Biomedical & Pharmacology Journal Vol. **11**(1), 519-523 (2018)

Apical Extrusion of Debris and Irrigants after using Different Irrigation Needles and Systems with Different Depth of Penetration: (A Comparative Study)

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http://dx.doi.org/10.13005/bpj/1402

(Received: December 08, 2017; accepted: January 30, 2018)

ABSTRACT

This study evaluate the amount of debris and irrigants extruded apically during the use of different irrigation needle (open end & double side vented needle) attached to different device (pressurized water device Aqua-pick 300 & syringe) with depth of penetration 2mm and 4mm from the working length. A Total number of 80 permanent single rooted teeth (premolars) with same working length were divided into two main groups, group A: penetration depth of irrigation syringe to 2mm from the working, group B: penetration depth of irrigation syringe to 4mm from the working length. Each group was subdivided into 4 subgroups (n=10) weight of extruded debris and irrigants were weighed and the data statistically analyzed by ANOVA and the Tukey test. Statistical analysis using one way ANOVA and Tukey test revealed that there was a high significant difference among the tested groups with least amount of apically extruded irrigants when the penetration length was 4mm from the working length with Aquapick device with double side vented needle. The study concluded that different irrigation needles attached to pressurized water(Aqua-pick 300 device) with different penetration depth lead to less amount of apical extrusion of irrigants when compared to syringe with statistically non-significant differences.

Keyword: Apical extrusion of irrigation, Endoactivator, Pressurized water.

INTRODUCTION

Endodontic irrigants are important step to remove pulp tissue, microorganisms and their byproducts and debris from the root canal system[1]. Apical extrusion of debris and irrigant during cleaning and shaping of the root canal is one of the serious problems effect on the treatment. Several studies have shown that dentin debris, necrotic tissue, microorganisms and irrigating solution may be forced towards the periapical tissues during root canal instrumentation and irrigation[2]. Apically extruded debris lead to sever inflammation reaction. Tissue reactions following instrumentation short from the apex are milder than those reactions that follow instrumentation beyond the apex. Therefore, the amount of apically extruded debris should be minimized in order to minimize postoperative reactions[3].

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Debris extrusion depends on several factors, including the apical anatomy , type and size of the irrigation needle, penetration depth of the needle, and the instrumentation technique[4]. The needle design also influences flow pattern, flow velocity and apical wall pressure, which are important parameters accounting for irrigation effectiveness and safety[5], for better effectiveness of the irrigation, the irrigant should make direct contact with all parts of the canal wall[1]. A flushing action, which is dependent on several factors such as the insertion depth, diameter of the needle[2], and the final size and taper of the prepared root canal[3], is necessary for optimal cleaning of the root canal[4]. It is the most widely used technique because it is very easy to manipulate and affords good control of needle depth and the volume of irrigant delivered. However, its safety has been questioned because of the positive pressure used to introduce the irrigant into the canal, which could cause the solution to extrude into the periapex despite strict control of the working length (WL) and result in severe tissue damage and postoperative pain[6].

Aquapick AQ-300 device (Aquapick Co, Ltd, Korea) available in the market as advanced oral irrigation device with 1800 pulsations per minute and maximum water pressure is 7kgf/cm[7].

The aim of this study was to compare amount of apically extruded debris & irrigants after use opened end needle with disposable syringe, double side vented needle with disposable syringe and the same needles attached to device which supply pressurized water (Aqua-pick-300) with different depth of penetration inside canal.

MATERIAL AND METHOD

Preparation of the samples

80 freshly extracted single root permanent premolars were used with mature apex and single canal and apical foramen with same length, teeth with caries, root curvature, cracks were discarded the teeth were cleaned with cumine scaler to remove calculus and soft tissue debris then washed under tap water and kept in distilled water solution.

After access opening for all teeth the working length was determined by placing #10 K file with a rubber stop carefully into each canal until it was just visible in the apical foramen, this length was noted and 1mm was subtracted to give the working length of the canal and all the selected teeth had a working length 19 mm. The teeth were prepared with Protaper (Dentsply, Maillefer) hand system in crown-down approach and the instruments were used according to the manufacturer's instructions.

The apical enlargement was done to size F3 (D0= 30)[8] distilled water was used as irrigants, in each group 30 second irrigation[9] with 4 ml of normal saline was used after each file with total irrigation time of 120 sec.

After canal preparation a method of Myers & Montgomery[10] was followed, the teeth were forced through a precut hole in a rubber stopper, then placed on the glass shell vials. A 27- gauge needle (KDL, China) was placed through the stopper into the flask to equalize the air pressure inside and outside the vial.

In this study we used open end needle gauge 23 & double side vented needle gauge 23 with disposable syringe and open end needle gauge 23 & double side vented needle gauge attached to (Aqua-pick 300) which produced water with 100psi pressure with 1800 pulsations per minute on its end and fix them by a glue to used it inside canal

Grouping

A total 80 freshly extracted single rooted teeth (permanent premolars) were used in this study which was divided into 3 groups consisting of 10 samples for each group and as follows:

Group A: Irrigation was made to 2mm from working length.
Group A1: Irrigation was made by open end needle with syringe
Group A2: Irrigation was made by double side vented needle with syringe.
Group A3: Irrigation was made by open end needle attached to Aqua-pick300
Group A4: Irrigation was made by double side vented needle attached to Aqua-pick300.
Group B: Irrigation was made to 4mm from the working length.

Group B1: Irrigation was made by open end needle attached to syringe.
Group B2: Irrigation was made by double side vented needle attached to syringe.
Group B3: Irrigation was made by open end needle attached to Aqu-pick300.
Group B4: Irrigation was made by double side vented needle attached to Aqua-pick300.

Debris & irrigants weighting

After complete instrumentation and irrigation specimens were removed from the apparatus and the vial then weighed three times on a precision electronic balance (Acculab-R-LSeries LA 60, Totalcomp, Inc, Fair Lawn, NJ, USA) (max x 60 g). The weight of the irrigant was calculated as the difference between the pre and post instrumentation weights. All irrigation and weighing procedures were carried out by the same operator.

RESULTS

The means and standard deviation values of the apical extrusion of irrigants are shown in Table 1. revealed that the aqua-pick device with double side vented needle with penetration depth of 4mm from full working length had lowest amount of apically extruded irrigants compared with the other experimental groups ($P < 0.001$) while aqua-pick with double side vented needle inserted 2mm from the full working length had the highest amount of apically extruded irrigants among the experimental groups. Also there was a statistically high significant difference between the groups according to the one-way ANOVA & Tukey test analysis of variance ($P < 0.001$) as shown in table 2.

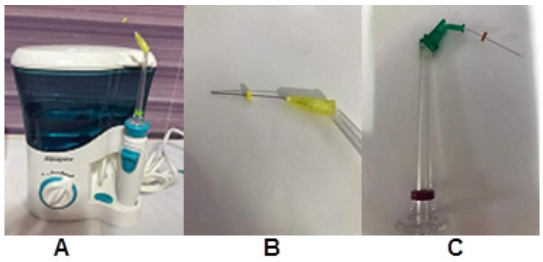

Fig. 1: Irrigation devices

DISCUSSIONS

Factors effect apical extrusion of irrigants are canal size, curvature, apical enlargement, instrumentation, type of irrigants and irrigation device.

Penetration depth of the irrigation needle inside canal affects apical extrusion of irrigants in this study 2 penetration depth inside canal was used 2mm & 4 mm shorter than the working length to provide enough place to irrigants to flow and improve cleaning efficiency and disinfection[11] distilled water was used to ensure that apical extrusion of irrigants was due to irrigation device not to the type of irrigants. Apical diameter was 0.3mm to provide minimal diameter for adequate irrigation for the apical third[8]. Irrigation with syringe was done with gentle pressure to prevent apical extrusion of irrigants periapically [13]

Table 1: Descriptive statistic and ANOVA test for tested groups

Depth of penetration	Group	mean	std. D	f	ANOVA p-VALUE	SIG
2mm from the WL	open end+ syringe	0.7	0.26	26.76	0.001	HS
	double side vented + syringe	0.09	0.03			
2mm from the WL	open end+ Aquapick	0.6	0.23	17.83	0.003	HS
	double side vented + Aquapick	0.07	0.05			
4mm from the WL	open end + syringe	0.2	0.12	4.73	0.06	S
	double side vented + syringe	0.06	0.07			
4mm from the WL	open end +Aquapick	0.11	0.1	3.4	0.1	NS
	double side vented+Aquapick	0.01	0.03			

Table 2: Tukey test was made between groups

Tukey HSD Groups		Mean Difference	P-Value	Sig
A1	A2	.60720*	.000	HS
	A3	.09400	.963	NS
	A4	.62600*	.000	HS
	B1	.49200*	.000	HS
	B2	.63600*	.000	HS
	B3	.59000*	.000	HS
	B4	.68400*	.000	HS
A2	A3	-.51320*	.000	HS
	A4	.01880	1.000	NS
	B1	-.11520	.899	NS
	B2	.02880	1.000	NS
	B3	-.01720	1.000	NS
	B4	.07680	.988	NS
A3	A4	.53200*	.000	HS
	B1	.39800*	.002	HS
	B2	.54200*	.000	HS
	B3	.49600*	.000	HS
	B4	.59000*	.000	HS
A4	B1	-.13400	.807	NS
	B2	.01000	1.000	NS
	B3	-.03600	1.000	NS
	B4	.05800	.998	NS
B1	B2	.14400	.746	NS
	B3	.09800	.954	NS
	B4	.19200	.415	NS
B2	B3	-.04600	1.000	NS
	B4	.04800	.999	NS
B3	B4	.09400	.963	NS

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

According to the result of this study the highest amount of apically extruded irrigants was with Aqua-pick with open end needle this finding was in agreement with previous studies[8, 11] this may be related to several factors: the open end needle produce more apical pressure and its design enable the apical extrusion of irrigants[12] depth of insertion of the needle to 2mm away from the apex increased the risk of apical extrusion of irrigants[8] also the irrigation device play an important role in pressurized water device water delivered with pressure about 7kgf/cm which increase the apical extrusion of irrigants.

Irrigation with Aqua-pick and double side vented needle with penetration depth of 4mm from the apex produced less amount of apical extrusion of irrigants this in agree with previous studies[4, 13, 14] side-vented is closed apically thus create more pressure on the walls of the root canal and improve the hydrodynamic activation of an irrigant and reduce the chance of apical extrusion which allows the irrigant to reflux and causes more debris to be displaced coronally, while avoiding the inadvertent expression of the irrigant into periapical tissues.

According to the result of this study the depth of insertion 4mm from the working length produced less apically extruded irrigants when compared to 2mm from the working length. The further the needle is positioned away from the apex, the less apical pressure is developed this finding was in agreement with previous study[14].

Within the limitation of this study there was less amount of apically extruded debris and irrigants when both tested needles attached to device with pressurized water in both tested depth of penetration with statistically non-significant differences ($p > 0.05$) when the needles attached to syringe.

CONCLUSION

Within the limitation of this study the use of open end needle and double side vented needle with pressurized water device produce less amount of apically extruded debris and irrigants when compared with the same needles attached to syringe and could be used as new intra-canal irrigation system further studies must be done about it.

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