in group I was 10.5 seconds and in group II was 9.4 seconds. The difference was non- significant (P> 0.05). **Conclusion:** Authors found no difference in time requiring in achieving fracture of their file system in both groups.

Key words: Fatigue resistance, Reciproc files, Wave one

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INTRODUCTION

The introduction of nickel–titanium (NiTi) alloys and the subsequent automation of mechanical preparation were the first steps towards a new era in endodontics. These changes ushered in ever-greater progress in the specialty, with scientific and corporate research focused on developing instruments capable of meeting the needs for a more anatomically predictable root canal preparation, achievable in less time and with greater comfort for dentist and patient alike, as inflexible instruments have substantial difficulty following the curvature found in most root canal systems.[1]

Over the last few years, many changes have been observed, including innovations in instrument design, surface and thermal treatments for NiTi alloys, and the incorporation and hybridization of new movement strategies to drive instrumentation systems. Knowing the morphological and mechanical characteristics of endodontic instruments, as well as their proper mode of use, provides greater security and versatility to the operator.[2]

Reciproc and Wave One Gold are a new generation single-file systems that have recently been introduced and used in the market. Both file systems have reciprocating motion. RPC files have an S-shaped cross-section, two cutting edges and a non-cutting tip.[3] A novel aspect of the new Wave One Gold file system is the molecular structure of the files. A new type of heat treatment, which increases the cyclic fatigue resistance of the files named M wire technology. The M-wire Technology promises to improve resistance to cyclic fatigue and increases flexibility, counts as one of these renovations.[4] This study assessed the cyclic fatigue resistance of two different Ni-Ti reciprocating rotary files Wave One Gold and Reciproc.

MATERIALS & METHODS

This in vitro study was conducted in the department of Endodontics. It comprised of Wave One Gold files and Reciproc files.

These file system were divided into 2 groups. Group I comprised of wave one gold files size 25 taper 0.07, and group II had reciproc files size 25 taper 0.04. The files were tested in artificial 600 curve canal on computer numerical control (CNC) machined metal block.

The canal in the block was filled with oil to lubricate the canal walls to mimic clinical conditions. Files were placed into artificial root canal without exerting any pressure to the hand piece. Working length of files was adjusted to 20 mm with Endoblock. Each file rotated continuously with 350 rpm speed and 2.5Ncm torque until the file was fractured. To standardize this protocol, two individuals placed the files and thereafter between each test 5 minutes break was given and the oil (WD40) of CNC block renewed. The time elapsed during rotation until fracture was recorded in minutes. Results thus obtained were tabulated and subjected to statistical analysis. P value less than 0.05 was considered significant.

RESULTS

Table I Distribution of file system

Groups	Group I	Group II
File system	Wave one gold files	Reciproc files
Number	10	10

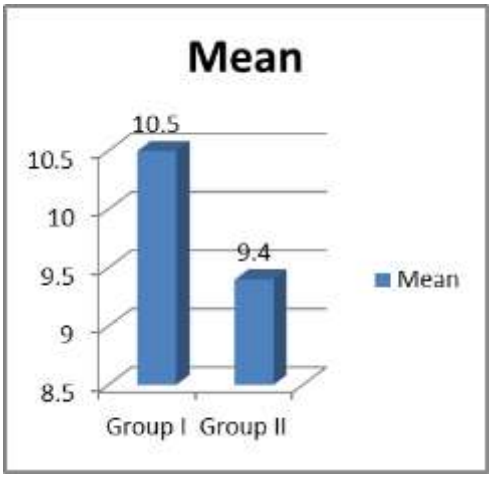
Table I shows that group I comprised of wave one gold files and group II had reciproc files.

Table II Comparison of time required to fracture the files

Groups	Group I	Group II	P value
Mean time (seconds)	10.5	9.4	0.12

Table II, graph I shows that time required fracturing file system in group I was 10.5 seconds and in group II was 9.4 seconds. The difference was non- significant (P> 0.05).

Graph I Comparison of time required to fracture the files



DISCUSSION

Most metallic materials exhibit an elastic behavior in which, within certain limits, the deformation caused is directly proportional to the force applied. This relationship is known as Hooke's Law. If the force applied exceeds a certain limit, it causes permanent deformation in the material (plastic deformation). According to Hooke's Law, most metal alloys can be elastically deformed by up to 0.1 or 0.2% beyond their elastic limit, or yield strength. Any deformation above this limit, known as the yield point, will be permanent. Nickel-titanium alloys, however, can be deformed up to 8% beyond their yield strength without showing any residual deformation.[5] This study assessed the cyclic fatique resistance of two different Ni-Ti reciprocating rotary files Wave One Gold and Reciproc.

In present study, group I comprised of wave one gold files and group II had reciproc files. Yared et al[6] carried out a study where all canal preparation was performed with a single F2 ProTaper file, using reciprocating motion, with different angles of rotation in the counterclockwise and clockwise directions, facilitating advancement of the instrument with little apical pressure. This landmark study represented an evolution in endodontic instrument kinematics, as the use of sequential files would no longer be necessary to achieve tapered shaping of the root canal system. Thus, new reciprocating instruments were developed for single-file preparation, such as the Reciproc (VDW) and Wave One (Dentsply Sirona) systems, both made from M-Wire alloy. These two instrument systems work in centric reciprocating motion, rotating initially counterclockwise (Reciproc 150°, Wave One 170°) to cut away dentin and clockwise (Reciproc 30°, Wave One 50°) to clear it, in order to avoid the screw-in effect that occurs with some continuous rotary systems.

We found that time required fracturing file system in group I was 10.5 minutes and in group II was 9.4 minutes. The difference was non- significant (P> 0.05). The Wave One system consists of instruments with different cross-sections along the active part. They are described as modified convex triangular from tip to D8 (the eighth millimeter), with three cutting edges oriented counterclockwise, and triangular convex from D9 to D16.[7] The taper is constant in the first three millimeters and decreases thereafter. This system was succeeded by Wave One Gold, which uses the Gold thermal process, with considerable improvement in strength and flexibility, in addition to greater resistance to torsional stress and flexibility compared to Reciproc and TF Adaptive files.[8] The variability of tip diameters allows the clinician to prepare a wide range of apical diameters and root canal anatomies commonly found in daily practice, while the reduced taper ensures a more conservative preparation with greater dentin preservation at D16 (cervical region of the preparation). The Wave One Gold design has four cutting edges with a rake angle of 85°, but only two edges are in permanent contact with the canal walls every 200 microns, which keeps the instrument

centered on the longitudinal axis of the root canal. The Dentsply patented cross-section, in which only one cutting edge is in contact with the canal wall, decreases the contact area between the file and the canal wall, thus reducing taper lock.[9]

Ovsay et al[10] evaluated the cyclic fatique resistance of two different Ni-Ti reciprocating rotary files syste. The files were tested in artificial 600 curved canal on computer numerical control (CNC) machined metal block. Each file rotated in a reciprocated motion with 350 rpm speed and 2.5 Ncm torque (Xsmart plus, Dentsply) until files were fractured. The time elapsed during rotation were recorded and the length of fractured part of the instruments measured for each file. The time periods and the length of the fractured parts of the instruments in each group: Group 1 Wave one Gold was 10:07±0.56 sec (n=7); Group 2 09:02±0:36 sec (n=7). No significant difference was observed between cyclic fatigue of Group 1 Wave one Gold and Group 2 Reciproc. No significant differences between groups were apparent regarding length of the fractured part.

CONCLUSION

Authors found no difference in time requiring in achieving fracture of their file system in both groups.

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