Dental Research Journal

Original Article

Comparison of the cleaning efficacy of XP-endo shaper and Mtwo rotary files in oval-shaped canals

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Received: 05-May-2020
Revised: 19-Jan-2021
Accepted: 03-May-2021
Published: 10-Dec-2021

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ABSTRACT

Background: Cleaning and shaping of root canals are essential steps for the success of endodontic therapy. This study compared two types of rotary files in oval-shaped root canals: XP-endo shaper (FKG, La Chaux-de- Fonds, Switzerland) and Mtwo (VDW, Germany, Munich) with regard to cleaning ability and canal preparation. Mtwo is a system of nickel–titanium files with S-shaped cross-sectional design and XP-endo shaper can change its shape according to the temperature.

Materials and Methods: This *in vitro* study was performed on 16 pairs of freshly extracted contralateral mandibular premolars with a single oval-shaped canal that were selected and divided into two groups according to the root canal instrumentation technique: XP-endo shaper and Mtwo. Then, each root cut into three coronal, middle and apical sections and processed for histologic evaluation of canal wall planning and the presence of debris. Sections were evaluated by using AutoCAD 2017 software. Statistical analysis was used to compare between both the groups using repeated measures multivariate analysis of variance with Bonferroni correction for *post hoc* comparison and independent sample *t*-tests. The level of statistical significance was set at $P < 0.05$.

Results: With a statistically significant difference in the middle third, untouched area and area with debris in XP-endo shaper group were smaller (respectively $P = 0.013$ and $P = 0.011$). Despite the percentage difference between groups, there was not a statistically significant difference in other sections.

Conclusion: Statistically in the middle section of the oval-shaped canals, the XP-endo shaper performs better than the Mtwo rotary files.

Key Words: Endodontics, histology, nickel–titanium alloy, root canal preparation

INTRODUCTION

Complete debridement of the root canal system that reduces the number of bacteria is the most important step in endodontic treatment.[1] Any residual tissue or debris can be effective in failing root canal treatment.[2] Due to the complex shape of the root canal system, complete debridement of canals using existing devices is not possible.[3] This is more evident in noncircular canals.[4] It should be noted that the mechanical preparation significantly reduces the number of microorganisms in the canal,[5] but it does not sterilize the canal.[6] Therefore, antimicrobial solutions were also recommended to improve mechanical preparation.[7-9] Introducing nickel–

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How to cite this article: Simdar N, Bashardoust N, Jahangir M. Comparison of the cleaning efficacy of XP-endo shaper and Mtwo rotary files in oval-shaped canals. Dent Res J 2021;18:107.

titanium (NiTi) rotary files created a revolution in root canal treatment. These devices were quickly converted by clinicians in many countries.[10-12] In comparison to hand instruments, fast canal preparation and greater flexibility are the benefits of these files.[13] On the other hand, these files have disadvantages such as the high probability of breaking in complex anatomical canals[14] and they usually shave a round cross-sectional shape so they can leave behind untouched areas in oval-shaped root canals.[8]

Mtwo (VDW, Germany, Munich) is a system of NiTi files with S-shaped cross-sectional design and has two cutting edges with minimal radical contact providing maximum space for dentin removal. Mtwo is the only system which has #10.04 and #15.05 instruments and has not any orifice shaper.[15]

The manufacturer claims that XP-endo shaper (FKG, La Chaux-de- Fonds, Switzerland) can change its shape according to the temperature. When the file is cool, it is in the martensitic phase and stands straight with size #30 and an initial taper of 0.01. However, when submitted to body temperature, it changes to its austenitic phase assuming snake shapes which if using this instrument alone, it can achieve a final canal preparation of #30/0.04. The producer stated that the XP-endo shaper applies minimal stress to the dentin walls and it can easily adapt itself to canal irregularities.[16]

In this study, we attempted to assess the amount of preparation and cleaning of oval-shaped canals using two types of rotary files to get the best cleansing and shaping as much as possible.

MATERIALS AND METHODS

Tooth selection

This *in vitro* study was done on 16 pairs of mandibular premolar teeth (single root and single canal) that were extracted bilaterally for orthodontic reasons. Each pair of contralateral teeth was extracted from the same patient. Approval for the study was obtained from the departmental Human Ethics Advisory Group, Guilan University of Medical Sciences. Teeth were stored in 10% formalin until usage. Teeth with cracks, immature apex, root resorption, caries or root fillings, and calcification were excluded from this study. All teeth were examined from both buccolingual and mesiodistal using parallel radiograph technique (10 mA, 70 kvp, and 0.4s) (Sordex, Finland). If the buccolingual diameter of the canal was at least twice that of the mesiodistal, we considered it oval-shaped and started studying on it.

Tooth preparation

Coronal access was achieved using a high-speed diamond bur. The working length (WL) was set 0.5 mm short of the apical foramen. A glide path was established with a #20 K-file to the WL. Then, two anatomically similar premolar teeth were randomly divided into two experimental groups. To provide a proper comparison between the two files, no other means were used for coronal flaring. Teeth were then prepared as follows:

Mtwo group: All instruments were operated using an electric motor (DESTi ES100, Korea) set at 280 rmp and 120 g/cm (following the manufacturer's instruction). To match the two groups, the sequence of files in this group was #10.06, #15.05, #20.06, #25.06 and #30.05.For both the groups, copious irrigation with 1% NaOCl solutions (1 mL over 1 min after each instrument) was used throughout instrumentation along with a final flush with 1 mL EDTA.

XP-endo shaper group: According to the manufacturer's instruction, the XP-endo shaper activated in the rotate mode (800rmp and 1 N/cm) applying light up and down movement. Five strokes applied until the file reached the WL. After that, another five strokes were made (30 s totally). Then with the same speed and torque started the motor and slowly thread the XP-endo finisher into the canal for 1 min (approximately 60 strokes), using slow and gentle 7–8 mm longitudinal movements to contact the full length of the canal. Similar to Mtwo, the preparation was checked with a #30.04 gutta-percha cone.

Root canal preparation was performed by previously trained operators in each system.

Specimen preparation

The teeth were calcified with 5% nitric acid and then, each root was sectioned at three levels: In the coronal, middle, and apical thirds using a microtome (Yidi, China), 6 μ thick samples were prepared. Root sections were processed for histologic examination (hematoxylin and eosin staining).

Evaluation

The histologic sections were examined blindly under a light microscope (Olympus BX41, Japan) at ×40. Microscopic images of the samples were digitally photographed and untouched areas or odontoblast

layer [Figure 1] and debris were identified [Figure 2]. Untouched surface was defined as unplanned by the instrument which might have residual predentin, while debris was defined as dentin chips and residual pulp tissue attached to the canal wall. For canal cleanliness assessment, a software package (AutoCAD 2017) was used which enables to calculate the canal perimeter as a whole or in shorter sections. The percentages of untouched areas or with debris present were calculated.

Statistical analysis

The percentage of debris and untouched surfaces of canal wall in the apical, middle, and coronal areas in both the groups was compared using repeated measures multivariate analysis of variance with Bonferroni correction for *post hoc* comparison and independent sample *t*-tests. The level of statistical significance was set at $P < 0.05$.

RESULTS

According to Table 1, in group XP-endo shaper in terms of untouched surfaces ($P = 0.036$) and debris ($P = 0.037$), the only statistically significant difference was between the apical and coronal sections which apical third was better. In group Mtwo, there was a statistically significant difference between apical and middle thirds ($P = 0.045$) and middle and coronal sections ($P = 0.018$) which more untouched areas were seen at the middle third. The middle section also has more debris than the coronal third ($P = 0.025$).

In general and without considering the sections, the *t*-test showed a statistically significant difference in the percentage of untouched surfaces ($P = 0.004$) and debris ($P = 0.004$) between both the groups. The XP-endo shaper performed considerably better at apical and middle thirds with less untouched surfaces and debris. However, it was only statistically significant in the middle third ($P = 0.013$ and $P = 0.011$).

Table 2 shows the comparison of the percentages of untouched and debris areas of the two files in general and regardless of the sections. According to the results, in terms of untouched areas ($P = 0.114$) and debris ($P = 0.078$), there was no statistically significant difference between the two files, but the effect Size test showed that the XP-endo shaper had better performance.

DISCUSSION

The preparation of oval canals is a clinical challenge.[8] This study used histological examination to determine the amount of cleansing of two rotary files. However, for this purpose, there were other methods such

Table 1: Influence of different files on planing of the canal wall and debris at three levels

Files	Level	Debris (%)		Uninstrumented (%)	
		Mean±SD	Range	Mean±SD	Range
Mtwo	Coronal	17.67±15.57	4.7-68	14.22±15.97	1.3-66.1
	Middle	34.02±22.13	5.9-81.7	30.71±23.05	3.7-80.2
	Apical	23.7±22.29	3-81.8	20.36±21.27	1-80.1
XP-endo shaper	Coronal	20.27±17.79	4.2-72.8	16.18±15.46	2.7-60.1
	Middle	16.56±14.02	2.3-64.1	11.93±14.45	1-62.1
	Apical	12.42±12.32	1.1-50.1	9.19±12.45	1-50.1

SD: Standard deviation; XP-endo shaper

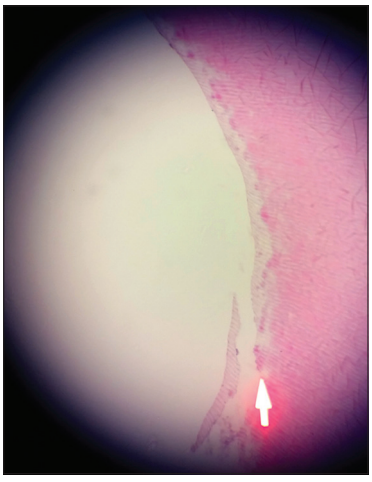

Figure 1: Uninstrument areas with odontoblast layer (H and E, 100).

Figure 2: The histologic cross-section of the middle third of a root canal prepared by Mtwo showing part of the canal wall planed without debris (smaller arrow), the canal wall with debris (bigger arrow), (H and E, ×40).

Table 2: The comparison of the percentages of untouched and debris areas of the two files in general and regardless of the sections

Areas	Files		Independent samples test	*P*	Effect size Gates' delta
	XP[a]	Mtwo[a]			
Uninstrumented (%)	16.4±13.58	25.13±16.53	1.63	0.114	0.64
Debris (%)	12.43±13.07	21.76±15.76	1.82	0.078	0.71

[a]Mean±SD. SD: Standard deviation; XP-endo shaper

as scanning electron microscopy,[17] reassembly technique,[18] and microcomputed tomography scans.[19] Although tomography can evaluate the cross-sectional shapes, it is not suitable for scoring debris.[1]

In the XP-endo shaper group, the lowest mean percentage of untouched areas was found in the apical third which was consistent with a study by Azim *et al*. in 2017.[20] In the Mtwo group, there were significantly more untouched walls in the middle third. Espir *et al*. in 2018 found more untouched areas in this section too.[21] This result indicated that Mtwo has a better clearance of the odontoblastic layer in the coronal and apical sections.

In the XP-endo shaper group, the apical section had the lowest amount of debris which this finding was different from that of Provenzano *et al*.[22] They found the apical region with the highest debris and said that the XP-endo shaper may have displaced pulp remnants by its frequent expansion and contraction in the canal.[22] They studied the distal root of the mandibular molar which this may be the reason why the results are different.

In this study, there was significantly more debris at the middle third in Mtwo group. However, Foschi *et al*. identified the apical region as having the highest debris.[23] Different shapes of the cross-sections of the investigated canals may be due to our disagreement.

We found that there was no statistically significant difference between the two files regardless of the sections. However, the effect size test showed that the XP-endo shaper had better performance. Azim *et al*. also found that the tendency to accumulate debris in the XP-endo shaper group was less than Vortex Blue (DENTSPLY, Tulsa Dental Specialties) group although there was no statistically significant ($P = 0.059$).[20]

To our knowledge, there are limited studies available on the canal preparation quality of the XP Shaper or its ability to expand beyond its core size. In this study, we attempted to find some clinical findings about XP-endo shaper to better understand the properties and behavior of them inside the oval-shaped canals. None of the files were broken during this research and in accordance with previous studies, we found that neither of the two files were able to completely plane and clean the root canals.[23,24] Velozo and Albuquerque in a review study reported that although XP-endo shaper exhibits good performance in root canal preparation, it leaves untouched walls.[25] Therefore, using different new instruments does not mean that the canal is completely clear and root canal preparation is influence by diverse factors, such as instrument design, kinematic, and number of instruments.[21] In our study, the accumulation of debris after root canal preparation usually involves areas as fins, isthmus, irregularities, and ramifications which this finding is consistent with previous studies too.[1,21] The tissue and debris remaining in the canal may affect the filling quality of the canal. They have the ability to act as a nutrient for bacteria and cause treatment failure.[8] Therefore, consideration should be given to finding a method that can reduce the remaining debris as low as possible.

CONCLUSION

None of the files could completely remove the debris or odontoblast layer, but statistically, in the middle section of the oval-shaped canals, the XP-endo shaper performs better than the Mtwo rotary files.

Financial support and sponsorship
Nil.

Conflicts of interest
The authors of this manuscript declare that they have no conflicts of interest, real or perceived or financial or nonfinancial in this article.

REFERENCES

1. Taha NA, Ozawa T, Messer HH. Comparison of three technique for preparing oval shaped root canals. J Endod 2010;36:532-5.
2. Provenzano JC, Siqueira JF, Ludmila S, Marceliano-Alves MF. Preparation of oval-shaped canals with TRUShape and reciproc systems: A micro-computed tomography study using

contralateral premolars. J Endod 2017;43:1018-22.
3. Walton RE. Histologic evaluation of different methods of enlarging the pulp canal space. J Endod 1976;2:304-11.
4. Wu MK, R'oris A, Barkis D, Wesselink PR. Prevalence and extent of long oval canals in the apical third. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2000;89:739-43.
5. Siqueira JF, Lima KC, Magalhaes FA, Lopes HP, de Uzeda M. Mechanical reduction of the bacterial population in root canal by three instrumentation tech. J Endod 1999;25:332.
6. Dalton BC, Orstavik D, Philips C, Pettiette M, Trope M. Bacterial reduction with nickel-titanium rotary instruments. J Endod 1998:24:763.
7. Siqueira JF, Rocas IN, Santos SR, Lima KC, Magalhaes FA, de Uzeda M. Efficacy of instrumentation technique and irrigation regimens in reducing the bacterial population within root canals. J Endod 2002;28:181-4.
8. Carvalho M, Zoulu M, Arruda-Vasconcelos R, Marinho A, Louzada L, Francisco P, *et al*. Effectiveness of XP-Endo Finisher in the reduction of bacterial load in oval-shaped root canals. Braz Oral Res 2019;33:e021.
9. Azim AA, Aksel H, Zhuang T, Mashtare T, Babu JP, Huang GT. Efficacy of 4 irrigation protocols in killing bacteria colonized in dentinal tubules examined by a novel confocal laser scanning microscope analysis. J Endod 2016;42:928-34.
10. Bird DC, Chambers D, Peters OA. Usage parameters of nickel-titanium rotary instruments: A survey of endodontics in the US. J Endod 2009;35:1193.
11. Parashos P, Messer MH. Uptake of rotary NiTi technique within Australia. Aust Dent J 2005;50:251.
12. Bjørndal L, Reit C. The adoption of new endodontic technology amongst Danish general dental practitioners. Int Endod J 2005;38:52-8.
13. Peters OA. Current challenges and concepts in the preparation of root canal systems: A review. J Endod 2004;30:559-67.
14. Elnaghy AM, Elsaka SE. laboratory comparison of the mechanical properties of TRU shape with several nickel-titanium rotary instruments. Int Endod J 2017;50:805-12.
15. Inan U, Gonulol N. Deformation and fracture of Mtwo rotary nickel-titanium instruments after clinical use. J Endod 2009;35:1396-9.
16. Silva EJ, Leal Vieira VT, Zolou A, Cavalcante D, De-Deus G. Cyclic and torsional fatigue resistance of XP-endo shaper and TRUShape instrument. J Endod 2018;44:168-72.
17. Lumley PJ, Walmsley AD, Walton RE, Rippin JW. Cleaning of oval canals using ultrasonic or sonic instrumentation. J Endod 1993;19:453-7.
18. Rödig T, Hülsmann M, Mühge M, Schäfers F. Quality of preparation of oval distal root canals in mandibular molars using nickel-titanium instruments. Int Endod J 2002;35:919-28.
19. Versiani MA, de Sousa-Neto MD, Pecora JD. Flat-oval root canal preparation with self-adjusting file instrument: A micro-computed tomography study. J Endod 2011;37:1002-7.
20. Azim A, Piasecki L, da Silva Neto UX, Cruz A, Azim K. XP shaper, a novel adaptive core rotary instrument: Micro–computed tomographic analysis of its shaping abilities. J Endod 2017;43:1532-8.
21. Espir C, Nascimento-Mendes C, Guerreiro-Tanomaru J, Cavenago B, Duarte M, Tanomaru-Filho M. Shaping ability of rotary or reciprocating systems for oval root canal preparation: A micro-computed tomography study. Clin Oral Investig 2018;22:3189-94.
22. Provenzano JC, Lacerda MF, Marceliano-Alves M, Perez A, Neves M, Pires F, *et al*. Cleaning and shaping oval canals with 3 instrumentation systems: A correlative micro–computed tomographic and histologic study. J Endod 2017;43:1878-84.
23. Foschi F, Nucci C, Montebugnoli L, Marchionni S, Breschi L, Malangnino VA, *et al*. SEM evaluation of canal wall dentine followin use of Mtwo and ProTaper NiTi rotary instruments. J Endod 2004;37:832-8.
24. Versiani M, Carvalho K, Mazzi-Chaves J, Sousa-Neto MD. Micro-computed tomographic evaluation of the shaping ability of XP-endo shaper, iRaCe, and EdgeFile systems in long oval-shaped canals. J Endod 2018;44:489-95.
25. Velozo C, Albuquerque D. Microcomputed tomography studies of the effectiveness of XP-endo shaper in root canal preparation: A review of the literature. ScientificWorldJournal 2019;2019:3570870.