Braz Dent J (2005) 16(1): 30-34 ISSN 0103-6440

Influence of Cervical Preflaring on Determination of Apical File Size in Maxillary Premolars: SEM Analysis

Juliana Machado BARROSO
Danilo M. Zanello GUERISOLI
Alexandre CAPELLI
Paulo César SAQUY
Jesus Djalma PÉCORA

Department of Restorative Dentistry, Faculty of Dentistry of Ribeirão Preto, University of São Paulo, Ribeirão Preto, SP, Brazil

The purpose of this study was to investigate the influence of cervical preflaring on the determination of the first file that binds at working length (WL) in buccal roots of maxillary premolars. Five groups (n=10) were formed at random and, after standard access cavities, the WL was determined 1 mm short from the apex. In group 1, the initial apical file was inserted without preflaring of cervical and middle thirds of the root canals. In groups 2 to 5, the cervical and middle thirds were enlarged with sizes 90 and 110 Gates-Glidden drills, K^3 Orifice Opener instruments, ProTaper instruments and LA Axxess burs, respectively. Canals were sized manually with K-files, starting with #08 K-files inserted passively up to the WL. File sizes were increased until a binding sensation was felt at the WL and the size of the instrument was recorded. Transversal sections of the WL regions were examined under scanning electron microscopy and the discrepancies between the canal diameter and first file to bind at the WL were assessed. Significant differences ($p<0.001$) were found between the groups. The major discrepancy was found without preflaring (mean 157.8 µm). LA Axxess burs produced the smallest discrepancy (mean 0.8 µm). Gates-Glidden drills and K^3 Orifice Opener instruments showed no significant differences ($p>0.05$) between their results (83.2 µm and 73.6 µm, respectively). The discrepancy for ProTaper instruments was 35.4 µm on average. In conclusion, the instrument binding technique for determination of the anatomical diameter at the WL was not precise. Preflaring of the cervical and middle thirds improved the determination of the anatomical diameter at the WL, and the type of instrument played a major role. Canals preflared with LA Axxess burs showed a more accurate binding of the files to anatomical diameter.

Key Words: apical file size determination, coronal preflaring, instrument type.

INTRODUCTION

Successful endodontic therapy depends on effective cleaning, shaping and disinfection of root canals prior to obturation. Some authors suggest that the amount of apical enlargement to be achieved during shaping of the canals should be based on the estimation of the initial apical diameter and instrumentation should be done up to three file sizes greater than the first file that fits at the apex (1-5).

The detection of the apical constriction and determination of the first file that binds at the working length (WL) are guided by the operator's tactile sense. This premise is based on an assumption that the root canal is narrower in the apical portion and the file would therefore pass without interference until this region (6).

Continuous and progressive dentin formation in the pulp space narrows root canal diameter, mainly at the cervical third (7). Wu et al. (8) reported that determination of the anatomical diameter based solely on the clinician's ability to detect the apical narrowing by tactile sense is an empirical and inaccurate method. Tan and Messer (6) stated that traditional methods for determination of the anatomical diameter at the apical third have underestimated the real diameter of this region.

Enlargement of the cervical and middle thirds of root canals yields a more accurate assessment of the

Correspondence: Prof. Dr. Jesus D. Pécora, Departamento de Odontologia Restauradora, Faculdade de Odontologia de Ribeirão Preto, USP, Av. do Café, S/N, 14040-904 Ribeirão Preto, SP, Brasil. Tel: +55-16-602-3982. Fax: +55-16-633-0999. e-mail: pecora@forp.usp.br

real anatomical diameter of the apical constriction (6,9-11).

The purpose of this study was to evaluate the influence of cervical preflaring performed with different rotary instruments on determination of the first file that binds at working length (WL) in buccal roots of maxillary premolars.

MATERIAL AND METHODS

Fifty human maxillary premolars with complete root formation, obtained from stock of the Endodontics Research Laboratory of the Faculty of Dentistry of Ribeirão Preto, University of São Paulo, were used in this study. The teeth were kept in 0.1% thymol solution at 9°C, from where they were taken 24 h before use and placed under running water to eliminate traces of thymol.

Standard access to pulp chamber was performed and specimens were immersed in 5.25% sodium hypochlorite under vacuum for 15 min to dissolve pulp remnants from the root canals. Teeth were washed and irrigated with distilled water to eliminate sodium hypochlorite, and the buccal canal of each tooth was explored using a size 06 K-file (Dentsply/Maillefer, Ballaigues, Switzerland) until the apical foramen was reached and the tip of the file was visible exiting the foramen. The actual canal length was determined and working length was established at 1 mm from the root apex.

Teeth were randomly assigned to five groups (n=10). Group 1 received the initial apical instrument without previous preflaring of the buccal root canal.Group 2 had the cervical and middle thirds of the buccal root canal enlarged with Gates-Glidden drills sizes 90 and 110 (Dentsply Maillefer). The length of this preflaring was determined by the resistance felt in the middle portion of the canal. Group 3 had the cervical portion of the buccal root canal enlarged with nickel-titanium K^3 Orifice Opener instruments sizes 25/.08 and 25/.10 (SybronEndo, Glendora, CA, USA), 5 mm short of the working length. ProTaper instruments SX and S1 (Dentsply Maillefer) were used 5 mm short of the working length to enlarge the cervical and middle portions of buccal canals of Group 4. Titanium-nitrite treated, stainless steel LA Axxess burs (SybronEndo) sizes 20/.06 and 35/.06 were used for preflaring the cervical and middle aspects of root canals in Group 5, until resistance was felt in the middle portion of the canal.

K^3 Orifice Openers and ProTaper instruments were used at 300 rpm, while Gates-Glidden and Axxess burs were used at 10,000 rpm. Irrigation with 2 mL of 1% sodium hypochlorite between instruments was performed during the preflaring of all canals, with a final flush of 5 mL of this solution. A final rinse with 10 mL of distilled, deionized water was done. The irrigating solutions were delivered with blunt tip, 31 gauge Endo-Eze irrigation needles (Ultradent Products Inc., South Jordan, UT, USA).

Root canals were instrumented manually using K-files (Dentsply/Maillefer), starting with size 08 files until the WL was reached. The size of the files progressively increased until obtaining an instrument that bound at the WL (binding file), and the file size was recorded for each tooth. The handles of the files had been painted in black to avoid identification, thus the operator was unaware of the file size used until a binding sensation was felt at the WL.

After apical file size determination, the files were fixed into the canals at the WL with methyl cyanoacrylate. Teeth were then sectioned transversally 1 mm from the apex, with the binding file in position. The apical region was observed under scanning electron microscopy (X100 magnification) and images were recorded digitally.

The analysis of the images was performed on a computer using the free UTHSCSA ImageTool program (developed at the University of Texas Health Science Centre at San Antonio, TX, USA and available from the Internet by anonymous FTP from ftp://maxrad6.uthscsa.edu). Root canal and binding file maximum diameters were recorded for each specimen. The discrepancy between these diameters was measured and the results of each group were submitted to statistical analysis. The measurements corresponding to the anatomical diameters of the root canals were also analyzed statistically.

Data were submitted to one-way ANOVA to examine whether the root canals from the different groups were similar and to assess the effect of the preflaring techniques on the discrepancies found between the diameter of the binding instruments and root canals. Statistical analysis was performed at the 0.05 significance level, using the GraphPad Prism version 4.00 for Windows (GraphPad Software, San Diego, CA, USA, available at www.graphpad.com).

RESULTS

The measurements (means ± SD) of the anatomical diameters of the canals from the different experimental groups are given in Table 1.

Statistical analysis revealed no significant differences ($p>0.05$) among the anatomical diameters of the root canals at the working length, which indicates that the specimens were drawn from the same population and validates the experimental model.

Differences between canal size and binding file diameter are shown in Table 2. Analysis of variance revealed statistically significant differences ($p<0.001$) among the groups with respect to discrepancies between anatomical diameter at working length and the size of the first file to bind at the WL. Post-hoc comparisons among the groups were done with Tukey's (HSD) test.

The greatest discrepancy was found in Group 1 (nonflared canals) (Fig. 1). Gates-Glidden drills and K^3 Orifice Opener instruments showed no statistically significant differences ($p>0.05$) between their results (Figs. 2 and 3). ProTaper instruments had lesser discrepancy values than Gates-Glidden drills and K^3 Orifice Opener and greater discrepancy than LA Axxess burs (Fig. 4). LA Axxess burs produced the smallest differences between the anatomical diameter and the diameter of the binding file (Fig. 5).

DISCUSSION

Root canal enlargement aims to provide sufficient space to act as a reservoir for irrigation, remove the superficial layer of infected dentin and produce a shape that facilitates sealing. Siqueira et al. (12) and Card et al. (13) reported that bacterial population in the root canal system might be mechanically reduced by instrumentation.

In general, the classic parameter for enlargement of the apical region at working length is still the use of three file sizes greater than the first file that fits at the apex (1-5). However, determination of the real anatomical diameter at working length is difficult when no preflaring is performed. The accuracy of this procedure may be enhanced when anatomical diameter determination is performed after flaring (6,9,11,14).

The use of scanning electron micrography in the present study yielded an accurate measurement of the discrepancies between canal size and binding file diameter.

K-files introduced in the canal before any flaring of cervical and middle thirds presented the greatest diameter discrepancy (157.8 µm on average) when compared to the other experimental groups. Preflaring allowed an increase of instrument size binding at the working length, which resulted in lower discrepancy values between file and anatomical diameter. These findings are consistent with those of previous studies (6,9,11,14).

Preflaring of the cervical and middle thirds of the root canal must be performed to enhance the determination of canal diameter at the apical constriction. This allows a more accurate estimation of the true anatomical diameter and may avoid leaving portions of canal walls untouched.

Based on the findings of this study, the following conclusions may be drawn: The instrument binding technique for determining anatomical diameter at working length is not precise; preflaring of the cervical and middle thirds improved the determination of the anatomical diameter at the WL, and the type of instrument played a major role in this procedure; canals preflared

Table 1. Anatomical diameters (µm) at the working length of the root canals for the different groups.

Preflaring techniques	Mean ± SD	Range	95% CI
No flaring	358 ± 40	289-427	330, 387
Gates-Glidden drills	355 ± 33	302-410	331, 379
K^3 Orifice Openers	353 ± 27	308-393	334, 373
ProTaper instruments	354 ± 44	300-424	323, 385
Axxess burs	357 ± 39	294-404	329, 385

CI = confidence interval.

Table 2. Discrepancies (µm) between the diameters of the binding files and canals at the working length, for the different groups.

Preflaring techniques	Mean ± SD	Range	95% CI
No flaring	157.8 ± 29.7	102-198	136.6, 179.0
Gates-Glidden drills	83.2 ± 30.8	34-126	61.2, 105.2
K^3 Orifice Openers	73.6 ± 25.0	41-121	55.7, 91.5
ProTaper instruments	35.4 ± 15.3	13-53	24.5, 46.3
Axxess burs	0.8 ± 0.8	0-2	0.2, 1.4

CI = confidence interval.

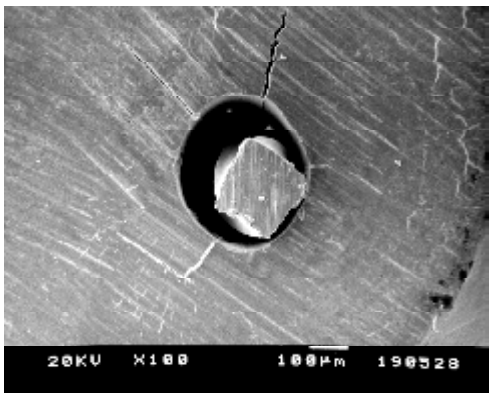

Figure 1. SEM micrograph of Group 1 (no cervical and middle preflaring). Transverse section at the working length.

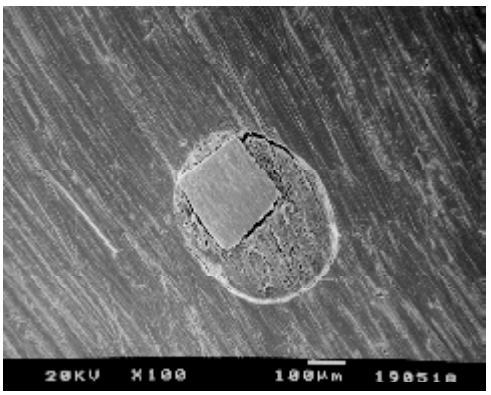

Figure 2. SEM micrograph of Group 2 (cervical and middle preflaring with Gates-Glidden drills). Transverse section at the working length.

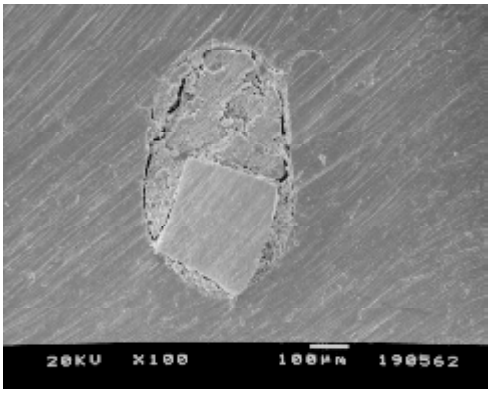

Figure 3. SEM micrograph of Group 3 (cervical and middle preflaring with K[3] Orifice Opener instruments). Transverse section at the working length.

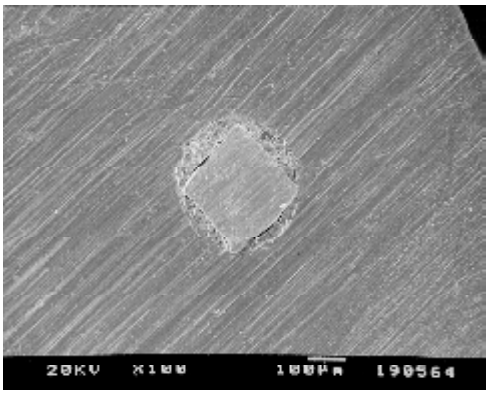

Figure 4. SEM micrograph of Group 4 (cervical and middle preflaring with ProTaper SX and S1 instruments). Transverse section at working length.

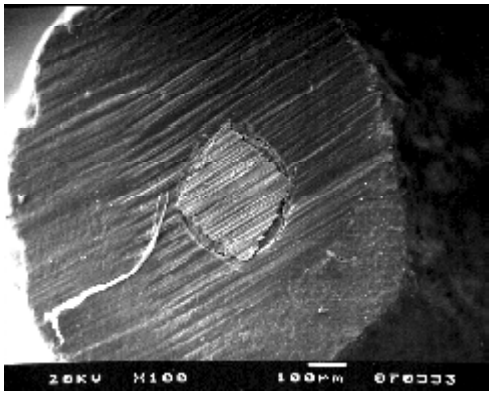

Figure 5. SEM micrograph of a specimen in Group 5 (cervical and middle preflaring with LA Axxess burs). Transverse section at working length.

with LA Axxess burs showed the lowest discrepancy between file size and anatomical diameter, and therefore a more accurate binding of the files at the working length.

RESUMO

O objetivo deste estudo foi avaliar a influência do pré-alargamento cervical na determinação do instrumento apical inicial em raízes vestibulares de pré-molares superiores. Foram selecionados 50 primeiros pré-molares superiores apresentando duas raízes. Após a cirurgia de acesso e determinação do comprimento de trabalho 1mm aquém do ápice, os dentes foram divididos aleatoriamente em 5 grupos distintos, de acordo com o tipo de alargamento realizado no terço cervical e médio de cada canal: Grupo 1- sem alargamento cervical; Grupo 2 – brocas Gates-Glidden (90, 110); Grupo 3 – instrumentos K[3] Orifice Openers;

Grupo 4 – instrumentos ProTaper; Grupo 5 – brocas LA Axxess. Os canais foram explorados com uma lima tipo K inserindo-se passivamente uma lima 08 no comprimento de trabalho. Limas de diâmetros maiores foram sucessivamente introduzidas no canal radicular até obter a sensação de travamento no comprimento de trabalho, e o diâmetro desse instrumento foi registrado. As secções transversais realizadas no comprimento de trabalho foram observadas por microscopia eletrônica de varredura e a diferença entre o menor diâmetro do canal e o diâmetro do instrumento apical inicial foi calculada para cada amostra. Houve diferença estatisticamente significante entre os grupos experimentais ($p<0,001$). A maior discrepância foi revelada pelo grupo em que não realizou-se o pré-alargamento (média: 157.8 µm). As brocas LA Axxess proporcionaram a menor diferença entre o diâmetro anatômico e o instrumento apical inicial (média: 0.8 µm). As brocas Gates-Glidden e os instrumentos Orifice Opener foram estatisticamente semelhantes (média: 83.2 µm e média: 73.6 µm, respectivamente). Os instrumentos ProTaper apresentaram uma média de 35.4 µm para os valores de discrepância. Pode-se concluir que a técnica de determinação do instrumento apical inicial não é precisa. O pré-alargamento dos terços cervical e médio do canal torna mais fiel a determinação do diâmetro anatômico no comprimento de trabalho. O pré-alargamento do canal realizado com brocas LA Axxess evidenciaram maior precisão do travamento das limas no diâmetro anatômico**.**

REFERENCES

1. Grossman LI, Oliet S, Del Río CE. Preparation of the root canal: equipment and technique for cleaning, shaping and irrigation. In: Grossman LI, Oliet S, Del Río CE (Editors). Endodontic Practice. 11th ed. Philadelphia: Lea & Febiger; 1988. p. 179-227.
2. Ingle JI, Bakland LK, Peters DL, Buchanan LS Endodontic cavity preparation. In: Ingle JI, Bakland LK (Editors). Endodontics. 5th ed. Malvern: Williams &Wilkins; 1994. p. 92-228.
3. Torabinejad M. Passive step-back technique. Oral Surg, Oral Med Oral Pathol 1994;77:398-401.
4. Walton RE, Rivera EM Cleaning and shaping. In: Walton RE, Torabinejad M (Editors). Principles and Practice of Endodontics. 2nd ed. Philadelphia: W.B. Saunders; 1996. p. 201-233.
5. Weine FS. Endodontic Therapy. 5th ed. St. Louis: Mosby; 1996.
6. Tan BT, Messer H. The effect of instrument type and preflaring on apical file size determination. Int Endod J 2002;35:752-758.
7. Wu MK, Barkis D, Roris A, Wesselink PR. Does the first file to bind correspond to the diameter of the canal in the apical region? Int Endod J 2002;35:264-267.
8. Philippas GG. Influence of occlusal wear and age on formation of dentin and size of pulp chamber. J Dent Res 1961;40:1186-1198.
9. Contreras MAL, Zinman EH, Kaplan SK. Comparison of the first file that fits at the apex, before and after early flaring. J Endod 2001;27:113-116.
10. Khan IU, Sobhi MB. Detecting the apical constriction in curved mandibular molar roots-preflared versus nonflared canals. J Ayub Med Coll Abbottabad 2003;15:47-49.
11. Pécora JD, Capelli A, Guerisoli DMZ, Spanó JCE, Estrela C. Influence of cervical preflaring on the apical file size determination. Int Endod J (in press).
12. Siqueira JF, Lima KC, Magalhães FAC, Lopes HP, Uzeda M. Mechanical reduction of the bacterial cell number inside the root canal by three instrumentation techniques. J Endod 1999;25:332-335.
13. Card SJ, Sigurdsson A, Orstavik D, Trope M The effectiveness of increased apical enlargement in reducing intracanal bacteria. J Endod 2002;28:779-783.
14. Leeb J Canal orifice enlargement as related to biomechanical preparation. J Endod 1983;9:463-470.

Accepted March 23, 2005