Research Article

JRAD Journal of Research and Advancement in Dentistry

J Res Adv Dent 2018;8:2:152-157.

Scouting Ability and Fracture Rate of Four Pathfinding Instruments in Negotiating Moderately Curved Molar Canals: An In Vitro Study

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ABSTRACT

Aim: To compare the effectiveness in reaching full working length and fracture rate of four pathfinding nickel titanium rotary systems in mechanically negotiating moderately curved molar canals.

Materials and method: Forty extracted permanent maxillary (n=20) and mandibular (n=20) first and second molars are included in this study. Access opening has done and patency of canal confirmed by inserting ISO size 08 K file. Samples were divided according to the type of pathfinding nickel titanium rotary systems:

Four groups: Group 1: Glide path preparation performed using M2, Group 2: Glide path preparation performed using Proglider, Group 3: Glide path preparation performed using G files, Group 4: Glide path preparation performed using Pathfiles

The absolute and percentage frequencies of molars in which the pathfinding instruments reaching full working length until resistance was encountered and instruments fracture rate in all root canals in all groups were recorded.

Results: The highest and lowest frequency of canals classified as RFWL were observed in the Pathfile (83.33) and proglider groups(73.33) whereas M2 and G files showed intermediate results. The highest percentage frequency of instrument separation was observed in the Proglider group (6.66).

Conclusions: The lack of glidepath establishment and glidepath enlargement is often the cause of ledge formation, transportation, blockage of root canals followed by obturation short of the apical constrictor.

Keywords: Glide path, Nickel titanium rotary instruments, Pathfinding instruments.

INTRODUCTION

Cleaning and Shaping of the root canals is one of the important step of endodontic therapy performed in order to obtain complete disinfection of root canal system and to achieve a continuously tapering funnel from the coronal access to the root apex, keeping the apical foramen in its original

Received: Apr. 17, 2018: **Accepted**: June. 6, 2018
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pISSN 2278-0076
eISSN 2321-9270

position[1]. Traditionally, stainless steel hand files have been used for achieving the goals of cleaning and shaping of root canal system. However, the use of stainless steel hand files in curved canals may lead to procedural errors such as transportations, ledging and perforations due to its stiffness. To avoid these procedural errors, Nickel-Titanium (Ni-Ti) instruments with shape memory and greater flexibility were developed. Ni-Ti rotary instruments have a lower modulus of elasticity compared to stainless steel instruments, therefore, less lateral forces are exerted on the dentine walls in curved canals.[2]The introduction of nickel-titanium rotary files has changed radically the root canal instrumentation techniques and the prognosis of endodontic complex cases which have been clearly demonstrated in many in vitro and in vivo studies especially during enlargement of apical third of severely curved canals.[3]

Separation of instruments is the most common procedural error that occurs during clinical use of rotary Ni-Ti instruments as a result of cyclic flexural fatigue or torsional forces during cleaning and shaping of the canal[3]. To reduce such failures, Glide path creation has been recommended as a mandatory clinical step to improve the safety and efficiency of rotary Ni-Ti instruments.

Glide Path preparation has been defined as a series of clinical procedural steps that aim to expand or preshape the root canal from its orifice to its physiological terminus before using greater tip diameter and tapered shaping files[2]. The importance of Glide Path is to maintain the original canal anatomy with less modification of canal curvature and fewer canal aberrations[1]. Creation of a Glide Path before using rotary instrumentation increases the canal diameter and facilitates the work of subsequent instruments which can smoothly clean and shape root canals and thus reduces the risk of separation[3]. Negotiation and Glide Path preparation are the initial phases of chemo-mechanical procedures and can be regarded as crucial steps for assessment of the root canal anatomy and establishment of unimpeded access to the apical part of the canal[4]. To achieve the proper Glide Path, pathfinding instruments should reach the full working length(RFWL). Several single and multiple rotary systems are available to create the Glide Path.These systems are available in various tapers, sizes and cross-sectional designs. Pathfinding instruments are usually extremely flexible, because of the small tip size and low taper. Similarly, while mechanically advancing a pathfinding instrument to the working length, the pathfinding instruments are largely subjected to stresses which may lead to separation of pathfinding instruments also [5]. However, there are not many studies which compare the efficacy in reaching full working length (RFWL) and separation rates of different pathfinding systems. Hence, this study was undertaken to check the effectiveness of four different pathfinding systems in reaching the full working length and their separation rates in mechanically negotiating moderately curved molar canals to the full working length.

MATERIALS AND METHODS

Tooth Specimen Selection and Groups

After approval by the institutional research ethics committee 40 freshly extracted permanent maxillary (n=20) and mandibular (n=20) first and second molars with moderately curved roots (ranging from 10-20 degrees) were selected . Preoperative digital radiographs were taken from different angles for each tooth. Only mandibular molars with a single distal canal were included, whereas any existing second canal in the mesiobuccal root of maxillary molars was excluded from the experimental procedures. The teeth were then randomly distributed into 4 experimental groups (n = 10, 5 maxillary and 5 mandibular molars) according to the instrument used for glide path preparation (Pathfile [13/.02], G file [12/.03], Mtwo [10/.04], and Pro- Glider [16/.02]).

METHODOLOGY

After gaining root canal access, each tooth was mounted on a specific alginate apparatus that simulated the alveolar socket and allowed connection of the metal lip clip of an apex locator to enable the electronic measurement of the working length. Initial scouting and patency of the canal were checked by inserting ISO size 08 K file to exclude calcified or blocked canals in all teeth. Then the working length was measured with the help of Apex locator (Raypex 6, VDW, Munich, Germany). Glide Path Preparation was then performed using X Smart plus (Dentsply) endomotor in each group by

Table 1: Absolute and Percentage Frequencies of Pathfinding Instruments That Reached the Full Working Length (RFWL) according to the Variables Studied.

TOOTH TYPES AND ROOT CANALS	PROGLIDER	PATHFILES	G FILE	M two
TOOTH TYPE	22(73.33)	25(83.33)	25(83.33)	20(66.66)
MAXILLARY MOLARS(n=5)				
ROOT CANALS				
MESIOBUCCAL	2(40)	3(60)	3(60)	2(40)
DISTOBUCCAL	3(60)	4(80)	4(80)	2(40)
PALATAL	4(80)	5(100)	5(100)	4(80)
MANDIBULAR MOLARS(n=5)				
ROOT CANALS				
MESIOBUCCAL	5(100)	5(100)	5(100)	4(80)
MESIOLINGUAL	4(80)	4(80)	4(80)	4()80
DISTAL	4(80)	4(80)	4(80)	4(80)

Table 2: Absolute and Percentage Frequencies of Pathfinding Instruments That Fractured after Reaching the Full Working Length (RFWL) according to the Variables Studied.

TOOTH TYPES AND ROOT CANALS	PROGLIDER	PATHFILE	G FILE	Mtwo
INSTRUMENT FRACTURE	2(6.66)	1(3.33)	1(3.33)	2(6.66)
TOOTH TYPE				
MAXILLARY MOLARS(n=5)				
MESIOBUCCAL	1(20)	0	1(20)	1(20)
DISTOBUCCAL	0	1(20)	0	0
PALATAL	0	0	0	0
MANDIBULAR MOLARS(n=5)				
MESIOBUCCAL	0	0	0	1(20)
MESIOLINGUAL	1(20)	0	0	0
DISTAL	0	0	0	0

Fig 1: Tooth mounted on a specific alginate apparatus.

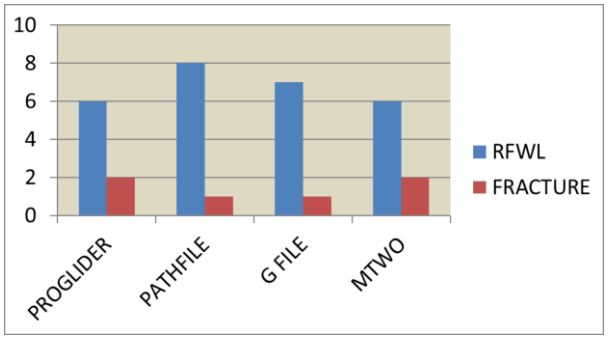
Fig 2: The apex locator file holder was clipped to the upper part of the pathfinding instrument to measure working length.

Fig 3: The pathfinding instrument mounted on a contra-angle handpiece to perform the glide path preparation procedure.

Mtwo (10/.04), ProGlider (16/.02), G files (12/.03), , Pathfiles (13/.02) in clockwise rotation to the full working length, which was established with the help of apex locator. All the pathfinding systems were used according to manufacturer's instructions.

Fig 4: Radiographic images of maxillary and mandibular molars with root canals classified as RFWL.

Fig 5: Representative images of instrument separation occurring in the apical third of the root canal after glide path preparation.



Graph 1: RFWL and Fracture rate in all groups.

Instruments were cleaned after three pecking motions and root canals were irrigated with 5.25% sodium hypochlorite between each preparation step. RFWL were attempted in all the groups until resistance is encountered and the autoreverse mode of the motor was triggered automatically and readings were recorded. Fracture rate were recorded. The absolute and percentage frequencies of molars in which the pathfinding instruments reaching full working length and instruments

separation rate in all root canals in all groups were recorded.

Statistical Analysis : The instrument fracture rate and absolute and percentage frequencies of molars in which the pathfinding instruments RFWL in all root canals according to tooth and canal types were recorded and statistically compared using the Pearson's chi- square test.

RESULTS

The absolute and percentage frequencies of pathfinding instruments that RFWL as well as the fracture rates according to the studied variables are summarized in Tables 1 and 2. Figure 4 & 5 shows representative images of molars in which the pathfinding instruments were able to RFWL in all the canals as well as images of instrument separation that occurred in the apical third after glide path preparation with all tested systems. Pearson's chi-square test showed that the instrument fracture rate and the frequency of teeth with all root canals classified as RFWL were influenced by the pathfinding system

- The highest and lowest frequency of canals classified as RFWL were observed in the Pathfile (83.33) and proglider groups(73.33) whereas M2 and G files showed intermediate results.
- The highest percentage frequency of instrument separation was observed in the Proglider group (6.66) followed by the Mtwo , G file , and Pathfile groups ($P < .05$).

DISCUSSION

The purpose of this study was to compare the effectiveness of four pathfinding systems in reaching full working length (RFWL) and to compare the fracture rate of four pathfinding nickel titanium rotary systems.

In this study, either tooth or canal types had no influence on the performance of the instruments while the tested pathfinding system exerted a significant impact on the frequency of teeth with all root canals classified as RFWL.[6] Pathfile appeared as the most effective pathfinding instrument, producing the highest frequency of canals classified as RFWL because of file's design, which has a small tip size and continuous low taper. This design has been found to minimize the contact area between the shaft and the dentinal walls, reducing torque.[6] This is the reason for the easier advance of the instrument toward the apex.

In this study, the highest percentage frequency of fracture was seen in ProGlider because of more taper of file. The variable taper of Proglider increased the contact area of instrument with canal walls (taper lock). Maintenance of the multi – planar geometries of the original root canal anatomy facilitates the vectors needed for three – dimensional sealing of the root canal system which is a prerequisite for successful endodontic therapy. [7] In curved canals achieving a tapered preparation large enough for the exchange of irrigants, while maintaining the position of the apical foramen, can be precarious. The risk of creating ledges, perforations and zipping of the apex, as well as file separation, increases in curved canals. Since most teeth have root canals with single curves and some with multi - planar curves, the risk of iatrogenic errors is ever present during endodontic instrumentation.[8] The risk is even higher during initial negotiation of the canals.[9] Though the introduction of NiTi instruments for shaping canals has reduced the risk of ledges, perforation and transportation, the risk of file fracture remains.[10,11,12]

The preparation of a glidepath has been shown to reduce torsional stress on rotary NiTi instruments, prolong their lifespan, reduce the occurrence of canal aberrations, better maintain the original curvature of the canal and provide for better efficiency when canals are being shaped with NiTi instruments in reciprocating movement.[13,14,15] A study by Arias stated that there is increased peak torque and force during glidepath preparation with Proglider compared with constant 2% taper Pathfile.[16] Jonker stated that Glidepath preparation increased the longevity of the wave one instrument and enabled more simulated canals before fracture.[17]

CONCLUSION

Within the conditions of this study, Pathfile performed more efficiently and with less instrument breakage than the other tested systems.

and ProGlider exhibited the highest rate of instrument breakage.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. Anil Dhingra, Neetika. Glide Path in endodontics. Endodontology June 2014 Vol.26 (1) .
2. Cassim, PJ van der Vyver. The importance of Glide Path preparation in endodontics : a consideration of instruments and literature. SADJ August 2013, Vol 68 (7) .
3. Pasqualini D, Bianchi CC, Paolino DS et al. Computed microtomographic evaluation of Glide Path with nickel titanium rotary PathFile in maxillary first molars curved canals. J Endod, Dec 2013 ,Vol38 (3).
4. Natasha C.C. Ajuz, Luciana Armada, Lucio S. Goncalves, Gilberto Debelian, Jose F. Siqueira . Glide Path preparation in S-Shaped Canals with Rotary Pathfinding Nickel – Titanium Instruments. JOE April 2013, Vol 39 (4).
5. Gustavo De-deus, Felipe Goncalves Belladonna, Erick Miranda Souza et al. Scouting Ability of 4 Path Finding instruments in Moderately Curved Molar Canals. J Endod, October 2016, Vol 42 (10).
6. Lopes HP, Elias CN, Mangelli M, et al. Buckling resistance of pathfinding endodontic instruments. J Endod 2012;38:402–4.
7. Schilder H . Filling the root canal in three dimensions. Dent Clin North Am 1967, 11, 723 – 744.
8. 8.Frank J. Vertucci. Root canal morphology and its relationship to endodontic procedures. Endodontic topics 2005; 1601 – 1538.
9. Jafarzadeh H, Abbott PV. Ledge formation: review of a great challenge in endodontics. J Endod. 2007 Oct; 33(10): 1155-62.
10. Arens FC, Hoen MM, Steiman HR, Dietz GC Jr. Evaluation of single use rotary nickel – titanium instruments. J Endod.2003, 29, 664-666.
11. Schafer E, Dammaschke T . Development and sequelae of canal transportation. Endod Topics.2009, 15, 75-90.
12. Peters OA, Paque F.Current developments in rotary root canal instrument technology and clinical use: a review. Quintessence Int.2010, 41, 479-488.
13. Berrutti E, Negro AR, Lendini M, Pasqualini D (2004). Influence of manual preflaring and torque on the failure rate of protaper instruments. J Endod, 2004, 30, 228-230.
14. Berrutti E, Paolino DS, Chiandussi G, Alovisi M, Cantatore G, Castellucci A, Pasqualini D. Root canal anatomy preservation of Waveone reciprocating files with or without glidepath. J Endod, 2012, 38, 101-104.
15. Patino PV, Biedma BM, Liebana CR, Cantatore G, Bahillo JG.The influence of a manual glide path on the separation rate of NiTi rotary instruments. J Endod, 2005,31, 114-116.
16. Arias A, Singh R, Peters OA. Differences in torsional performance of single- and multiple-instrument rotary systems for glide path preparation. Odontology 2016;104:192–8.
17. Jonker CH, Van der Vyver PJ, De Wet FA. The influence of Glidepath preparation on the failure rate of Wave one reciprocating instrument. SADJ. 2014, 69(6): 266-9.