10.5005/jp-journals-10024-1185

ORIGINAL RESEARCH

The Influence of Cervical Preflaring of Root Canal on Determination of Initial Apical File using Gates Glidden Drills, Protaper, Race and Diamond-Coated Galaxy Files

TS Ashwini, Sonam Bhandari

ABSTRACT

Aim: To investigate the influence of cervical preflaring on apical file size determination using four different rotary instruments.

Materials and methods: Fifty root canals from extracted human maxillary premolars with complete root formation, straight roots were used for the study. Access opening was done and the working length established with 8 no K-file for each canal. Teeth were randomly divided into five groups of 10 canals. In Group 1- no preflaring was done and acted as control and in Groups 2, 3, 4 and 5 cervical and middle third preflaring of the root canals were done using Gates Glidden drills, Protaper instruments, Race instruments and Galaxy files respectively.

After preflaring, the apical file size determination was done and the initial apical file (IAF) was fixed at the working length. Teeth were sectioned transversally 1 mm from the apex, with the binding file in position. The samples were imaged under stereomicroscope with 30× magnification. Root canal and file maximum diameters were recorded for each sample. The readings were subjected to analysis of variance test and Scheffe's multiple comparison test.

Results: Preflaring with Race instruments lead to most accurate determination of the IAF. It was followed by Protaper, Galaxy files and Gates Glidden drills.

Conclusion: Traditional method of apical size determination may lead to a substantial underestimation of actual canal size. Cervical preflaring increases the accuracy of apical size determination.

Clinical significance: Thus, cervical preflaring is recommended before selection of IAF as it increases the accuracy of apical size determination.

Keywords: Apical enlargement, Cervical preflaring, Initial apical file, Working width of root canal, Original research.

How to cite this article: Ashwini TS, Bhandari S. The Influence of Cervical Preflaring of Root Canal on Determination of Initial Apical File using Gates Glidden Drills, Protaper, Race and Diamond-Coated Galaxy Files. J Contemp Dent Pract 2012; 13(4):554-558.

Source of support: Nil

Conflict of interest: None declared

INTRODUCTION

Endodontic success relies on the accurate determination of working length (WL) and adequate apical enlargement of the root canal.[1,2] It is still not clear how large is large enough. Many studies have demonstrated that widely accepted endodontic cleaning and shaping techniques are inadequate.[3] Walton's[4] histologic study, showed that canals that were instrumented to three sizes larger still were not thoroughly cleaned. To date, there is no method to determine the amount of apical preparation during instrumentation[5] and clinicians are making treatment decisions without any support of scientific evidence.

The amount of apical enlargement is typically based on the estimation of the diameter at the apical constriction, i.e working width of root canal. The working width of the root canal system is not only more complicated than the WL but also more difficult to investigate because it varies at each vertical level of the root canal.[3]

The initial apical size of a root canal is assumed as the size of the first file that binds at the WL and is defined as the initial apical file, IAF.[6] The detection of the apical constriction and the determination of the IAF are based on the tactile sense of the clinician. This is done by passing consequently larger instruments to the WL until one binds. This premise relies on the assumption that the root canal is narrowest in the apical third and the file would pass without any interference.[7] However, the continuous and progressive dentin formation on pulp chamber floor creates dentin projections that narrows the canal diameter, especially at the cervical third. Hence, the sensation of file fit does not necessarily occur because of contact at apex but may instead be the result of interference in the coronal and middle thirds of the canal.[8-10] This method of determination of IAF is inaccurate and leads to underestimation of the real diameter of the apical portion.

There are many other factors like irregularity of the canal walls, curvature of root, etc. which affect the initial working width determination. To minimize these factors, cervical preflaring is recommended.[3]

Previous studies have investigated the influence of different rotary instruments like Gates Glidden drills and other Ni-Ti instruments for cervical flaring on the determination of IAF.[1,11-15] The objective of the present study is to investigate the influence of preflaring using conventional stainless steel Gates Glidden drills (Mani), current and widely used rotary Ni-Ti instruments like Protaper (PT; Denstply, Maillefer, Switzerland), Race (RC; FKG Dentaire, Genf, Switzerland) and recently introduced diamond-coated Galaxy files (Plastic endo, Lincolnshire USA) on determination of IAF.

MATERIALS AND METHODS

Tooth Selection and Preparation

Fifty root canals from extracted human maxillary premolars which showed complete root formation, patent root canals and straight roots were selected for the study. Teeth were stored in normal saline until the study was done. Standard access cavities were prepared and pulp extirpated. The precise tooth length was specified by inserting 08 no K-file into the canal until the file was visible at the apex. The working length was set 1 mm short of tooth length. Reference points were recorded for each canal.

Teeth were randomly divided into five groups with 10 canals in each group $n = 10$.

Group 1: The teeth were not preflared and acted as control group.

For groups 2, 3, 4 and 5 the instruments were used according to manufacturer's instructions up to middle-third of the root canal. The canals were irrigated with 1% sodium hypochlorite between the instrumentation.

Group 2: Gates Glidden drills. No 4,3,2,1 were used in the crown down sequence. Each drill was penetrated 2 mm deeper than the preceding drill.

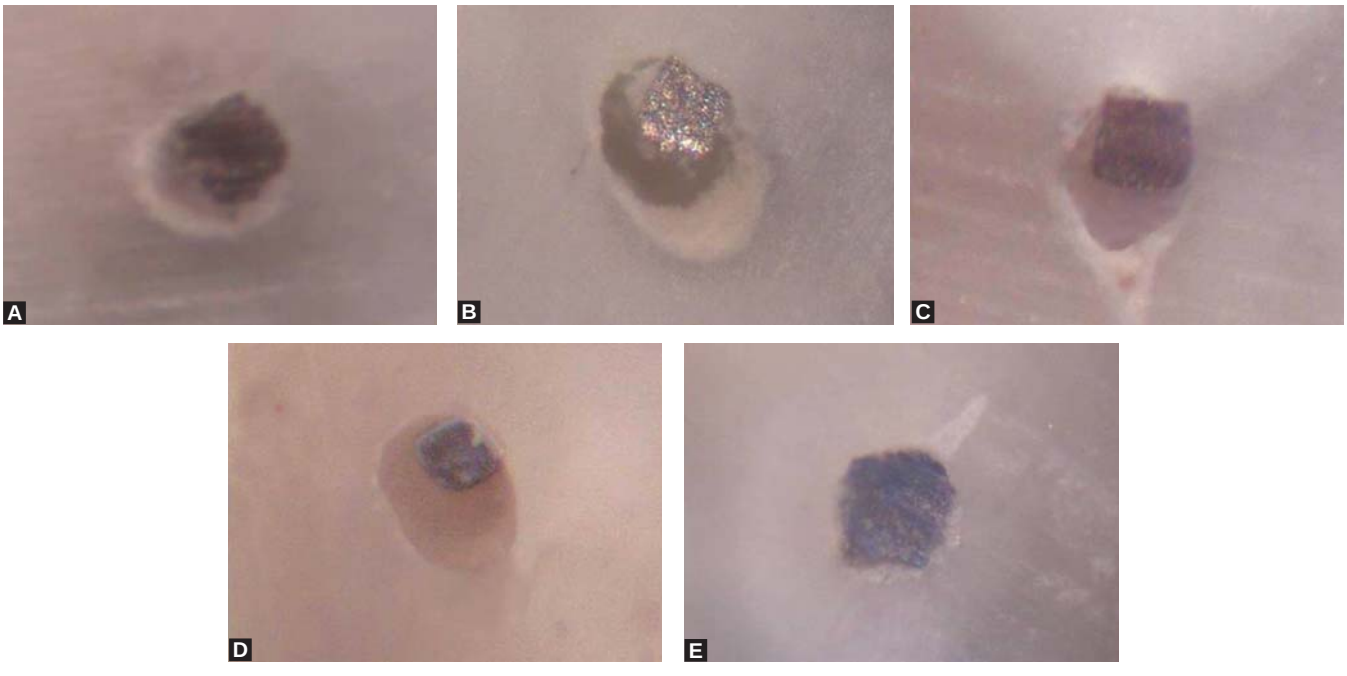
Group 3: Protaper instruments. SX, S1, S2 were used.

Group 4: Race instruments. Pre-Race instruments of size 0.10/40 and 0.08/35 were used.

Group 5: Galaxy diamond files. No 30/0.08 and 40/0.10 were used in slow speed air driven handpiece. Here, we have not enlarged the canals till K-file ISO 20/02 prior to preflaring as manufacturer's instructions states because, according to the study IAF is determined after preflaring.

Determination of IAF

Consequently larger files were inserted up to WL starting with K-file ISO 10/02. The first file that snugly fitted at WL was fixed into the canal with cyanoacrylate. One millimeter of root apex was cut with diamond disk and teeth were mounted in wax. The apical cross-sections were viewed under the stereomicroscope 30× magnification (Figs 1A to E). The maximum apical file diameters and root canal diameters



Figs 1A to E: Stereomicroscope pictures of transverse sections of root canals at the WL with the IAF fixed in the root canal to show the discrepancies of root canal diameter and the diameter of IAF: (A) Protoper files, (B) Gates Glidden drills, (C) Galaxy files, (D) without preflaring, (E) race files

Table 1: Discrepancy between canal and the file diameter ($\times 10^{-2}$ mm)

Groups	*Mean*	*Standard deviation*	*95% confidence interval*
No preflaring	13.3	1.31	10.3-16.2
Gates Glidden drills	10.8	1.24	7.9-13.6
Protaper files	5.9	0.97	3.7-8.09
Race files	4.5	0.70	2.9-6.09
Galaxy files	7.9	1.03	5.7-10.1

were recorded for each canal (Table 1). The readings were subjected to analysis of variance test and Scheffe's multiple comparison test to compare between the groups ($p < 0.05$).

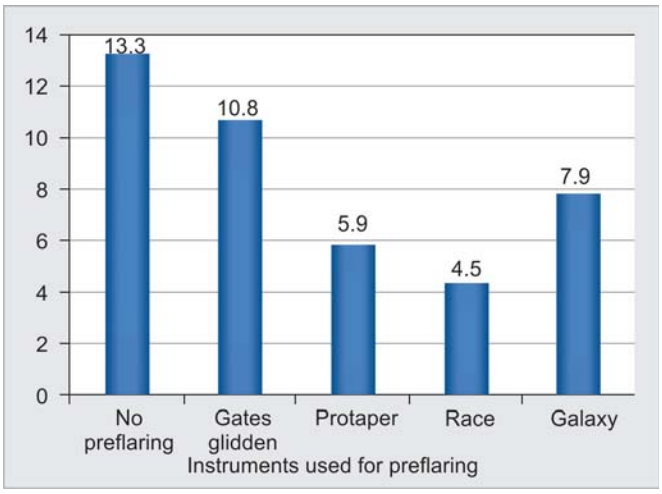
RESULTS

Flaring of cervical and middle-third of root canal and the type of instruments had a significant effect on apical size estimate. Preflaring with Race instruments lead to most accurate determination of the IAF. It was followed by Protaper, Galaxy files and Gates Glidden drills.

The Race instruments had lowest discrepancy ($4.5 \pm 0.70 \times 10^{-2}$mm), Protaper ($5.9 \pm 0.97 \times 10^{-2}$mm), Galaxy diamond files ($7.9 \pm 1.03 \times 10^{-2}$mm) and Gates Glidden drills ($10.8 \pm 1.24 \times 10^{-2}$ mm) showed greater discrepancies between the IAF diameter and the apical root canal diameter whereas the highest discrepancy was seen in the group without preflaring ($13.3 \pm 1.31 \times 10^{-2}$mm). No significant differences were found between Race, Protaper and Galaxy file groups ($p < 0.05$; Graph 1).

DISCUSSION

Clinicians typically begin shaping by placing a file to the apex and determine the apical diameter of root canal. From this procedure, they make judgments that determine the extent of apical shaping and how much canal space must be enlarged.[15] One recommended approach is that the amount of apical enlargement should be three file sizes greater than the first file that fits at the apex (Grossman et al 1988, Ingle et al 1994, Torabinejad 1994, Walton and Rivera 1996, Weine 1996). The present and previous studies have shown that the IAF is underestimated without cervical preflaring of the root canal. This information suggests that canal interference and curvature are a factor in the clinician's ability to sense the apical diameter with a file. Thus, this concept of enlarging the canal is not based on scientific evidence (Wu et al 2002) and will not guarantee removal of infected dentine from the canal walls.



Graph 1: Mean discrepancy between canal and the file diameter ($\times 10^{-2}$ mm)

Early flaring regardless of the method used removes the cervical and middle-third interferences, opens the space, and reduces file contact; thus a file progresses more easily toward the apex after flaring. Thus, the discrepancy of the diameter of IAF and the initial apical diameter is reduced.[7,10,11,13,16,17] This better sense of apical diameter provides information that should result in better control of biomechanical preparation.

There are untouched surface areas at the apical region after root canal preparation, regardless of the preparation technique.[18,19] Underestimation of the initial apical root canal diameter will leave a greater portion of untouched surface areas at the apical region. Using larger size files for instrumentation will lead to an adequate cleaning of the apical canals.[20,21]

Early flaring offers several clinical advantages. It not only allows better sense of apical constriction and diameter but also facilitate cleaning by allowing the irrigant to work deeper, more quickly and more effectively into the apical third region (Ram 1977).[22] Apical shaping is easier when flaring is used because only the apical one-third remains unshaped. Preflaring of root canal would be advantageous for all teeth, no matter the tooth type because interfering contacts can exist in any canal.[15]

According to the results of this study, preflaring with Race instruments lead to most accurate determination of the IAF, followed by Protaper, Galaxy files and Gates Glidden drills.

The Gates Glidden drills are inexpensive, safe and clinically beneficial tools but these conventional stainless steel instruments may lead to stripping and transportations. Protaper instruments embody two new concepts. Firstly, cross-section instruments do not have a U-file design and secondly, the instrument shaft has variable taper along its cutting surface. This concept minimizes the number of instruments per set and is claimed to decrease tortional loads by reducing the friction thereby increasing cutting efficiency.[23]

Rotary Ni-Ti instruments used for preflaring vary in terms of ISO and taper. Because of the different characteristics of the instruments, each system has its own preparation technique. Analyzing the data of this study, the accuracy of IAF determination is obviously depending on the taper of instruments used for cervical flaring. Using larger tapered instruments (Race) leads to most accurate determination of the actual root canal diameter by the IAF.[1]

The recently introduced Galaxy diamond files have safe guided tip and claims less aggressive cutting than Ni-Ti instruments. Further studies and research is required to evaluate the efficiency of this instrument.

CONCLUSION

- Traditional method of apical size determination may lead to a substantial underestimation of actual canal size.
- Cervical preflaring increases the accuracy of apical size determination.
- Preflaring techniques differ in the accuracy of measuring the initial apical diameter.
- Race instruments leads to the best results in apical size determination followed by Protaper, Galaxy files and Gates Glidden drills.

CLINICAL SIGNIFICANCE

Cervical preflaring is recommended before selection of IAF as it eliminates the cervical dentinal projections and increases the accuracy of apical size determination. Thus accurate estimation of endodontic working width at the apex will ensure adequate apical enlargement required for successful endodontic treatment.

ACKNOWLEDGMENT

The author would like to thank the Department of Oral Pathology, KLE Institute of Dental Sciences for their technical support.

REFERENCES

1. Tennert C, Herbert J, Altenburger MJ, Wrbas K-T. The effect of cervical preflaring using different rotary nickel-titanium systems on the accuracy of apical file size determination. J Endod 2010;36:1669-72.
2. Adorno CG, Yoshioka T, Suda H. The effect of root preparation technique and instrumentation length on the development of apical cracks. J Endod 2009;35:389-92.
3. Jou Y-T, Karabucak B, Levin J, Liu D. Endodontic working width: Current concepts and techniques. Dent Clin N Am 2004;48:323-35.
4. Walton RE. Histological evaluation of different methods of enlarging pulp canal space. J Endod 1976;2:304-11.
5. Jacobson SJ, Westphalen VP, da Silva Neto UX, Fariniuk LF, Picoli F, Carneiro E. The accuracy in the control of the apical extent of rotary canal instrumentation using Root ZX II and Protaper instruments an in vivo study. J Endod 2008;34:1342-45.
6. Grossmann LI, Oliet S, Del Rio CE. Preparation of root canal: Equipment and technique for cleaning, shaping and irrigation. Endodontic Practice 1988;1:179-222.
7. Pecora JD, Capelli A, Guerisoli DMZ, Spano JCE, Estrela C. Influence of cervical preflaring on apical file size determination. Int Endod J 2005;38:430-35.
8. Leeb J. Canal orifice enlargement as related to biomechanical preparation. J Endod 1983;9:463-70.
9. Philippas GG. Influence of occlusal wear and age on formation of dentin and size of pulp chamber. J Dent Res 1961;40:1186-98.
10. Adam Stabholz, IIan Rotstein, CD, Mahmaud Torabjenad. Effect of preflaring on tactile detection of the apical constriction. J Endod 1995;21:92-94.
11. Schmitz Mda S, Santos R, Capelli A, et al. Influence of cervical preflaring on determination of apical file size in mandibular molars: SEM analysis. Braz Dent J 2008;19:245-51.
12. Guilherme Siqueira IBELLI, juliana Machado BARROSO, Alexandre CAPELLI, Júlio César Emboava SPANÓ, Jesus Djalma PÉCORA. Influence of cervical Preflaring on apical file size determination in maxillary lateral incisors**.** Braz Dent J 2007;18:102-06.
13. Barroso JM, Guerisoli DMZ, Capelli A, Saquy PC, Pécora JD. Influence of cervical preflaring on determination of apical file size in maxillary premolars: SEM analysis. Braz Dent J 2005;16:30-34.
14. Vanni JR, Santos R, Limongi O, Guerisoli DM, Capelli A,Pecora JD. Influence of cervical preflaring on determination of apical file size in maxillary molars: SEM analysis. Braz Dent J 2005;16:181-86.
15. Contreras MAL, Zinman EH, Kaplan SK. Comparison of the first file that fits at the apex, before and after early flaring. J Endod 2001;27:113-16.
16. Weiger R, Bartha T, Kalwitzki M, Lost C. A clinical method to determine the optimal apical preparation size. Part I. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006;5:686-91.
17. Bartha T, Kalwitzki M, Lost C, Weiger R. Extended apical enlargement with hand files versus rotary NiTi files. Part II. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006;5: 692-97.
18. Paqué F, Balmer M, Attin T, Peters OA. Preparation of oval shaped root canals in mandibular molars using nickel-titanium rotary instruments: A microcomputed tomography study. J Endod 2010;36:703-07.
19. Paque F, Ganahl D, Peters OA. Effects of root canal preparation on apical geometry assessed by microcomputed tomography. J Endod 2009;35:1056-59.
20. Wu MK, Wesselink PR. Efficacy of three techniques in cleaning the apical portion of curved root canals. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1995;79:492-96.
21. Card SJ, Sigurdsson A, Orstavik D, Trope M. The effectiveness of increased apical enlargement in reducing intracanal bacteria. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2002;28:779-83.
22. Tan BT, Messer H. The effect of instrument type and preflaring on apical file size determination. Int Endod J 2002;35:752-58.

23. Peters OA, Peters CI, Schonenberger K, Barbakow F. ProTaper rotary root canal preparation: Effect of canal anatomy on final shape analyzed by micro-CT. Int Endod J 2003;36:86-92.

ABOUT THE AUTHORS

TS Ashwini

Professor, Department of Conservative Dentistry and Endodontics Maratha Mandal's NGH Institute of Dental Sciences and Research Center, Belgaum, Karnataka, India

Sonam Bhandari

Postgraduate, Department of Conservative Dentistry and Endodontics Maratha Mandal's NGH Institute of Dental Sciences and Research Center, Belgaum, Karnataka, India

CORRESPONDING AUTHOR

TS Ashwini, Professor, Department of Conservative Dentistry and Endodontics, RS No. 47/2, Bauxite Road, Near APMC Ground Belgaum-590010, Karnataka, India, e-mail: drashts2000@yahoo.co.in