Original Article

The Effect of Using Patency File on Apical Transportation in Canals Prepared with Passive Step Back Technique

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ABSTRCT

Background: The purpose of this study was to assess the effect of patency file on apical transportation in curved canals prepared with passive step back (P.S.B) technique.

Methods: This is an interceptive experimental, Invitro, study. Human extracted first permanent molars with 19-23mm length and curvature of 15-35 degrees (Schneider method) were considered for use in this study. Simple sampling was done and 35 teeth for each group was selected. In experimental group A canal preparation was done with P.S.B technique and usage of a # 10 file (as Patency file) between successive files. In experimental group B preparation was done in the same way except for usage of patency file. Pre and post operative radiographs were taken with similar condition. Radiographs were scanned and changes in canal curvature was determined using four different methods [Schneider, Weine, Long – Axis techniques (L. A.T), and Digital image overlay technique (overlay. T)] , using Idrisi for windows and AutoCAD softwares.

Results: The mean of canal transportation angle in experimental group A with Schneider, Weine , LAT, and Over Lay techniques was: 7.006 ± 3.478, 12. 285 ± 6.032, 4.376 ± 3.516, 3.147 ± 2.744 respectively. Mean of canal transportation angle in experimental group B with the same methods was also determined: 8.009 ± 4.178, 13.55 ± 7.602, 9.464 ± 5.384, and 9.641 ± 5.382 respectively. T- test statistical analysis shows that there are no significant differences between the mean of canal transportation angles in two groups as measured by Schneider and Weine method ($P>0.05$). Mann- Whitney test shows that there are statistically significant differences between two groups as measured by LAT and Over Lay techniques ($P<0.001$).

Conclusions: Results of this study shows that patency file in conjunction with P.S.B techniques causes significant reduction in apical transportation angle. Shortcomings of Schneider method in determination of canal curvature and specially assessment of apical transportation after instrumentation is mentioned in several studies. Our study shows that both Schneider and Weine techniques are not reliable methods for transportation assessment when compared with Image Over Lay technique. The result of LAT Shows close proximity with Over Lay technique and can be used for evaluation of apical transportation as a simple and reliable technique.

Keywords: Apical transportation, Passive step back, Apical patency, Schneider technique, Weine technique, Long axis technique, OverLay technique.

There is wide spread agreement among endodontists that cleaning and shaping [as described by Schneider in 1974] is the most important phase in endodontic therapy[1]. To emphasize the importance of this stage in endodontic therapy, it should be noticed that, chemicomechanical preparation of canal leads to healing process initiation in periodontal tissues by elimination of intra canal irritants[2].

It has often been said that, when a canal is properly prepared, a variety of filling materials or techniques would probably be successful[1, 2].

One of the most common methods for evaluation of canal shape, before and after instrumentation, is sectioning of the root in different levels, considering principles explained by Bramante[3] and assessing these sections with photography,

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microphotography, and even computed tomography. This procedure provides the possibility of direct viewing of canal shape and position in relation to the borders to the root surface.

Another commonly used technique for this purpose is to compare preoperative radiographs with intermediate and post instrumentation films[1]. The Schneider method is the primary technique used to measure canal angulation. This involves drawing a line parallel to the long axis of the canal in the coronal third. A second line is then drawn from the apical foramen to intersect, the point where the first line left the long axis of canal. The angle formed is then measured[1,4]. Weine referred to an alternative method for determining canal angulation. A straight line is drawn from the orifice through the coronal portion of the curve and a second line is drawn from the apex through the apical portion of the curve. The angle formed is then measured[1].

Hankins and ELDeeb developed another method for determining canal angulation. This method is called Long – Axis technique[1]. A line is drawn parallel to the long axis of tooth. The second line is the same as described for Weine method. The angle formed by these two intersecting lines is then measured (figure 1). This technique was developed in an attempt to measure more accurately the curvature in the apical portion of the canal, even as the coronal portion is straightened due to instrumentation.

Digital superimposition of radiographs (Overlay technique) which is used in our study in conjunction with other methods (which were mentioned above) is benefited by usage of very accurate software for Image superimposition (Overlay).

Several instrumentation techniques have been developed with the intent of creating an ideally shaped canal that follows the natural curvatures of root canals. These include the Step-Back techniques used in conjunction with anti curvature Filing[5], the Step-Down technique[6], Crown-Down pressureless technique[7], and Balanced–Force technique[8].

Passive Step Back technique[9] uses a combination of hand and rotary instruments to provide an unforceful and gradual enlargement of root canals in an apical coronal direction. In addition, it is applicable in every canal type, easy to master, and reduces procedural accidents. Maintaining canal patency is very important in each of cleaning and shaping techniques, although, the methods of creating and maintaining canal patency is controversial[10,11,12], Considering that apical patency , has the potential effect for reducing the risk of canal blockage, ledge formation, and perforation. In addition, enhancement of access to apical tissues and facillitation of periapical drainage within the root canal is anticipated.

The purpose of this study was two- fold: to evaluate the effect of using patency file on apical transportation of canal prepared with P.S.B technique , and to compare Schneider, Weine and, LAT methods with digital image Overlay technique in distinguishing apical transportation angle.

Materials and Methods

Selection and preparation of teeth

Seventy mesial canals of human extracted permanent first molars were chosen for this study. The teeth were maintained in 100% humidity. Canals which their length from mesiobuccal cup tip to the apex was 19-23 millimeters were selected.

In addition, after preparing access cavity and radiographic determination of working length, only canals with curvature of 15-35 degrees (as determined by Schneider method) with a snug fit of either # 10 or # 15 k-file were included.

Samples which had all the above mentioned conditions were randomly assigned into two groups. For maxillary first molars, palatal root was resected to prevent radiographic superimposition. With high-speed handpiece and No.169 bur, small holes with 1mm depth were created on the crown and distal root of selected teeth; holes were then filled with Amalgam. This procedure leads to formation of fixed radio opaque points on the obtained radiographs and are extremely useful for digital image overlay technique.

Methods of tooth mounting

Self–cured acrylic resin was used for tooth mounting. The tip of mesial root sealed With wax before mounting to provide the possibility of using pantency file. Special metal boxes were formed in dimensions similar to the standard periapical film. Acrylic resin was poured in these

boxes and teeth were vertically mounted in. With attention to the description of LAT, the importance of perpendicular placement of samples in acrylic blocks will be better understood. If this is not done well, the line drawn parallel to the lateral side of acrylic block, can not be accepted as the long axis of mounted tooth.

In an attempt to be sure about perpendicular placement of the teeth, vertical grooves were prepared on different sides of mounting boxes. We also prepared Similar grooves on buccal and mesial sides of tooth crown. These grooves were held parallel to each other during mounting procedure.

Radiographic procedures

All radiographs were taken at 0.58 S at 70 kvp and 15 mA, with the buccal surface of the tooth facing upward. AGFA E-Speed intra oral films (made in Belgium) were utilized.

The distance between X-ray source and periapical film was kept unchangable (14 inches) by using an additional localizator which is in contact with short cone X- ray tube. This is clear that, increasing the distance between X-ray source and object will decrease the geometric properties of final radiographs, specially magnification[13].

Determination of canal curvature

After preparation of access cavity, a 15# file was placed 0.5-1 mm short of radiographic apex for working as length determination. Obtained radiographs were digitized using Genious color page HR6X Scanner, then with AutoCAD software and by using the mentioned definitions (figure 1), Schneider, Weine, and LAT angles were measured and registered as preoperative canal curvature.

After canal preparation was completed, a # 25 file (unused master apical file) was inserted to the working length and second (final) radiographs were taken in absolutely similar conditions. All of the above measurements was done on the latter image and the difference between pre and post instrumentation angles were calculated.

Image digital overlay technique

Digital images of pre and post operative radiographs were superimposed using Idrisi for windows 2.0 software. This software can compare and overlap different images of the same object, if there are at least four distinct and unchangable point on both images. In fact , each of these graphic images will convert into certain columns and rows, producing unique mathematical coordinates (x,y) for each of opaque points on the radiographic images. At this time, two pictures will over lap around these fixed opaque points.

Finally, picture contrast was adjusted with PhotoShop 6 software (figure 2) and apical transportation angle was calculated with AutoCAD.

Canal instrumentation

After working length was determined, canals of first experimental group(A) were prepared with Passive Step Back technique with # 15-40 k-type steel files (MANI, Japan). #20,25,30,35 and 40 files were inserted passively into canals. Passive canal instrumentation was done and a number 10 steel file with 1/4 to 1/8 rotational movement was inserted one millimeter beyond working length (as patency file). Sodium hypochlorite was used as irrigating solution. This procedure was repeated until a # 25 steel file reached passively to the working length and # 30, 35 and 40 files reached 1,2,and 3 millimeters short of working length, respectively.

In the second group (experimental groupB) canal preparation was done in similar manner except that the patency files was not used. Rotary instruments were excluded in this study because coronal enlargement results in significant changes in the amount of Schneider and Weine angles which lead to misinterpretation as apical transportation[1]. Thus, minimal coronal enlargement which allows passive access to apical area was performed.

It should be noticed that every five canals were instrumented by a new package of stainless steel k- type files. On the other hand, just five canals instrumented per day to minimize the effects of operator fatigue on final outcome. Pre curving and anticurvature filing were also considered.

Results

Mean and standard deviation of apical transportation angle in experimental groups with four different measurement techniques are shown in table 1. With all measurement techniques, the mean apical transportation angle in experimental group A is less than experimental group B but this difference isn't statistically significant in Schneider

and Weine methods (P>0.05). On the other hand, there is significant difference between experimental group A and experimental group B results , as measured by LAT and Overlay techniques.
Fridman statistical analysis shows that there are significant differences between the results of Schneider and Weine methods and Overlay technique (P<0.001) But differences between LAT and Overlay methods are not Significant (P>0.05).
In experimental group A, Weine technique shows largest (12.285 ± 6.032) and the Overlay technique shows the smallest (3.147 ± 2.744) amount of canal transportation. In experimental group B, the result of Weine method shows significant difference in comparison with the other approaches (P<0.001).

Discussion

Angle of canal curvature is calculated before and after canal instrumentation with three measurement techniques (Schneider, Weine, LAT). True apical transportation angle is also determined with digital image overlay technique. Data analysis shows the shortcomings of Schneider method in measuring canal curvature and specially post instrumentation changes in the apical area. It is apparent that some canals with a seemingly high amounts of curvature are not approaching the anticipated degrees of angulation as measured by Schneider technique.

This result is in accordance with the results of Hankins and ELDeeb study. This is specially evident in canals which have gradual curvature in coronal two- thirds and a sharp dilaceration in the apical one-third[1]. It is easily evident that Schneider method is completely affected by coronal enlargement as mentioned in the above study. Although Weine technique shows the initial canal curvature better than Schneider method, but because of its dependence on coronal segment of canal, it is not appropriate for assessment of apical area.

Our study showed that Long Axis technique is an accurate method for assessment of apical transportation as compared with the essential method of assessment (overlay).

Rother than the Schneider method, the LAT is more sensitive to these changes. This is mainly because the LAT shows changes in canal curvature in the apical portion only, whereas the Schneider and Weine techniques are also affected by changes of canal position coronally. Another noticeable point is the amount of apical transportation (in degrees) in the experimental group B as measured by Overlay technique (9.641 ± 5.382). degrees of canal straightening shows that stainless steel files tend to straight curved canals and this event occurs frequently. Usage of patency file and its passive passage through apical constriction prevents canal blockage without enlarging this constriction and results in significant reduction of transportation angle. Buchanan (1989) advocated the use of patency file in canal preparation in order to enhancing the apical seal. In fact, patency file makes the apical area devoid of remaining debries and reshape this region. He recommended the use of a #15 file as patency file, while Fairbourn prefered to use a #10 file for this purpose[14]. It should be noted that, patency file can reduce the amount of smear layer. It has been claimed that in the absence of this layer, perhaps stronger junction between filling material – sealer with dentin wall of the canals is established[12]. In a recent study by Goldberg and Massone , the effects of using patency file in apical canal transportation was adressed. # 10 to # 25 steel and NiTi files were used in maxillary lateral incisors as patency files. Results of this study showed no significant differences in the amount of apical transportation in relation to the file type. More than half of the samples showed some degrees of transportation that can be attributed to # 25 file (too large) for apical patency in curved canals[15].

Finally, it could be said that although ideal shape of canal preparation is hardly achieved in severely curved canals, but considering some of simple principles of cleaning and shaping such as keeping canal patency during instrumentation, the final outcome can be close to ideal.

The mean canal angulation changes measured with these different methods were significantly different with each other (P<0.001).

In experimental group A , mean of canal transportation angle is less than experimental group B. This difference is not statistically significant in Schneider and Weine methods (P>0.05). In LAT and Overlay techniques , differences between two groups are significant (P<0.001). Fi-

nally it can be said that under the conditions of this study, using patency file in conjunction with P.S.B technique causes significant reduction in the amount of canal transportation in apical area.

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Table 1. Comparison of canal transportation angle in experimental groups with four different measurement techniques. Data are mean ± SD.

	Experimental group	
Method of measurement	A	B
Schneider	7.006 ± 3.478	8.009 ± 4.178
Weine	12.285 ± 6.032	13.550 ± 7.602
LAT	4.376 ± 3.516*	9.646 ± 5.384
Over lay	3.147 ± 2.744*	9.641 ± 5.382

* P < 0.001 compared to group B

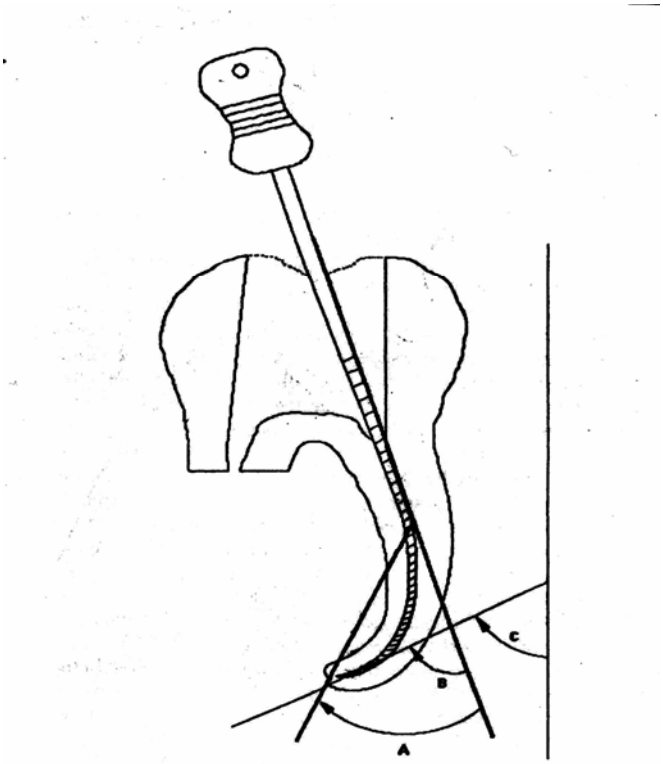

FIG 1. Schneider technique (*A*), Weine technique (*B*), and LAT (*C*) for determination of canal curvature.

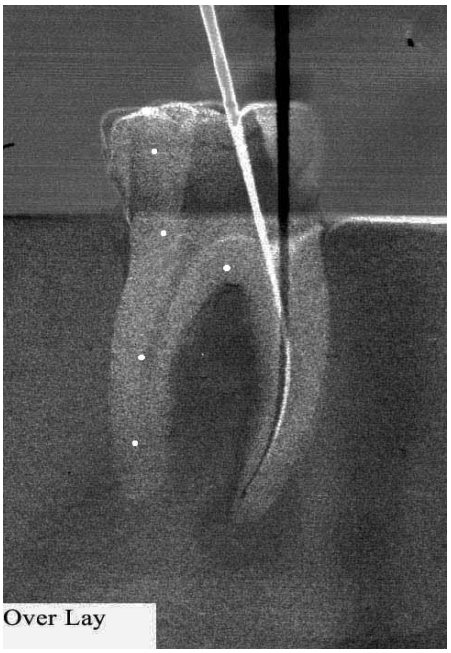

Figure 2. Digital superimposed position or overlap of initial file and master apical file images.

References

1. Hankins P,ELDeeb M. An evaluation of the Canal Master, Balanced-Force and Step Back techniques. JoE. 1996; 22: 123-130.
2. Weine FS. Endodontic therapy, ed 5. St Louis: Mosby, 1996: 335-394.
3. Bramante CM. Berbert A. Borges RP. A methodology for evaluation of canal instrumentation. JoE, 1987; 13: 243-45.
4. Schneider S. A comparison of canal preparation in straight and curved root canals. Oral Surg, 1971; 32: 271-7.
5. Abou-Rass M, Frank A, Glick D. The anticurvature filing method to prepare the curved root canal. J Am Dent Assoe 1980; 101: 792-4.
6. Goerig A, Michelich R, Schultz H. Instrumentation of root canals in molars using the step-down technique. JoE, 1982: 8: 550-4.
7. Morgan L. Montgomery S. An evaluation of the crown-down pressureless technique. JoE, 1984; 10: 491-8.
8. Roane J, Sabala C, Duncanson M. The "balanced force" concept for instrumentation of curved canals. JoE, 1985; 11: 203-211.
9. Torabinejad M. Passive step back technique. Oral Surg Oral Med Oral Pathol. 1994; 77: 398-401.
10. Walton RE, Torabinejad M. Principles and Practices of Endodontics, 3rd ed. Philadelphia: Saunders, 2002, p 206-239
11. Flanders DH. Endodontic patency. How to get it. How to keep it. Why it is so important. N Y State Dent J. 2002; 68: 30-2.
12. Cohen S, Burns RC. Pathways of the Pulp. 8th ed. Mosby Inc, 2002, p 231-291.
13. White SC, Pharoah MJ. Oral Radiology, Principles and Interpretation. 4th ed. Mosby Inc, 2000, p 83 – 91
14. Buchanan LS. Management of the curved root canal. J Calif Dent Assoc. 1989; 17:18-25
15. Goldberg F, Massone EJ. Patency file and apical transportation: an in vitro study. J Endod. 2002; 28: 510-1.