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Evaluation of Cyclic Fatigue Resistance of Wave One Gold Glider and Some Rotary NiTi Preflaring Files

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ABSTRACT

Aim: *To evaluate the cyclic fatigue resistance for the new reciprocating glide path file Wave one gold glider, Proglider, Pathfile and path glider komet.* ***Materials and Methods:*** *Forty instruments were used in this study divided into four groups (n=10): G1: Path file, G2: Path glider komet, G3: Wave one gold glider, G4: Proglider. The instruments were tested for their cyclic fatigue resistance by an artificial canal 60° angle of curvature with a width of the canal was 1.5 mm and radius of curvature for both canals was 5 mm within a block, cyclic fatigue resistance data were analyzed with one way ANOVA and Tukey test.* ***Result:*** *There was a high significant difference (P<0.000) between tested instruments in ANOVA and Tukey test, with the highest cyclic fatigue resistance value produced by Wave one gold glider.* ***Conclusion:*** *Wave one gold glider reciprocating path glider instruments had the highest cyclic fatigue resistance with high flexibility.*

Keywords: Cyclic fatigue resistance, Glide path, Reciprocating, Wave one gold glider

INTRODUCTION

The main goal of the manufacturers of Nickel-Titanium (NiTi) rotary instruments is to reduce the instrument separation and improve safety [1]. Cyclic fatigue and torsional fracture are the main mechanisms that may lead to instrument separation, caused by bending and torsional stress [2]. Canal curvature is the predominant risk factor for increased bending stress and a clinician may have no influence on this parameter create a glide path during the initial preparation considered as one of the recommendations to reduce fracture risk of NiTi instruments [2].

The endodontic glide path is performed using small-sized and slightly tapered NiTi rotary instruments or stainless-steel manual files [2], when NiTi instruments with larger tapers are used the creation of a glide path may facilitate root canal preparation and reduce the possibility of procedural errors [3,4].

Path glider komet (komet dental, Germany) is a small highly flexible NiTi file with a non-cutting tip with .03 taper, the unique kite shaped cross-section ensures smooth canal walls and excellent control of the file inside the canal, two sizes 015, 020 with three lengths 21 mm, 25 mm and 31mm [5].

PathFiles (Dentsply, Sirona) is the first instrument for mechanical pre-flaring in NiTi: the pathfiles are three instruments with tip diameters of #13, #16, and #19 with elevated flexibility and 0.2 constant taper [6].

Proglider (Dentsply, Sirona) features are: M-wire alloy, a square cross-section with semi-active tip, and a single size of 16/.02 with progressive tape; with three different lengths are available: 21 mm, 25 mm, 31 mm.[7] The instrument is used in continuous rotation at 300 rpm/2 Ncm. Preliminary studies have shown that Proglider preserves canal anatomy better than steel files [7].

The new single glide path files introduced to markets Wave one gold glider (Dentsply, Sirona) with flexibility and resistance to cyclic fatigue, Sterile and ready for single use, which preserves cutting efficiency, reduces breakage and prevents cross-contamination, the Wave One Gold Glider is only for use in reciprocating motion with compatible Dentsply Sirona motors, one size glider: .15 with variable taper 2% to 6% NiTi wire+gold treatment, with three different lengths, are available: 21mm, 25 mm, 31mm [8].

The aim of the study was to compare the cyclic fatigue resistance of Wave one gold glider (WO), Proglider (PR), Path file (PA) and Path glider komet (PG).

MATERIALS AND METHODS

Cyclic fatigue resistance for 40 instruments were tested using artificial canal fig 1 (60° angle of curvature) with width of canal was 1.5 mm and radius of curvature for both canals was 5 mm within a block made from stainless steel and a glass cover allowed for visualization of the rotating file in the canal and allow the removal of broken instruments among tests [9].

Instruments divided into eight groups (n=10) as following:

Group 1: Path file #16\02

Group 2: Path glider komet #15\03

Group 3: Wave one gold glider #15\02

Group 4: Proglider #16\04

All instruments were used according to manufactures instructions by the same operator only 6 instruments tested each time to prevent operator fatigue. Rotary instruments were rotated by Wave one endodontic motor (Dentsply Maillefer, Ballaigues, Switzerland) and connected to cyclic fatigue tested device especially designed for this study that allowed a reproducible placement of the instruments in the canal [10], the instrument rotates freely in the canal and does not bind in it, generating tension/compression cycles at the point of maximum flexure until the fracture occurs. If an instrument is held in a static position and continues to rotate, one-half of the instrument shafts on the outside of the curve is in tension, whilst the half of the shaft on the inside of the curve is in compression. This repeated tension/compression cycle, caused by rotation within curved canals, increases cyclic fatigue of the instrument [11]. The instance of fracture was based on visual observation of the fracture occurring in the instrument. The time (T) of fracture recorded in second (from starting of the test until fracture occurred). Synthetic oil was used for the lubrication of mechanical parts (Super Oil; Singer Co Ltd, Elizabethport, NJ).

Cyclic fatigue data were analyzed by one way ANOVA and Tukey test to determine any significant differences to 0.05 (Figure 1).

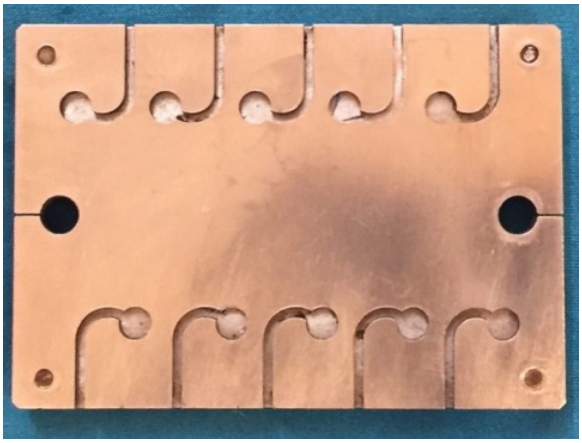

Figure 1 Artificial canal used in the study

RESULTS

Descriptive statistic (Mean, Standard deviation, Minimum, Maximum) was presented in Table 1, high mean correlated to high cyclic fatigue resistance, Wave one gold glider (WO) had the highest mean (927.7500) while Path glider komet had the lowest mean of cyclic fatigue resistance (312.7500)

According to the ANOVA test, there was a high significant difference among 4 tested groups ($P<0.000$) (Table 2).

Table 1 Descriptive statistic

Groups	N	Mean	Std. Deviation	Minimum	Maximum
Path file 1	10	394.125	23.45474	345	423
Path glider komet	10	312.75	10.6066	300	327
W.o.g glider	10	927.75	19.49176	900	960
Proglider	10	446.25	13.95657	417	465

Table 2 ANOVA test among tested groups

ANOVA					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	3694124.109	7	527732.016	1101.855	0
Within Groups	26821.125	56	478.949		
Total	3720945.234	63			

Table 3 Tukey test among tested groups

		Mean difference	**Std. Error**	**P-value**	**Significant**
Path file	Path glider komet	81.37500*	6.87423	0	HS
	W.o.g glider	-533.62500-*	6.87423	0	HS
	Proglider	-52.12500-*	6.87423	0	HS
Path glider komet	W.o.g glider	-615.00000-*	6.87423	0	HS
	Proglider	-133.50000-*	6.87423	0	HS
W.o.g glider	Proglider	481.50000*	6.87423	0	HS

DISCUSSION

Glide path can be achieved when the file creating it could enter from the orifice and follow the smooth canal walls without interruption to the terminus to reduce the effect of torsional stress along the canal and risk of instrument failure [12].

In this study, an artificial model was used for standardization and to minimize the contributions of other mechanisms of failure (torsional) aside from cyclic fatigue (Table 3). Although the extracted tooth model was more resembles the clinical situation, it was not an ideal model if the objective of the study was to determine the physical properties of NiTi files, as no two root canals were perfectly identical [13].

The result of this study showed that there were highly significant differences in cyclic fatigue resistance between the tested instruments, with high cyclic fatigue resistance showed by WO (mean=927.7500), this can be explained by its variable taper from 2%-6% and gold treatment and high flexibility [8] this in agreement with many studies [14,15]. WO has been newly introduced to the market. Therefore, there are limited reports concerning its cyclic fatigue.

The other instrument which had high cyclic fatigue was Proglider (mean=446.2500) with high significant difference (P<0.000) from the other instruments as shown in table 3 this can be explained by M-wire NiTi instruments had high resistance to fracture by cyclic fatigue this in agreement with other studies [1,2,16,17] which showed that fatigue life of rotary instrument is sensitive to raw material used in manufacturing. Another cause was their progressive taper from 2% to 8% over its length in agreement with other studies [18,19]

Pathfiles #15 had cyclic fatigue resistance (mean=394.1250) had high significant difference (P<0.000) with other instruments this finding was in agreement with other studies [18,19] which related the result to instruments fixed 0.02 taper of the PF file results in an instrument with a smaller metal core that usually leads to an enhanced cyclic fatigue resistance and made from conventional NiTi alloy [19] also related to instrument design with square cross-section [19]

Path glider komet had cyclic fatigue resistance (mean=312.7500) with high significant differences with other tested instruments this may be related to their 03 taper and unique cross-section [5], there are limited reports concerning its cyclic fatigue.

CONCLUSION

The new reciprocating file Wave one gold glider had high cyclic fatigue resistance when compared with other NiTi glide path files.

CONFLICT OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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