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The effect of canal size on the penetration depth of endodontic irrigants

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ABSTRACT

Aim: To evaluate the effectiveness of canal size change on the penetration level of endodontic irrigant solution. **Materials and Method:** Five canals of different sizes (20, 25, 30, 35 and 40) were tested by preparing Class I cavity in the apex. Paper point was placed in this cavity and sealed 4 mm by sticky wax. Irrigation was done by methylene blue solution 15 times for each canal size, then the paper point piece examined under stereomicroscope for discoloration and wetness. **Results:** The irrigant solution was penetrated up to the apical area of the all canal sizes in the all 15 irrigation trials. The volume of fluid, the degree of fairing, the use of apical patency files, and the needle depth were the other different factors improving penetration depth of irrigating solution. **Conclusions:** There was no effect of canal size on the penetration level of the endodontic irrigant.

Key Words: Canal size, irrigation, level of penetration.

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INTRODUCTION

The triad of biomechanical preparation, chemotherapeutic sterilization and three–dimensional obturation is the hallmark of endodontic success.[1] It is a well–known fact that only the mechanical action of instruments is not capable of promoting satisfactory cleansing due to the complexity of internal dental anatomy (apical deltas, lateral canals, accessory canals) and because there is no direct contact of instruments with all walls of the root canal system. Therefore, the physical and chemical actions of irrigating solutions become necessary.[2] Sinanan *et al*.[3] found that lavage is a necessary adjunct to debridement procedures, since root canal instruments alone do not cleanse adequately.

Vansan[4] found that the apical third showed more debris than the middle third. Indeed, there are studies suggested that effective irrigation may not occur unless the canals are enlarged to at least the diameter of a size #40 instrument. Other studies have shown that no apical flushing will occur until proper flaring of the canal and an apical diameter of a size #25 instrument has been achieved.[1] Yamashita *et al*.[5] found that better cleaning was found in the cervical and middle thirds for all groups with the worst results in the apical third. Hülsmann, *et al*.[6] found that the apical third of the root canals was not cleaned as well as the middle and coronal thirds.

The aim of this study was to determine the size of the canal that permit the irrigant solution to reach the apical area.

MATERIALS AND METHOD

Five distobuccal roots of extracted human matured permanent maxillary first molars were used in the study. The criteria for tooth selection included: No visible fractures or cracks of roots, no caries, no apical (external and internal) root resorption, completely formed apex, no canal obstruction, and patent apical foramen.

Removal of the soft tissue was accomplished by placing the tooth in 5.2% sodium hypochlorite (NaOCl) (Fass Company, Iraq) for 20 minutes, and stored in normal saline until used. The samples were examined radiographically. A photograph of the radiograph was processed according to the method of Schneider[7] to determine the degree of the curvature. All the four canals ranged in the same degree of curvature (20–30 degree).

Evaluation was performed according to the classification of Mullaney.[8] The pulp chambers were accessed, the patency of each canal was checked by passing # 15 K file (Mani Corporation, Japan). A K–file was inserted into the canal until the tip of the file was just seen at the apical foramen by nacked eye. Then the file was withdrown one millimeter shorter than the foramen and the working length was determined for each canal. The canals were instrumented according to the step–back technique as recommended by Weine.[9] Stainless steel K file hand instruments (Mani Corporation, Japan) was used, and 5 ml of 5.2% NaOCl was used as irrigant between each file size. Recapitulation was performed after each reamer size using reamer # 15 (Mani Corporation, Japan). The five canals were divided randomly to A, B, C, D and E.

Each canal was enlarged to the sizes shown in Table (1). Canal A was instrumented to a master apical file size #20 and flared to a size #45 file; canal B was instrumented to a master apical file size #25 and flared to a size #50 file; canal C was instrumented to a master apical file size #30 and flared to a size #55 file; canal D was instrumented to a master apical file size #35 and flared to a size #60 file; and canal E was instrumented to a master apical file size #40 and flared to a size #70 file.[10]

Table (1): Type of each canal with its master apical file size and flared file size

Canal Type	Size of Master Apical File	Size of the Flared File
A	20	45
B	25	50
C	30	55
D	35	60
E	40	70

A Class I cavity preparation was performed in the apex of each root 2 mm in depth by slow speed hand piece with cut end straight fissure carbide bur size 1/3 (KG Sorensen, Dfenmark). The cavity was washed and dried by triple syringe, then a 2.5 mm paper point (Dia Dent) size # 50 was fitted to the cavity leaving 0.5 mm extended beyond the root apex for removal. The paper point and the 4 mm root apex were coated by sticky wax (Quayle Dental, England). To facilitate the application of paper point and wax, the palatal and mesiobuccal roots were sectioned at the bifurcation level using diamond disc and then sealed by sticky wax.

Disposable hypodermic syringe (Hayat, Turkey) of 5 ml size with needle 23G was filled with 5 ml of 1% methylene blue (Aldrich Co, USA). The needle was inserted into the canal until the distance between the tip of the needle and the paper point at the root apex became 10 mm. This could easily be determined by the following equation: WL–12 mm= X (WL means working length, X means the length of the needle to be inserted into the tooth to keep 10 mm distance between needle tip and paper point). This was easily measured by endodontic ruler and endodontic rubber stop (Maillefer, Switzerland).

Each canal was irrigated conventionally with the same irrigant solution for the same volume and duration (5ml for 7 seconds) by using a side beveled needle while exercising normal clinical precautions. Specifically, the side beveled needle was placed toward the distal curvature of the canal without wedging by doing flaring size as shown in Table (1) while irrigants were expressed slowly as not to produce a “water cannon” effect.[11] The canal was placed like in normal anatomical position the crown is downward and the root is upward with longitudinal axis perpendicular to the floor.

After that the canal was dried by paper point inserted 3 mm shorter than working length. The wax was removed and the paper point was examined for discoloration and wetness. Each canal then washed from methylene blue by distilled water and dried by compressed air and paper points. The procedure was repeated 15 times for each canal type using the same technique. The paper point pieces examined for blush discoloration and wetness under stereomicroscope (Hamilton, Italy) magnification power ×10. Most of the cases appeared clearly discolored and wet by naked eyes, but also conferred microscopically. The data were collected and tabulated.

RESULTS AND DISCUSSION

Table (2) Summarized the sizes of the canals with the repeated times of irrigation for each canal size and the number of discolored apical paper points. For all canal sizes, the endodontic irrigating solution can penetrate deeply to the apical area of all 15 trials of irrigation for each canal (A, B, C, D and E).

As shown in Table (2), 75 paper points of the samples appeared bluish in color and wet. In this study, the canal sizes, distance between the needle tip and the apical paper point, direction of needle bevel, volume and type of irrigating solution, tooth position of each canal, irrigation volume/ time, and canal curvature was standardized. The only variable factor is the size of the canal.

Table (2): Number of repeated times of irrigation for each canal and its related discolored apical paper point

Canal Type	Size of Master Apical File	No. of Repeated Irrigation for Each Canal Size	No. of Discolored and Wet Paper Point
A	20	15	15
B	25	15	15
C	30	15	15
D	35	15	15
E	40	15	15

This result showed that the canal size has no effect on the penetration depth of endodontic irrigant. Therefore, irrigating solution can flush the apical area at all canal sizes of this study.

This result agreed with the results of Lynn *et al.*,[12] who found that there were no differences in debris removal between the two preparations sizes (size #20 and size #40). The study agreed with the results of other studies,[13, 14] which found that no apical flushing will occur until proper flaring of the canal and an apical diameter of #25 instrument has been achieved, but the study did not coincide with the results of Falk and Sedgley,[15] who found that there was no significant difference in mechanical efficacy of irrigation between size #60 and #80 while significantly less effective in canals prepared to size #35.

The study did not agree with the results of Abou–Rass and Piccinino,[16] who suggested that effective irrigation may not occur unless the canals are enlarged to at least the diameter of a size # 40 instrument.

When irrigant solution just reach the apical area, at least the following points could be insured (a) antibacterial, (b) dissolution of tissues, (c) lubricant action, (d) gross debridement, (e) dilution of bacterial toxins, and (f) possibly partial removal of smear layer.

In this study since the irrigating solution penetrating to the same level in types A, B, C, D and E, this means that there are other factors rather than canal size affect on the penetration depth of irrigating solution. These factors could affect the degree of flushing and cleaning of the apical third of the canal: (I) the volume of fluid, (II) the degree of flaring, (III) The use of apical patency files, and (IV) needle depth.

The irrigating solution volume which was used in this study between each file size was scientifically preferred to be 5 ml. Some studies used 1 to 2 ml of irrigant between each two different sizes of file which my not enough for effective irrigation. Glassman and Serota[1] advised to use after completion of the canal shaping 5 ml flush of 17% ethylene diamine tetra acetic acid (EDTA).

Increasing the degree of the flaring improves greatly the mechanical function of endodontic irrigant by permitting a good draining space for excess irrigant to be drained completely, so it will improve the stream of solution movements.[11] Also flaring permits deeper penetration of needle tip which decrease the distance between needle tip and apical area. In this study sufficient flaring was performed as shown in Table (1). The apical patency files must be used to allow penetration of the root canal irrigants to working length.[1] Recapitulation has very important functions; among them to improve or increase the penetration depth of irrigant solution because accumulation of derbies in the canal my obstruct the canal and prevent the irrigant to penetrate deeply to the apical area.

The needle depth is the last factor that affects the penetration depth of endodontic irrigating solution. Decreasing the distance between the needle and the apex; i.e., increasing the insertion depth of the needle improving the effect of irrigation. The mechanical efficacy of 6 ml of irrigant in reducing intracanal bacteria was significantly greater when delivered 1 mm compared with 5 mm from working length.(17)

This results did not coincide with the results of Usman *et al*.,(18) who found that irrigant volume, number of instrument changes and depth of penetration of irrigation needle were not likely to explain differences in debridement.

CONCLUSIONS

Under the condition of this study the results revealed that the irrigating solution can reach the apical area of the all canal sizes from # 20 to # 40.

There were different factors other than the canal size improving the penetration depth of irrigation: The volume of fluid, the degree of flaring, the use of apical patency files and the needle depth.

REFRENSES

1. Glassman GD, Serota KS. A predictable protocol for the biochemical cleansing of the root canal system. *Oral Health J*. 2001; 7: 487-492.
2. Sassone LM. Antimicrobial activity of different concentrations of NaOCl and chlorhexidine using a contact test. *Braz Dent J*. 2003; 14(2): 20-23.
3. Sinanan S, Marshall FJ, Quinton–Cox R. The effectiveness of irrigation in endodontics. *J Can Dent Assoc*. 1983; 11: 771-776.
4. Vansan LP, Pecora JD, Costa WF, Campos GM. Effects of various irrigating solutions on the cleaning of the root canal with ultrasonic instrumentation. *Braz Dent J*. 1990; 1(1): 37-44.
5. Yamashita JC, Tanomaru F, Leonardo MR, Rossi MA, Silva LAB. Scanning electron microscopic study of the cleaning ability of chlorhexidine as a root–canal irrigant. *Int Endod J*. 2003; 36(6): 391-397.
6. Hülsmann T, Peters J, Dummer M. Mechanical preparation of root canals: Shaping goals, techniques and means. *J Endod*. 2005; 31(1): 67-70.
7. Schneider SW. A comparison of canal preparation in straight and curved roots canal. *Oral Surg*. 1971; 32: 271-275.
8. Mullaney TP. Instrumentation of finely curved canals. *Dent Clin North Am*. 1979; 23: 571-588.
9. Weine FS. Endodontic Therapy. 5th ed. CV Mosby Co. St Louis. 1996; p: 274.
10. Sabins RA. A comparison of the cleaning efficacy of short–term sonic and ultrasonic passive irrigation after hand instrumentation in molar root canals. *J Endod*. 2003; 29(10): 674-678.
11. Schoeffel J, Sbeih M, Wallace FS. Efficacy of a new endodontic irrigation method using negative pressure. *J Endod*. 2005; 31: 97-104.
12. Lynn A, Baumgartner JC, Marshall JG. Evaluation of apical debris removal using various sizes and tapers of profile GT files. *J Endod*. 2004; 30(6): 425-428.
13. Salzgeber RM, Brilliant JD. An *in vivo* evaluation of the penetration of an irrigating solution in root canals. *J Endod*. 1977; 3(10): 394-398.
14. Mader CL, Baumgartner JC, Peters DD. Scanning electron microscopic investigatin of the smeared layer on root canal walls. *J Endod*. 1984; 10(10): 477-483.
15. Falk KW, Sedgley CM. The influence of preparation size on the mechanical efficacy of root canal irrigation *in vitro*. *J Endod*. 2005; 31(10): 742-745.
16. Abou–Rass M, Piccinino MV. The effectiveness of four clinical methods on the removal of root canal debris. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 1998; 54: 323-328.
17. Sedgley CM, Nagel AC, Hall D, Applegate B. Influence of irrigant needle depth in removing bioluminescent bacteria inoculated into instrumented root canals using real–time imaging *in vitro*. *Int Endod J*. 2005; 38(2): 97-104.
18. Usman N, Baumgartner JC, Marshall JG. Influence of instrument size on root canal debridement. *J Endod*. 2004; 30(2): 110-112.