

A comparative study of cyclic fatigue resistance of two reciprocating files

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Abstract

To evaluate the cyclic fatigue resistance of two different Ni-Ti reciprocating rotary files Wave One Gold and Reciproc at angle of 60 degrees in a metal block. This study was performed on 7 files in each group including Wave One files 25/07(Group 1) and Reciproc R25/08 files (Group 2). The files were tested in artificial 60° 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. Mann-Whitney U test was used to compare two independent groups. Kruskal-Wallis test was conducted to compare time and length among groups. The time periods and the length of the fractured parts of the instruments in each group: Group1 Wave one Gold #25 10:07±0,56 sec (n=7); Group2 Reciproc #25: 09:02±0:36 sec/(n=7). No significant difference was observed between cyclic fatigue of Group1 Wave one Gold #25 and Group2 Reciproc #25. No significant differences between groups were apparent regarding length of the fractured part.

Keywords: Cyclic fatigue, Wave one gold, Reciproc.

Introduction

NiTi rotary instruments are popular among clinicians because of their high flexibility and elasticity when compared with stainless steel files. Nickel-titanium (NiTi) file fracture during root canal preparation is one of the most frequently seen complications.^{1,2} Removing the fractured segment of the file, which is inside the root canal, is usually a difficult process, and the amount of residual dentin tissue significantly decreases while taking the instrument outside the canal. As a result, the prognosis of endodontic treatment might be negatively affected.³ Cyclic fatigue occurs when all parts of NiTi file rotates continuously in the curved root canal.⁴ At that point, flexion and tension cycles occur until file is broken. All Studies showed that 70% of file fractures in curved root canals were caused by cyclic fatigue during shaping procedures.⁵ To avoid this unwanted situation, many investigations and renovations were done on metallurgical, chemical and mechanical properties of NiTi alloys to make files resistant to fracture.⁶

Reciproc (RPC, VDW, Munich, Germany) and Wave One Gold (WOG; Dentsply Maillefer, Baillagues, Switzerland) 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. 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.

Materials and Methods

Wave One Gold files size 25 taper 0,07 (Group 1 #25) (n=7), Reciproc files size 25 taper 0,04 (Group2#25) (n=7); were used. The files were tested in artificial 60° curved

canal on computer numerical control (CNC) machined metal block. (Fig. 1)^{7,8}



Fig. 1: CNC machined block used in the study

The canal in the block was filled with oil (WD40) 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 (Xsmart plus, Dentsply) 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 and the length of the apical part of the fractured instruments were measured for each file.

Results

The files in Group1#25 and Group 2 #25 were compared statistically there was no significant difference in time was required until fracture ($p<0,01$). Also when fractured parts observed there was no significant differences between groups were apparent regarding length of the fractured part.

Discussion

In this study two different reciprocation systems were compared. Design of metal CNC block was inspired from

Gambarhini et al.⁹ In order to mimic clinical conditions, single clinician tested the files inside artificial root canal. Metal CNC block cannot represent root dentin because of their difference in microhardness. Artificial root canal in CNC block has 2-dimensional curvature but natural roots may be curved in 3-dimensions so the practical conditions can change due to morphology and remaining dentine thickness.

Conflict of Interest: None.

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