

# Increase the glide path diameter improves the centering ability of F6 Skytaper

Giuseppe Troiano<sup>1</sup>, Mario Dioguardi<sup>1</sup>, Armando Cocco<sup>1</sup>, Khrystyna Zhurakivska<sup>1</sup>,  
Domenico Ciavarella<sup>1</sup>, Lorenzo Lo Muzio<sup>1</sup>

**Correspondence:** Dr. Giuseppe Troiano  
Email: giuseppe.troiano@unifg.it

<sup>1</sup>Department of Clinical and Experimental Medicine,  
University of Foggia, Foggia, Italy

## ABSTRACT

**Objective:** The aim of this study was to assess the impact of glide path preparation, performed with PathGlider 0.15 (Komet Brasseler GmbH & Co., Lemgo, Germany) and PathGlider 0.20 (Komet Brasseler GmbH & Co., Lemgo, Germany), on the centering ability of 25-size F6 Skytaper in J-shape simulated root canals, compared with no glide path executed. **Materials and Methods:** Sixty J-shaped ISO 15 0.02 taper endo training blocks (Dentsply Maillefer) were assigned to three groups ( $n = 20$  for each group). Photographic images were taken on endoblocks before and after shaping procedures. After superimposition, the software AutoCAD 2013 (Autodesk Inc., San Rafael, USA) was used for record the centering and shaping ability at 9 different levels from the apex. **Results:** Shaping procedures including the using of PathGlider 0.20 resulted in a lower amount of resin removed and in a clear improvement of centering ability of the Skytaper 0.25 at almost all reference point levels. **Conclusions:** Within the limitations of this study, it could be concluded that the glide path procedure, performed with the PathGlider 0.20 before the shaping with 25-size F6 Skytaper, might determine a lower amount of resin removed and a better centering ability compared with the groups without glide path procedure and those treated with PathGlider 0.15.

**Key words:** Centering ability, endodontic, root canal preparation, root canal therapy, shaping ability, Skytaper

## INTRODUCTION

The shaping of root canals is one of the most important steps in root canal treatment. After the age of stainless steel hand files, many nickel-titanium (Ni-Ti) instruments have been introduced to improve root canal preparation since they showed relevant advantages in canal shaping.<sup>[1-4]</sup> Recently, some single-file root canal preparation systems have been introduced.<sup>[5,6]</sup> They consist of using a single Ni-Ti instrument in rotational or reciprocating motion for the preparation of root canals and seem to offer different advantages, such as the rapidity of the shaping,<sup>[7]</sup> reduction of the risk of file separation as well as the prevention of possible cross-contamination among patients.<sup>[8]</sup>

In the last years, many new instruments were launched, and among them, the F6 Skytaper (Komet Brasseler GmbH & Co., Lemgo, Germany) was introduced in 2016 like a single-file and single-use rotational system. The F6 Skytaper is available in five different sizes (of 20, 25, 30, 35, and 40) with a constant taper of 0.06. Each file is characterized by the S-shaped section, and they are developed for use in continuous clockwise rotation.

Although these new systems lead to a reduction in the time of shaping, still they determine to a certain degree of procedural errors.<sup>[9]</sup> All the shaping systems aim to

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

**How to cite this article:** Troiano G, Dioguardi M, Cocco A, Zhurakivska K, Ciavarella D, Muzio LL. Increase the Glide path diameter improves the centering ability of F6 Skytaper. Eur J Dent 2018;12:89-93.

DOI: 10.4103/ejd.ejd\_231\_17

### Access this article online

Quick Response Code:



Website:  
www.eurjdent.com



respect as much as possible the width and centering ratio of the canal, in order to reduce the possibility of mistakes.<sup>[10,11]</sup>

The impact of a glide path on the shaping ability of different instruments is discussed controversially. Recently, rotary Ni-Ti files became available, and the use of these rotary instruments seems to improve centering ability when compared with manual preflaring or hand-operated scouting instruments.<sup>[12-14]</sup>

The aim of this study was to assess the impact of glide path preparation, performed with PathGlider 0.15 (Komet Brasseler GmbH & Co., Lemgo, Germany) and PathGlider 0.20 (Komet Brasseler GmbH & Co., Lemgo, Germany), on the centering ability of 25-size F6 Skytaper in J-shape simulated root canals, compared with no glide path executed.

## MATERIALS AND METHODS

### Shaping procedures

Sixty J-shaped ISO 15 0.02 taper endo training blocks (Dentsply Maillefer) were assigned to three groups for a final amount of 20 in each group. Endoblocks belonging to Groups A, B, and C were shaped by an experienced operator, postgraduate in endodontics. The working length was measured by a K10 file. In the first group (Group A), no glide path was performed, while in other two groups, the glide path was achieved with PathGlider 0.15 (Komet Brasseler GmbH & Co) in Group B and PathGlider 0.20 (Komet Brasseler GmbH & Co) in Group C. In a second phase, all the samples were shaped with a single F6 Skytaper F06.025 (Komet Brasseler GmbH & Co). The files were mounted on a dedicated handpiece at the recommended setting suggested by the manufacturer for the handpiece (X-Smart, Dentsply Maillefer). Before the use, each instrument was lubricated with a lubricating agent Glyde (Dentsply Maillefer), and the simulated canal was rinsed with 2.5% NaOCl after the use of each instrument. It is to note that a new set of instruments was used for shaping procedure of each endoblock.

### Data recording

Pre- and postinstrumentation images were recorded with a digital camera (Canon 1100D, Tokyo, Japan) at a fixed position and magnification using stable supports for digital camera and for specimens. Reference points were placed on the blocks to allow the superimposition and performed through the use of an imaging software (GIMP 2.8, Free Software

Foundation, Boston, USA). To perform shaping analysis, superimposed images were loaded on AutoCAD 2013 as raster image reference (Autodesk Inc., San Rafael, USA). The 9 level reference points were built after the construction of 9 concentric circles with center in the apex and increasing diameters of 1 mm. For a detailed explanation readers can refer to a previous publication of our group.<sup>[6]</sup> Thanks to this procedure, we have been able to better evaluate the amount of resin removed accordingly to the curvature of the canal (18 measurements for each canal). Centering ability was then evaluated at each reference point subtracting the amount of resin removed from the inner part to that removed from the outer wall of the canal<sup>[15]</sup> while the overall postoperative shape was calculated adding these two measurements.<sup>[16]</sup>

### Statistical analysis

Data have been analyzed using GraphPad Prism software 6.00 (GraphPad Prism Software, San Diego, CA, USA) by an expert in statistical analysis. The presence of normal distribution was assessed by Kolmogorov-Smirnov test and probability plot graph. Statistical significance between different groups was determined with analysis of variance, and multiple comparisons were performed with Tukey test; a level of  $P < 0.05$  was considered to be statistically significant.

## RESULTS

### Amount of resin removed

The measurements of resin removed from the inner and outer wall of the canal were performed at 1-9 mm from the apex [Table 1]. The total quantity of resin removed was calculated through the sum between the internal and external measurements [Figure 1]. The difference between the three systems has been calculated and reported like the mean difference for

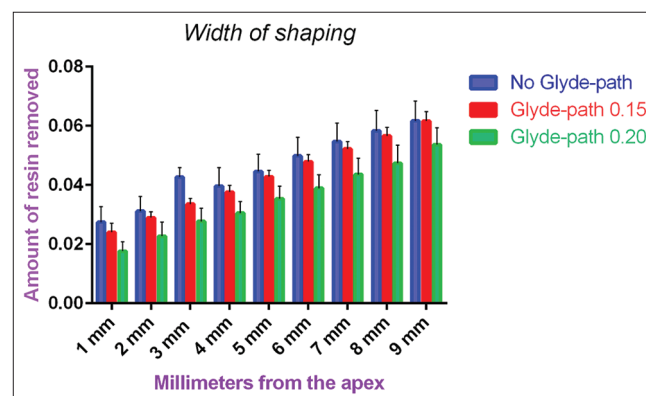


Figure 1: Amount of resin removed at 9-point levels



Table 1: Analysis of the amount resin removed from the inner and outer aspect of the canal at nine-point level from the apex																		
	Inner canal side (mm from the apex)									Outer canal side (mm from the apex)								
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
Group no-glyde path																		
Mean	0.0162	0.0170	0.0202	0.0252	0.0300	0.0333	0.0332	0.0318	0.0317	0.0112	0.0141	0.0224	0.0144	0.0146	0.0165	0.0215	0.0266	0.0300
SD	0.0047	0.0051	0.0058	0.0063	0.0069	0.0074	0.0071	0.0072	0.0068	0.0025	0.0029	0.0312	0.0024	0.0031	0.0031	0.0030	0.0031	0.0031
Group glyde path 0.15																		
Mean	0.0145	0.0159	0.0182	0.0235	0.0292	0.0330	0.0325	0.0307	0.0316	0.0095	0.0131	0.0154	0.0141	0.0136	0.0148	0.0197	0.0259	0.0300
SD	0.0029	0.0025	0.0025	0.0026	0.0026	0.0026	0.0032	0.0034	0.0037	0.0023	0.0023	0.0026	0.0021	0.0023	0.0029	0.0033	0.0034	0.0034
Group glyde path 0.20																		
Mean	0.00779	0.0086	0.0122	0.0181	0.0231	0.0255	0.0241	0.0220	0.0251	0.0098	0.0141	0.0155	0.0124	0.0122	0.0133	0.0195	0.0255	0.0285
SD	0.001768	0.0034	0.0031	0.0038	0.0045	0.0038	0.0035	0.0052	0.0035	0.0020	0.0028	0.0038	0.0032	0.0024	0.0024	0.0035	0.0033	0.0035
SD: Standard deviation																		

every pair of variables. The difference between the methods resulted significant for all the comparisons with Group C (glide path 0.20) [Table 2]. As shown in Figure 1, in the Group C, there was a lower amount of resin removed at all the reference points analyzed.

### Centering ability

The evaluation of the centering ability related to the three groups was performed [Figure 2]. Every method was compared with each other, and the mean difference in centering ability was recorded. The difference was statistically significant for almost all the comparisons with Group C (glide path 0.20) [Table 3]. The centering ratio resulted better in the Group C compared both to Groups A and B.

## DISCUSSION

The introducing of innovative Ni-Ti instruments has improved the endodontic procedures and their performance has been evaluated by numerous studies.<sup>[4]</sup>

Various methods have been adopted to evaluate the shaping abilities of the Ni-Ti instruments. Within these, natural teeth and resin canals have been used to conduct the experimental instrumentation. As demonstrated by Peters,<sup>[17]</sup> natural teeth present anatomic variations that make difficult the standardization of the shaping procedure. For this reason, using of the resin blocks<sup>[18]</sup> allowed us to standardize the experimental conditions and easily compare the shaping ability of the three different procedures, accepting, however, the limits that this approach entails.<sup>[19]</sup>

Recently, a new single-file Ni-Ti rotational instrument, named F6 Skytaper, has been developed by Komet Brasseler GmbH & Co., Lemgo, Germany. Five different sizes ranging from 20 to 40 are available.

Increasing the apical diameter ensures the penetration of irrigation solution into the apical region, so in the

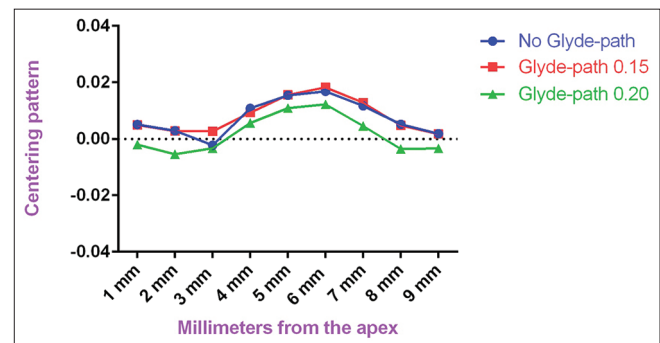


Figure 2: Centering ability in the three groups at 9-point levels



**Table 2: Mean difference in term of the total amount of removed resin between the groups for the 9 levels examined**

	mm from apex								
	1	2	3	4	5	6	7	8	9
No glyde-path versus glyde-path 0.15	0.0034	0.0022	0.0023	0.002	0.0018	0.0019	0.0025	0.0017	0.0001
No glyde-path versus glyde-path 0.2	0.00976*	0.00847*	0.00821*	0.00912*	0.009225*	0.01091*	0.01113*	0.01091*	0.008045*
Glyde-path 0.15 versus glyde-path 0.2	0.00636*	0.00627*	0.00591*	0.00712*	0.007425*	0.00901*	0.008625*	0.009208*	0.007945*

\*Statistically significant ( $P < 0.05$ )**Table 3: Mean difference in term of the centering ability between the groups for the 9 levels examined**

	mm from apex								
	1	2	3	4	5	6	7	8	9
No glyde-path versus glyde-path 0.15	0.0002	0.0001	0.0019	0.0015	-0.0002	-0.0014	-0.0011	0.0004	10.000e-005
No glyde-path versus glyde-path 0.2	0.00716*	0.00832*	0.00792*	0.00515*	0.004525	0.00459*	0.007145*	0.008798*	0.005145*
Glyde-path 0.15 versus glyde-path 0.2	0.00696*	0.00822*	0.00602*	0.00365	0.004725*	0.00599*	0.008245*	0.008398*	0.005045*

\*Statistically significant ( $P < 0.05$ )

present study, Ni-Ti file having an apical diameter of 0.25 mm was chosen for shaping the J-shaped simulated canals according to previous studies.<sup>[20]</sup>

According to the manufacturer's instructions, a preflaring should be performed before the use of the Ni-Ti instrument. Various studies have been conducted to evaluate the influence of the glide path procedures on the performance of the rotary and reciprocating Ni-Ti files;<sup>[21]</sup> nevertheless, no scientific papers are available about the influence of various glide path procedures on the performance of the F6 Skytaper.

In the present study, we have assessed the influence of two glide path instruments, i.e. PathGlider 0.15 and PathGlider 0.20 (Komet Brasseler GmbH & Co., Lemgo, Germany) on the centering ability of the 25-size F6 Skytaper, comparing such results with a group not subjected to glide path.

Analysis on centering ability and width of shaping was performed after photographic superimposition, at nine reference points from the apex.

No instrument fracture was observed at the end of the shaping procedures.

Differences in width of shaping have been found at all nine levels when the Group C was compared with the others, whereas no statistically significant difference was observed for performing of glyde path 0.15, compared with the Group A. Hence, according to the results, the performing of Glyde-path

0.20 before the shaping with Skytaper 0.25 was found to remove statistically significantly less resin at all the measurement points when compared with the No-Glyde and Glyde-path 0.15 groups ( $P < 0.05$ ). In the same way, the results of this study showed the best centering ability in the group where the shaping procedure was preceded by a Glyde-path with PathGlider 0.20 ( $P < 0.05$ ).

Through the analysis of centering ability, it is possible to evaluate the symmetry of shaping. This is very important during clinical shaping procedures to avoid formation of iatrogenic lesions.<sup>[22]</sup> In fact, if the instrument works more against one of the canal walls, this could cause stripping or other canal aberrations.<sup>[23]</sup>

The results of this study indicate a clear improvement in centering ability of Skytaper 0.25 when the shaping procedure is preceded by the Glyde-path performed with PathGlider 0.20. On the other hand, the using of PathGlider 0.15 seems not to add any improvement in the centering ability of the instrument in question when compared with No-Glyde group. This observation may be connected to the initial size of the endoblock canals, relatively wide compared to the PathGlider 0.15, and in which the real improvement is made only by an instrument of larger diameter.

The results of the present study may carry important improvements in the clinical practice; however, it is necessary to consider that the hardness level of resin is different from the dentin, and for this reason, it is very important to validate the study results in terms of clinical conditions.<sup>[24]</sup>



## CONCLUSIONS

With all the above considerations, it could be concluded that the glide path procedure, performed with the PathGlider 0.20 before the shaping with 25-size F6 Skytaper, might determine a lower amount of resin removed and a better centering ability compared with the groups without glide path procedure and those treated with PathGlider 0.15.

**Financial support and sponsorship**  
Nil.

## Conflicts of interest

There are no conflicts of interest.

## REFERENCES

1. Thompson SA, Dummer PM. Shaping ability of proFile. 04 taper series 29 rotary nickel-titanium instruments in simulated root canals. Part 1. *Int Endod J* 1997;30:1-7.
2. Pruett JP, Clement DJ, Carnes DL Jr. Cyclic fatigue testing of nickel-titanium endodontic instruments. *J Endod* 1997;23:77-85.
3. You SY, Kim HC, Bae KS, Baek SH, Kum KY, Lee W, *et al.* Shaping ability of reciprocating motion in curved root canals: A comparative study with micro-computed tomography. *J Endod* 2011;37:1296-300.
4. Peters OA. Current challenges and concepts in the preparation of root canal systems: A review. *J Endod* 2004;30:559-67.
5. Yared G. Canal preparation using only one ni-ti rotary instrument: Preliminary observations. *Int Endod J* 2008;41:339-44.
6. Troiano G, Dioguardi M, Cocco A, Giuliani M, Fabiani C, D'Alessandro A, *et al.* Centering ability of ProTaper next and WaveOne classic in J-shape simulated root canals. *ScientificWorldJournal* 2016;2016:1606013.
7. Bürklein S, Hinschitzka K, Dammaschke T, Schäfer E. Shaping ability and cleaning effectiveness of two single-file systems in severely curved root canals of extracted teeth: Reciproc and WaveOne versus Mtwo and ProTaper. *Int Endod J* 2012;45:449-61.
8. Letters S, Smith AJ, McHugh S, Bagg J. A study of visual and blood contamination on reprocessed endodontic files from general dental practice. *Br Dent J* 2005;199:522-5.
9. Bürklein S, Poschmann T, Schäfer E. Shaping ability of different nickel-titanium systems in simulated S-shaped canals with and without glide path. *J Endod* 2014;40:1231-4.
10. Vallaey K, Chevalier V, Arbab-Chirani R. Comparative analysis of canal transportation and centring ability of three Ni-Ti rotary endodontic systems: Protaper(R), MTwo(R) and Revo-S, assessed by micro-computed tomography. *Odontology* 2016;104:83-8.
11. Burroughs JR, Bergeron BE, Roberts MD, Hagan JL, Himel VT. Shaping ability of three nickel-titanium endodontic file systems in simulated S-shaped root canals. *J Endod* 2012;38:1618-21.
12. Troiano G, Dioguardi M, Cocco A, Giannatempo G, Laino L, Ciavarella D, *et al.* Influence of operator's experience on the shaping ability of protaper universal and waveone systems: A Comparative study on simulated root canals. *Open Dent J* 2016;10:546-52.
13. Berutti E, Cantatore G, Castellucci A, Chiandussi G, Pera F, Migliaretti G, *et al.* Use of nickel-titanium rotary pathFile to create the glide path: Comparison with manual preflaring in simulated root canals. *J Endod* 2009;35:408-12.
14. Ajuz NC, Armada L, Gonçalves LS, Debelian G, Siqueira JF Jr. Glide path preparation in S-shaped canals with rotary pathfinding nickel-titanium instruments. *J Endod* 2013;39:534-7.
15. Yang GB, Zhou XD, Zhang H, Wu HK. Shaping ability of progressive versus constant taper instruments in simulated root canals. *Int Endod J* 2006;39:791-9.
16. Schäfer E, Lohmann D. Efficiency of rotary nickel-titanium FlexMaster instruments compared with stainless steel hand K-Flexofile – Part 1. Shaping ability in simulated curved canals. *Int Endod J* 2002;35:505-13.
17. Peters OA, Laib A, Göhring TN, Barbakow F. Changes in root canal geometry after preparation assessed by high-resolution computed tomography. *J Endod* 2001;27:1-6.
18. Dioguardi M, Troiano G, Laino L, Lo Russo L, Giannatempo G, Lauritano F, *et al.* ProTaper and WaveOne systems three-dimensional comparison of device parameters after the shaping technique. A micro-CT study on simulated root canals. *Int J Clin Exp Med* 2015;8:17830-4.
19. Bonaccorso A, Cantatore G, Condorelli GG, Schäfer E, Tripi TR. Shaping ability of four nickel-titanium rotary instruments in simulated S-shaped canals. *J Endod* 2009;35:883-6.
20. Zhang L, Luo HX, Zhou XD, Tan H, Huang DM. The shaping effect of the combination of two rotary nickel-titanium instruments in simulated S-shaped canals. *J Endod* 2008;34:456-8.
21. Dhingra A, Nagar N, Sapra V. Influence of the glide path on various parameters of root canal prepared with WaveOne reciprocating file using cone beam computed tomography. *Dent Res J (Isfahan)* 2015;12:534-40.
22. Gergi RM, Osta NE, Naaman AS. Dentine crack formation during root canal preparations by the twisted file adaptive, reciproc and WaveOne instruments. *Eur J Dent* 2015;9:508-12.
23. Türker SA, Uzunoglu E. Apical root canal transportation of different pathfinding systems and their effects on shaping ability of ProTaper next. *J Clin Exp Dent* 2015;7:e392-5.
24. Schäfer E, Diez C, Hoppe W, Tepel J. Roentgenographic investigation of frequency and degree of canal curvatures in human permanent teeth. *J Endod* 2002;28:211-6.