Effect of apical preparation on different needle depth penetration

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Introduction: Irrigation is a fundamental part of endodontic debridement as because it allows for cleaning beyond what might be accomplished by root canal instrumentation. The flushing action produced by the irrigant and the penetration of the irrigant is not dependent only on the anatomy of the root canal system, but also on the depth of placement, system of delivery, the volume and fluid properties of the irrigant. Aim: The aim of the study was to evaluate the effect of apical preparation on the penetration depth of different types of needles.

Methods: Thirty single rooted lower premolar teeth were involved in this study. The access opening was performed by using a round diamond bur turbine (diameter 12) and Kfiles (diameter 15) were used for initial penetration in the canal. Stereo- microscope under 20 magnifications was used to determine the working length of the canal. Then the canals were prepared using protaper next in continuos rotation according to manufacture instructions with sequence files reached the WL (X1, X2, X3, X4). 4 mL of 5.25% NaOCl was used between each instrument. Three different types of endodontic needles were used. Needles size 27, 30-gauge stainless steel and IRRIFLEX endodontic irrigation needle. Each needle was inserted in the canal and its length of penetration was measured before canal preparation and after finishing files then the depth of penetration was measured.

Results: ANOVA test showed that there are significant differences among all groups also results show a significant difference when comparing 27 with 30 needle gauge irriflex but there was no significant difference between the needle gauge 30 and irriflex.

Conclusion: This study shows that the penetration depth of needles influences on apical preparation it appears that 27 -gauge needles show less depth penetration when compared to irriflex and 30- gauge needles.

Keywords: apical, needle, penetration depth, endodontics

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INTRODUCTION

The objective of root canal instrumentation includes complete debridement and disinfection of canals also to create an appropriate shape for perfect three- dimensional obturation. Removing necrotic and vital remnant of pulp tissues, microbial toxins and microorganisms from the canal system is fundamental for root canal successful.[1] Thus Mechanical instrumentation alone is not effective in wholly removing necrotic debris and residual bacteria. [2] Even with presently available use of the nickel-titanium rotary instruments, they work on the central body part of the canal and after complete preparation of canal it leaving untouched area, canal fins and isthmi.[3, 4]

Irrigation is a fundamental part of endodontic debridement as because it allows for cleaning beyond what might be accomplished by root canal instrumentation. The flushing action produced by the irrigant and the penetration of the irrigant is not dependent only on the anatomy of the root canal system, but also on the depth of placement, system of delivery, the volume and fluid properties of the irrigant.[5-12] The common factors of pulpal and periapical disease are microorganisms and their toxic byproducts. Consider as well the complex anatomy of canal system and also the failure of available systems in proper preparation and disinfection of root canal, as 35-80% of canal walls remain underprepared even after its full preparation. Therefore, the combination of mechanical and chemical cleansing of root canals plays an important role in root canal disinfection. [13] Successful of root canal treatment is based on proper and ideal irrigation of canal is known to be considered a substantial element. In the majority of cases failure is always reoccurring due to impossible removing microorganisms even after proper treatment. According to tudies stated that E. faecalis cause nearly about 45.8% of failed cases, which is a gram positive facultative anaerobe capable of invading dental tubules and also capable of resisting medicaments and variety of irrigants used in root canal treatment.[14] In order for better cleaning of canal as well as penetration of sealers into the dentinal tubules several different types of commercial delivering systems for irrigation have been developed.[13, 15-17] However, regarding the efficiency of these irrigation devices comparing to a needle and syringe there are controversial results, needle and syringe remains the most commonly used method for irrigation of canals, with the irrigation being injected under positive pressure into the depths of the canal.[18, 19] Several factors, which affect the success of syringe and needle in removing debris and bacteria from the root canal, such as the volume of irrigant, the size, type and depth of insertion of the irrigation needle were investigated.[5,10,20-26] Using irrigant in delivery syringe which allows controlling depth penetration of needle inside the canal.[24] It has been advocated to insert the needle as close as possible to the working length for cleaning the apical part of canal efficiently,[8, 10, 25,26] because the irrigation rarely flows 1mm beyond tip of the needle.[10, 27] On the other hand, this may increase the possibility of extrusion of irrigation solution to the periapical area.[28, 30] Aim The aim of the study was to evaluate the effect of apical preparation on the penetration depth of different needle types.

MATERIALS AND METHOD

Thirty single rooted lower premolar teeth were collected; the inclusion criteria include mature apex and root curvature less than 15 degrees confirmed by taking an x-ray. The teeth with caries or crack or endodonticaly treated or resorbed apexes were excluded from the study. The access opening was performed by using a round diamond bur turbine (diameter 12) and Kfiles (diameter 15) were used for initial penetration in the canal. Stereo- microscope under 20 magnifications was used to determine the working length of the canal. Working length was determined one millimeter shorter when the file appears at the apex. Then the canals were instrumented using protaper next files (X-Smart1, Dentsply, Konstanz, Germany), the file was used in continuous rotation motion at a speed 350 rpm according to manufacturer instructions, each group was shaped with a ProTaper next sequence was used with the files reached the WL (X1, X2, X3, X4). 4 ml of 5.25% NaOCl was used between each file. Three types of endodontic needles were used. Needles size 27, 30 gauges of stainless steel and IRRIFLEX endodontic irrigation needle. Each needle was inserted inside the canal without bending and its length of penetration was measured before the canal preparation and after the finishing files. Polydentia gauge with an accuracy of the quarter of a millimeter was used to measure the penetration depth and was measured by a double rubber stop on the needle. Analysis of the variance and LSD Fisher's tests was done with Stat view 5.0 software (Sas Institute, Orange, CA) and alpha risk was fixed at 5%.

RESULTS

The penetration depth of each needle was

measured and the distance between the needle tip and the working length was calculated. ANOVA was used to determine the difference among groups and the result showed that the difference among groups was significant as shown in Table 1.

Table 1: ANOVA test Comparison of Penetration depth of each needle among groups .

	Sum of squares	Df	Mean Square	F	Sig.
Between groups	22.200	2	11.100	16.558	.000
Within groups	18.100	27	.670		
Total	40.300	29			

Further analysis by LSD test showed that there was a significant difference between needle gauge 27 and 30, 27 and irriflex, while the difference between needle gauge 30 and irriflex was non-significant as shown in Table 2.

Table 2: LSD Fisher's test for the finishing parameter

(I) Factor	(J) Factor	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
N30	N27	-1.2000*	.3662	.003	-1.951	-.449
	irriflex	.9000*	.3662	.021	.149	1.651
N27	N30	1.2000*	.3662	.003	.449	1.951
	irriflex	2.1000*	.3662	.000	1.349	2.851
irriflex	N30	-.9000*	.3662	.021	-1.651	-.149
	N27	-2.1000*	.3662	.000	-2.851	-1.349

*. The mean difference is significant at the 0.05 level.

DISCUSSION

Chemomechanical preparation is a most challenging aspect of root canal treatment, disinfection of the canal is the most difficult part of root canal treatment especially the apical third of the canal. This study showed that apical preparation and difference in needle size and type affect the depth penetration of needles; low curvature natural teeth were used as the results were not affected by the angle and radius of curvature.[31] The needle could block above with more curvatures leading to increasing differences between the needles. In this study a small number of teeth 10 per group was chosen but this leads to sufficient statistical power to consider the variability of measurement.[32, 33] Stereomicroscope was used to record the working length that allows accurate visualization of the file when it reaches the apex.[32] This method is more credible and reproducible when compared to a radiograph and prevents any bias or electronic measurement related to radiographic interpretation. The needle was inserted to working length or one millimeter shorter or at least in apical third during instrumentation for flushing efficiency and removing undesirable substance from the canal, [34, 35] Specially designed irrigation needles vary in diameter closed-end, side-vented, or notched openend are intended for use in root canal treatment. [36] For evaluating the different penetration depths needles of three diameters were used. Also compared needles of different material the two needles of stainless steel and irriflex needle was used, both irriflex and needle gauge 30 shows deeper penetration in the canal because of needle 30-gauge is flexible which optimizes the penetration and has smaller dimension when comparing with 27-gauge needle, a study done by Vinel et al showed that 30-gauge needle had good penetration with all finishers files. [37] Irriflex is a very flexible needle easily adapts to complicated anatomies of the root canal. Unlike conventional metal needles, the irriflex made from the polypropylene body that allows the needle to penetrate easily to apical region without resistance or damage to dentinal walls and is designed in shaped to follow the taperness of the canal.

CONCLUSION

The study concluded that the penetration depth of needles that reach the biological criteria is influenced by apical preparation for more effectivenss the tip of the irrigation needle should place as close as to apical third of the canal. Although the protocol of the protaper next rotary system utilizes progressive tapers on a single file, the irrigation needle is designed to complement root canal procedure for efficient disinfection and cleaning of the canal until the apex. Different needle types should be used depending on the apical preparation. Both irriflex and needle gauge 30 shows deeper penetration in the canal comparing to needle gauge 27 because of their flexibility.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest relevant to this article.

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