

A Comparative Analysis of Cyclic Fatigue Resistance of TruNatomy, VDW.ROTATE, R-Pilot and HyFlex EDM Files System

Research Article

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Abstract

Background: The purpose of endodontic treatment is diagnosis, cleaning, shaping and disinfection of root canal system.

Objectives: To compare cyclic fatigue resistance of TruNatomy, VDW.ROTATE, R-Pilot and HyFlex EDM files system at room temperature.

Materials and Method: We grouped 100 files into 4 groups of 25 each. Group I comprised of TruNatomy, group II had VDW. ROTATE, group III had R-Pilot and group IV had HyFlex EDM files. The number of cycles to fracture (NCF) and the length (mm) of fracture tips (FL) of files was measured.

Results: The mean \pm SD cycles to failure (NCF) in group I was 1210.76 ± 162.4 , in group II was 1856.24 ± 284.6 , in group III was 4981.2 ± 652.1 and in group IV was 2145.32 ± 472.4 . Maximum value was obtained with R- pilot files system. Kruskal-Wallis test revealed significant inter- group difference ($P < 0.05$). The mean \pm SD fragment length (FL) of tested files in group I was 5.52 ± 0.54 mm, in group II was 5.64 ± 0.68 mm, in group III was 4.62 ± 1.36 mm and in group IV was 4.44 ± 1.42 mm. Maximum value was obtained with VDW.ROTATE files system. Kruskal-Wallis test revealed significant inter- group difference ($P < 0.05$).

Conclusion: Authors found that maximum fatigue resistance was found with R- pilot followed by HyFlex EDM, VDW.ROTATE and TruNatomy.

Keywords: Fatigue Resistance; R-pilot; VDW.ROTATE.

Introduction

The purpose of endodontic treatment is diagnosis, cleaning, shaping and disinfection of root canal system. The role of minimally invasive endodontic therapy is to enhance the preservation of pericervical dentin. This purpose is fulfilled by applying idea of conservative endodontic access cavity and with the use of less tapered nickel-titanium (NiTi) files [1].

Large-tapered NiTi files lead to excessive loss of root dentin resulting in compromised outcome of treatment whereas small tapered NiTi files helps in preservation of root dentin tissue. More tapered the files are, more is the chances of their fractures whereas small tapered files offer maximum fracture resistance [2]. TruNatomy is a small tapered new NiTi file rotary systems recently introduced in the market. TruNatomy files are pre-packaged and pre-sterilized rotary instruments [3]. This files system

offers maximum preservation of pericervical dentin owing to its continuously tapering preparation. It is safer to use, simple and having better cutting efficiency. VDW.ROTATE is another useful small tapered new NiTi files having S-shaped cross-section. It has constant taper. It is very effective in restricted narrow endodontic cavities. It also helps in preserving pericervical dentin [4].

R-Pilot is the first NiTi rotary glide path file made up of M-Wire alloy. It has S-shaped cross-section which possesses 4% constant taper having 0.125 mm tip diameter. It is used in a reciprocation motion. HyFlex EDM (electrical discharging machining) NiTi glide path files are made of controlled memory [5]. This file system possesses three horizontal cross-sections. The shape at the tip is quadratic, at middle is trapezoid and at shaft is triangular. It is found to have better cyclic fatigue resistance. This is single file system having taper of 5% and diameter of 0.10 mm tip [6]. This study compared cyclic fatigue resistance of TruNatomy, VDW. ROTATE, R-Pilot and HyFlex EDM files system at room tem-

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perature.

Materials and Methods

The present was conducted in department of Conservative dentistry and endodontics after obtaining ethical approval from concerned committee of the institute. The sample size was selected based on the calculation performed with G*Power 3.1 (Heinrich Heine University, Dusseldorf, Germany) software.

We grouped 100 files into 4 groups of 25 each. Group I comprised of TruNatomy, group II had VDW.ROTATE, group III had R-Pilot and group IV had HyFlex EDM files. The size and taper of TruNatomy was of size 25 with 0.04 taper, TruNatomy was of size 26 with 0.04 taper, R-Pilot was of size 12.5 with 0.04 taper and HyFlex EDM files were of size 10 with 0.05 taper.

The artificial canal was immersed in distilled water in a glass container, and the box made of glass was put onto a warm plate that kept the distilled water temperature at $37^{\circ}\text{C} \pm 1^{\circ}\text{C}$. In each group, we did rotation with 60° angle and a 5 mm radius of curvature in stainless steel artificial canals having canals which reproduced the exact size and taper of the instruments. The D5 point of the file was located at the maximum curvature of the artificial canal.

Files systems were used as per instructions. In group I, files were used at 500 rpm and 1.5 Ncm torque, in group II at 300 rpm and 2.3 Ncm torque, in group III was operated in the 'Reciproc ALL' programme and in group IV files at 300 rpm and 1.8 N cm torque. Rotation was continued until fracture occurred. Digital chronometer recorded the time for breakage of file system in each group.

The number of cycles to fracture (NCF) was measured as $\text{NCF} = \text{revolutions per minute (rpm)} \times \text{time to fracture (sec)}/60$. The length (mm) of fracture tips (FL) of files was measured with a digital microcaliper. The fracture type was evaluated under a scanning electron microscope (SEM) and photomicrographs were taken at 100X and 3000X magnifications which were studied by two independent observers.

Statistical Analysis

Data thus achieved was tabulated and entered in MS excel sheet.

The results were assessed with SPSS 21.0 (IBMSPSS Inc., Chicago, IL, USA) software. Intergroup comparison with Kruskal–Wallis test was done. P value less than 0.05 indicated significant results.

Results

Table 1 shows distribution of files in different groups. Each group had 25 files. Table 2, graph 1 shows that mean \pm SD cycles to failure (NCF) in group I was 1210.76 ± 162.4 , in group II was 1856.24 ± 284.6 , in group III was 4981.2 ± 652.1 and in group IV was 2145.32 ± 472.4 . Maximum value was obtained with R-pilot files system. *Kruskal-Wallis* test revealed significant inter-group difference ($P < 0.05$).

Table 3, graph 2 shows that mean \pm SD fragment length (FL) of tested files in group I was 5.52 ± 0.54 mm, in group II was 5.64 ± 0.68 mm, in group III was 4.62 ± 1.36 mm and in group IV was 4.44 ± 1.42 mm. Maximum value was obtained with VDW.ROTATE files system. *Kruskal-Wallis* test revealed significant inter-group difference ($P < 0.05$).

Discussion

A glide path is a smooth radicular tunnel from the canal orifice to the physiological terminus of the root canal. Glide path creation promotes root canal preparation by developing a path that the larger nickel-titanium (NiTi) rotary files can follow [7]. It has been found that degree of canal curvature and experience of the operator can affect the glide path. It is evident that glide path using manual files is little bit time-consuming and it is difficult also [8]. Rotary NiTi files in curved canals can lead to less postoperative pain, faster recovery from symptoms and less extrusion of debris apically [9]. TruNatomy files have off-center design and variable taper having a square cross-section. Different types of heat treatments increase the elasticity and resistance to cyclic fatigue of the files [10]. This study compared cyclic fatigue resistance of TruNatomy, VDW.ROTATE, R-Pilot and HyFlex EDM files system at room temperature.

In this study we used TruNatomy, VDW. ROTATE, R-Pilot and HyFlex EDM which were distributed among group I, group II, group III and group IV respectively. We found that mean \pm SD

Table 1. Distribution of files system.

Groups	Group I	Group II	Group III	Group IV
System	TruNatomy	VDW.ROTATE	R- pilot	HyFlex EDM
Number	25	25	25	25

Table 2. Assessment of number of cycles to failure (NCF).

Groups	Mean	SD	P value
Group I	1210.76	162.4	0.01
Group II	1856.24	284.6	
Group III	4981.2	652.1	
Group IV	2145.32	472.4	

Kruskal–Wallis test, Significance, $P < 0.05$.

Graph 1. Assessment of number of cycles to failure (NCF).

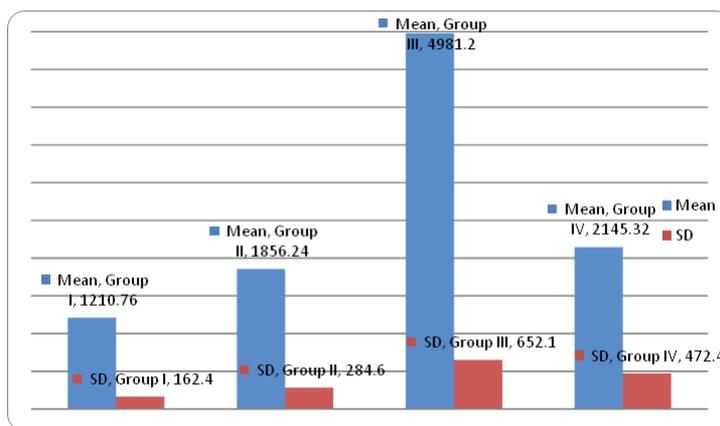
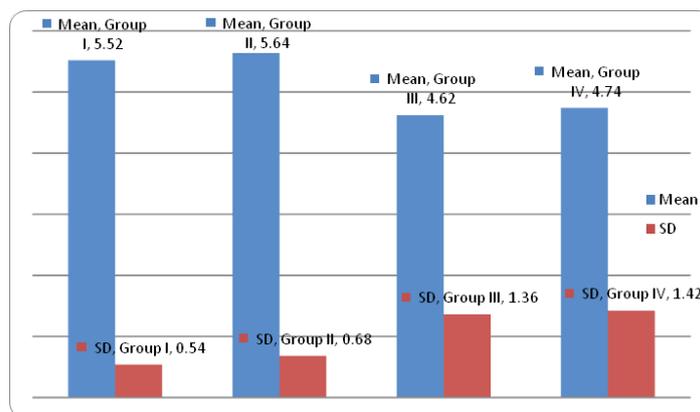


Table 3. Assessment of fragment length (FL) of tested files.

Groups	Mean	SD	P value
Group I	5.52	0.54	0.01
Group II	5.64	0.68	
Group III	4.62	1.36	
Group IV	4.74	1.42	

Kruskal–Wallis test, Significance, P < 0.05

Graph 2. Assessment of Fragment Length (FL) of Tested Files.



cycles to failure (NCF) in group I was 1210.76 ± 162.4 , in group II was 1856.24 ± 284.6 , in group III was 4981.2 ± 652.1 and in group IV was 2145.32 ± 472.4 . Maximum value was obtained with R- pilot files system. Gundogar et al., [11] included VDW. ROTATE, TruNatomy, 2 Shape and HyFlex CM NiTi rotary files and found that highest NCF values was found with VDW. ROTATE (1840.84) followed by HyFlex CM (1566.62), 2Shape (1155.53), and TruNatomy (1110.72). There were significant differences in the cyclic fatigue resistance among the groups ($p < 0.05$), the lengths of the fractured fragments was maximum with VDW.ROTATE (5.68), 2 Shape (5.63), HyFlex CM (5.61) and TruNatomy (5.56). There was no significant difference in the lengths of the fractured fragments among the groups.

We observed that maximum value of fragment length (FL) was obtained with VDW.ROTATE files system. The mean \pm SD FL in group I was 5.52 ± 0.54 mm, in group II was 5.64 ± 0.68 mm, in group III was 4.62 ± 1.36 mm and in group IV was 4.44 ± 1.42 mm. Uslu et al., [12] tested the cyclic fatigue resistances in each 20 files of R-Pilot, HyFlex EDM and PathFile NiTi glide path files in

S-shaped artificial canals. Results showed that files fractured first in the apical curvature and then in the coronal curvature. In the double-curved canal, R-Pilot had the greatest cyclic fatigue resistance, followed by the HyFlex EDM and PathFile in both the apical and coronal curvatures with significant difference ($P < 0.05$).

Grande et al., [13] in their study assessed fatigue resistance of Mtwo and ProTaper in 260 instruments. It was found that Mtwo files (VDW) exhibited higher fatigue resistance than that of ProTaper files. Authors further suggested that smaller instruments showed fracture in more time whereas larger instruments showed fracture in less time. Capar et al., [14] compared HyFlex GPF, G Files, ProGlider, PathFile and Scout RaCe rotary glide path files in artificial canals to assess cyclic fatigue resistances. Results showed that HyFlex GPF made of CM alloy had the greatest cyclic fatigue resistance. Özyürek et al., [15] found higher fatigue resistance of HyFlex EDM files with a controlled memory feature as compared with that of 2Shape TS1 files and concluded that the alloy properties might have contributed to these results.

The shortcoming of the study is small sample size. Only 4 files systems were compared. Comparison with multiple files system could reveal different results.

Conclusion

Authors found that maximum fatigue resistance was found with R- pilot followed by HyFlex EDM, VDW.ROTATE and TruN-atomy.

References

- [1]. Clark D, Khademi J. Modern molar endodontic access and directed dentin conservation. *Dent. Clin. N. Am.* 2010 Apr 1;54(2):249-73.
- [2]. Plotino G, Grande NM, Isufi A, Ioppolo P, Pedullà E, Bedini R, et al. Fracture strength of endodontically treated teeth with different access cavity designs. *J. Endod.* 2017 Jun 1;43(6):995-1000.
- [3]. Plotino G, Özyürek T, Grande NM, Gündoğar M. Influence of size and taper of basic root canal preparation on root canal cleanliness: a scanning electron microscopy study. *IntEndod J.* 2019 Mar;52(3):343-351. Pubmed PMID: 30129186.
- [4]. Filizola de Oliveira DJ, Leoni GB, da Silva Goulart R, Sousa-Neto MD, Silva Sousa YTC, Silva RG. Changes in Geometry and Transportation of Root Canals with Severe Curvature Prepared by Different Heat-treated Nickel-titanium Instruments: A Micro-computed Tomographic Study. *J Endod.* 2019 Jun;45(6):768-773. Pubmed PMID: 30954280.
- [5]. Plotino G, Grande NM, Mazza C, Petrovic R, Testarelli L, Gambarini G. Influence of size and taper of artificial canals on the trajectory of NiTi rotary instruments in cyclic fatigue studies. *Oral Surg Oral Med Oral Pathol Oral RadiolEndod.* 2010 Jan;109(1):e60-6. Pubmed PMID: 19926504.
- [6]. Shen Y, Zhou HM, Zheng YF, Campbell L, Peng B, Haapasalo M. Metallurgical characterization of controlled memory wire nickel-titanium rotary instruments. *J Endod.* 2011 Nov;37(11):1566-71. Pubmed PMID: 22000465.
- [7]. Plotino G, Grande NM, Testarelli L, Gambarini G. Cyclic fatigue of Reciproc and WaveOne reciprocating instruments. *Int. Endod. J.* 2012 Jul;45(7):614-8.
- [8]. Gambarini G, Grande NM, Plotino G, Somma F, Garala M, De Luca M, et al. Fatigue resistance of engine-driven rotary nickel-titanium instruments produced by new manufacturing methods. *J Endod.* 2008 Aug;34(8):1003-5. Pubmed PMID: 18634935.
- [9]. Gambarini G, Plotino G, Grande NM, Al-Sudani D, De Luca M, Testarelli L. Mechanical properties of nickel-titanium rotary instruments produced with a new manufacturing technique. *IntEndod J.* 2011 Apr;44(4):337-41. Pubmed PMID: 21219362.
- [10]. Tripi TR, Bonaccorso A, Condorelli GG. Cyclic fatigue of different nickel-titanium endodontic rotary instruments. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology.* 2006 Oct 1;102(4):e106-14.
- [11]. Gündoğar M, Uslu G, Özyürek T, Plotino G. Comparison of the cyclic fatigue resistance of VDW. ROTATE, TruNatomy, 2Shape, and HyFlex CM nickel-titanium rotary files at body temperature. *Restorative Dentistry & Endodontics.* 2020 Aug;45(3).
- [12]. Uslu G, Özyürek T, Yılmaz K, Gündoğar M. Cyclic fatigue resistance of R-Pilot, HyFlex EDM and PathFile nickel-titanium glide path files in artificial canals with double (S-shaped) curvature. *IntEndod J.* 2018 May;51(5):584-589. Pubmed PMID: 28856692.
- [13]. Grande NM, Plotino G, Pecci R, Bedini R, Malagnino VA, Somma F. Cyclic fatigue resistance and three-dimensional analysis of instruments from two nickel-titanium rotary systems. *IntEndod J.* 2006 Oct;39(10):755-63. Pubmed PMID: 16948660.
- [14]. Capar ID, Kaval ME, Ertas H, Sen BH. Comparison of the cyclic fatigue resistance of 5 different rotary pathfinding instruments made of conventional nickel-titanium wire, M-wire, and controlled memory wire. *J Endod.* 2015 Apr;41(4):535-8. Pubmed PMID: 25510316.
- [15]. Özyürek T, Gündoğar M, Uslu G, Yılmaz K, Staffoli S, Nm G, et al. Cyclic fatigue resistances of Hyflex EDM, WaveOne gold, Reciproc blue and 2shape NiTi rotary files in different artificial canals. *Odontology.* 2018 Oct;106(4):408-413. Pubmed PMID: 29383604.