

Evaluation of Cyclic Fatigue Resistance of two Rotary Files Systems - A Comparative Study

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ABSTRACT

Background: Seventy percent of NiTi rotary instrument fractures are due to cyclic (flexural) fatigue. The present study was conducted to compare cyclic fatigue resistance of Hero shapers and one shape NiTi files in artificial canals.

Methods: The present study was conducted in the department of Endodontics. It consisted of 40 rotary NiTi files which were divided in 2 groups such as group I (Hero Shapers, MicroMega) and group II (One Shape, MicroMega). The study was approved from institutional ethical committee. Rotary files were kept standardized of 21 mm length, 6% taper and ISO size 25. All these files were tested in a simulated constructed apparatus with angle of curvature 60° and radius of curvature 5 mm. Each file was placed in TriautoMini endomotor handpiece and allowed to rotate at 400 rpm and 2.5 N/cm torque. Time taken until file fractured was recorded. Number of cycles performed by a file until fracture was calculated as no. of cycles performed by experimental file until fracture = 400/60 x Time taken till fracture was recorded.

Results: Group I comprised of Hero Shapers and group II One Shape. Each group had 20 files. The time taken until fracture in group I was 12.4 seconds and in group II was 36.2 seconds. The difference was significant (P < 0.05). The number of cycles performed in group I files until fractured was 82.6 and in group II was 256.5. The difference was significant (P < 0.05). **Conclusion:** Authors found that one shape files system had higher cyclic fatigue resistance as compared to Hero shaper.

Keywords: Fatigue resistance, Hero shaper, one shape.

INTRODUCTION

Endodontics has emerged and changed over the years like many other dental and medical specialties.^[1] It primarily comprises of root canal treatment involving access cavity preparation followed by cleaning and shaping of root canal and finally a three dimensional seal of that prepared pulp space. The endodontic instruments play a major role in contributing to reach success. Earlier, the root canal instrumentation was by performed by carbon steel alloy instruments which were replaced by stainless steel instruments due to their disadvantage of being corroded and rusted.^[2]

Seventy percent of NiTi rotary instrument fractures are due to cyclic (flexural) fatigue. This type of failure happens when the instrument rotates freely in a curved root canal. The part of the instrument shaft that is located on the inside wall of the curvature is compressed and the opposite side is in tension. Numerous cycles of tension and compression are produced at the point of maximum curvature. This leads to metal fatigue and

subsequent breaking of the file.^[3]

Recently, new instruments with improved NiTi alloys and higher cyclic fatigue resistance (CFR) have become available.^[4] Accordingly, introduction of NiTi rotary systems with fewer or even single instrument(s) to the market become possible, and canal preparation becomes faster and easier for practitioners. Single file engine-driven systems are introduced with two types of motion: Complete rotation and reciprocation.^[5] The present study was conducted to compare cyclic fatigue resistance of Hero shapers and One shape NiTi files in artificial canals.

MATERIALS AND METHODS

The present study consisted of 40 rotary NiTi files which were divided in 2 groups such as group I (Hero Shapers, MicroMega) and group II (One Shape, MicroMega). The study was approved from institutional ethical committee.

Rotary files were kept standardized of 21 mm length, 6% taper and ISO size 25. All these files were tested in a simulated constructed apparatus with angle of curvature 60° and radius of curvature 5 mm. Each file was placed in TriautoMini endomotor handpiece and allowed to rotate at 400 rpm and 2.5 N/cm torque. Time taken until file

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fractured was recorded. Number of cycles performed by a file until fracture was calculated as no. of cycles performed by experimental file until fracture = $400/60 \times$ Time taken till fracture was recorded. Results were subjected to statistical analysis. P value less than 0.05 was considered significant.

RESULTS

Table 1: Distribution of file system

Groups	Group I	Group II
System	Hero Shapers	One Shape
Number	20	20

[Table 1] shows that group I comprised of Hero Shapers and group II One Shape. Each group had 20 files.

Table 2: Time taken until fracture

Groups	Mean (Seconds)	P value
Group I	12.4	0.01
Group II	36.2	

[Table 2, Figure 1] shows that time taken until fracture in group I was 12.4 seconds and in group II was 36.2 seconds. The difference was significant ($P < 0.05$).

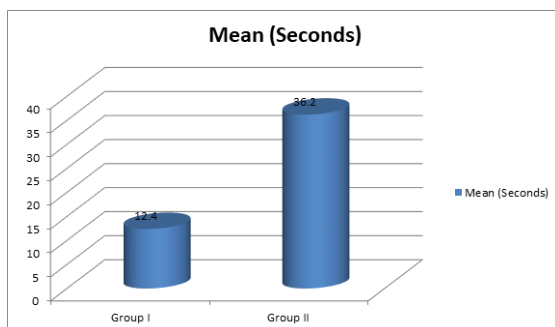


Figure 1: Time taken until fracture

Table 3: Number of cycles performed by files until file fractured

Groups	Mean	P value
Group I	82.6	0.01
Group II	256.5	

[Table 3, Figure 2] shows that number of cycles performed in group I files until fractured was 82.6 and in group II was 256.5. The difference was significant ($P < 0.05$).

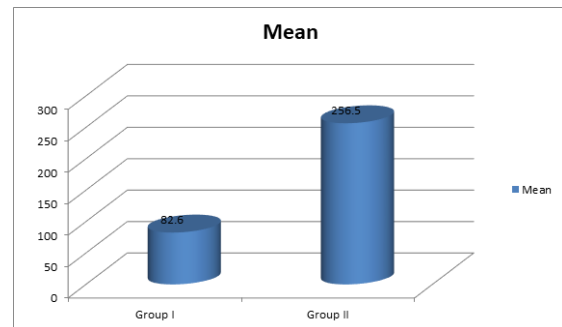


Figure 2: Number of cycles performed by files until file fractured

DISCUSSION

Endodontic files in a reciprocating motion along with new alloys and new manufacturing processes have been introduced recently to improve fracture resistance.^[6] M-wire is an NiTi alloy prepared by a special thermal process that is claimed to increase flexibility and resistance to cyclic fatigue. Reciprocation was shown to extend the life-span of a NiTi instrument, hence resistance to fatigue, in comparison with continuous rotation.^[7] Recently, two M-wire NiTi endodontic file systems such as Reciproc and WaveOne. were introduced for use in reciprocating motion. These instruments are single-use files, avoiding metal weakening through prolonged clinical use; however, single-use means that the same instrument can be used in 3-4 root canals, which could be complex and tortuous.^[8] The reciprocating working motion consists of a counterclockwise and a clockwise motion, whereas the angle of the counterclockwise cutting direction is greater than the angle of the reverse direction. As the counterclockwise angle is greater than the clockwise one, it is recommended that the instrument continuously progresses toward the terminus of the root canal.^[9] The present study was conducted to compare cyclic fatigue resistance of Hero shapers and One shape NiTi files in artificial canals.

In this study, group I comprised of Hero Shapers and group II One Shape file system. Each group had 20 files. Dagna et al,^[10] assessed the cyclic fatigue resistance of three single-use nickel-titanium (NiTi) instruments. 40 files each of One Shape, Reciproc R25, Wave One Primary file, and ProTaper F2 were tested in four curved artificial canals with different angles and radii of curvature. It was found that R25 showed the highest cyclic fatigue resistance. One Shape and WO files showed similar cyclic fatigue resistance values, higher than PT F2.

We found that time taken until fracture in group I was 12.4 seconds and in group II was 36.2 seconds. Bhatt et al,^[11] compared the flexural fatigue resistance for Hero Shapers, Hyflex CM, One Shape, Profile Vortex and Protaper Next rotary NiTi files. Time taken until the file got fractured

was recorded. Time taken to fracture ranged from 7 to 58 seconds in different groups. There was a statistically significant intergroup difference. Tukey HSD test showed the significant differences. The Weibull modulus values ranged from 7.31 to 24.19.

We found that number of cycles performed in group I files until fractured was 82.6 and in group II was 256.5. Pessoa et al,^[12] determined cyclic fatigue resistance in rotary nickel-titanium instruments after simulated clinical use in curved root canals using 36 RaCe rotary NiTi files, size #5, taper 0.04 which were divided into 3 groups: Groups A, B and C with one, three and five cycles of use, respectively. Time to failure was recorded with a stopwatch in seconds and subsequently converted to number of cycles to fracture. Five sets of clinically used files (group C) reached significantly lower cycle-numbers before fracture (mean=197.5 cycles) when compared with one set of clinically used files (mean=309.2) and three sets (mean=287.5). Results showed that the number of simulated clinical uses of RaCe instruments for shaping curved canals affects adversely the fatigue resistance of these instruments after five uses. The limitation of the study is small sample size and only 2 files systems were compared.

CONCLUSION

Authors found that one shape files system had higher cyclic fatigue resistance as compared to Hero shaper.

REFERENCES

1. Nabavizadeh MR, Sedigh-Shams M, Abdolrasoulia S. Cyclic Fatigue Life of Two Single File Engine-Driven Systems in Simulated Curved Canals. Iranian endodontic journal. 2018;13(1):61.
2. Merrett SJ, Bryant ST, Dummer PM. Comparison of the shaping ability of RaCe and FlexMaster rotary nickel-titanium systems in simulated canals. J Endod 2006;32:960-962.
3. Pruett JP, Clement DJ, Carnes DL. Cyclic fatigue test of nickel-titanium endodontic instruments. J Endod 1997;23:77-85.
4. Sattapan B, Nervo GJ, Palamara JEA, Messer HH. Defects in rotary nickel titanium files after clinical use. J Endod 2000;26:161-165.
5. Martín B, Zelada G, Varela P, Bahillo JG, Magán F, Ahn S, et al.. Factors influencing the fracture of nickel-titanium rotary instruments. Int Endod J 2003;36:262-266.
6. Zelada G, Varela P, Martín B, Bahillo JG, Magán F, Ahn S. The effect of rotational speed and the curvature of root canals on the breakage of rotary endodontic instruments. J Endod 2002;28:540-542.
7. Lopes HP, Ferreira AA, Elias CN, Moreira EJ, de Oliveira JC, Siqueira JF. Influence of rotational speed on the cyclic fatigue of rotary nickel-titanium endodontic instruments. J Endod 2009;35:1013-1016.
8. Arens FC, Hoen MM, Steiman HR, Dietz GC Jr. Evaluation of single-use rotary nickel-titanium instruments. J Endod 2003;29:664-666.

9. Bahia MG, Buono VT. Decrease in the fatigue resistance of nickel-titanium rotary instruments after clinical use in curved root canals. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2005;100:249-255.
10. Dagna A, Poggio C, Beltrami R, Colombo M, Chiesa M, Bianchi S. Cyclic fatigue resistance of OneShape, Reciproc, and WaveOne: An in vitro comparative study. J Conserv Dent 2014;17:250-4.
11. Bhatt A, Rajkumar B. A comparative evaluation of cyclic fatigue resistance for different endodontic NiTi rotary files: An in-vitro study. Journal of oral biology and craniofacial research. 2019 Apr 1;9(2):119-21.
12. Pessoa OF, Silva JM, Gavini G. Cyclic fatigue resistance of rotary NiTi instruments after simulated clinical use in curved root canals. Brazilian dental journal. 2013 Apr;24(2):117-20.

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