Comparative Evaluation of AED of Two Root Canal Irrigants- An Ex Vivo Pilot Study

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ABSTRACT

Introduction: Extrusion of debris during endodontic preparation carries the risk of flare-ups. The purpose of this ex vivo study is to evaluate and compare the amount of apically extruded debris between 2% chlorhexidine gluconate and 3% hydrogen peroxide.

Material and methods: The present study is an in vitro study. Extracted maxillary anterior teeth were used for the study and were divided into various groups. Biomechanical preparations of the specimens were done using ProTaper Next file systems and irrigation was done using 2% chlorhexidine gluconate and 3% hydrogen peroxide in different groups. The apically extruded irrigant was collected and measured using Myers and Gawdat S model.

Results: It was observed that 3% hydrogen peroxide extruded least debris and 2% chlorhexidine gluconate the highest which was statistically significant.

Conclusion: Significant amount of debris extrusion was seen in chlorhexidine gluconate followed by hydrogen peroxide while insignificant AED was observed in control group.

Keywords: Irrigants, Chlorhexidine Gluconate, Hydrogen Peroxide, Protaper, Debris, Flare Up

INTRODUCTION

A successful endodontic therapy is possible on complete elimination of microbes from the root canal. This can be achieved by chemo-mechanical preparation where endodontic files and root canal irrigants are used to remove bacteria harboring tissues.[1] Endodontic flare-ups is a complication encountered during chemo-mechanical preparation that requires additional visits and active intervention. Its etiology is complex, the extrusion of irrigants, bacteria and debris into the periapical tissue being the most common.[2-7]

Sodium hypochlorite though a popular root canal irrigant, it is not readily accepted by patients specially children due to its unpleasant taste and high incidences of flare ups.[8] In comparison chlorhexidine and hydrogen peroxide have a wider acceptance amongst children during root canal therapy due to their milder irritation potential and nearly comparable antibacterial efficacy.[9]

Studies[10-11] have evaluated the amount of apically extruded debris (AED) by various instruments or techniques. But very few studies have evaluated AED due to action of root canal irrigants. Hence the aim of the present study is to compare the effect of 2% chlorhexidine gluconate and 3% hydrogen peroxide on the amount of apically extruded debris.

MATERIAL AND METHODS

Freshly extracted human maxillary anterior teeth with one root canal and 1 apical foramen, root curvature between 0^0 to 10^0, no signs of cracks, internal or external resorption, root caries, calcification and open apices were assessed radiographically and selected for the study. The teeth were cleaned after extraction and were stored in phosphate buffered saline solution. The crowns of the teeth were ground to achieve standardized lengths.

All external tooth surfaces except for 1 mm around the apical foramen and around the access cavity were covered with 2 layers of nail polish. Access cavity was prepared in each tooth, and working length of each tooth was determined. The root canals of all the teeth were prepared using the rotary ProTaper file system (Dentsply) till F3 file. 1 milliliter of irrigating solution was used between each subsequent change of instrument. Finally the apical part of each tooth was washed with 0.5ml of distilled water to collect any AED that had adhered to the root.

One Test tube for each tooth was pre weighed with electronic weighing machine and the teeth were inserted with their apical portions suspended in the test tubes. The apical part of the root was suspended within. The prepared samples were then randomly divided into 3 groups (table 1). All of the tubes were incubated at 37°C for 15 days before being weighed. The mean weight was considered to be the new weight of the tubes.

RESULTS

The apically extruded debris in all the groups was measured by calculating the difference between the weighs of the test tubes weighed before and after the root canal preparation (Table 2). Observation of all the samples demonstrated that all the experimental groups produced apically extruded debris whereas there was insignificant AED in the control group where no irrigant was used. In this study maximum extrusion was seen in the 2% chlorhexidine gluconate and least by 3% hydrogen peroxide group (Table 3 and 4).

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Group	n	Irrigant
Group 1	5	Control Group (No irrigant)
Group 2	5	Chlorhexidine gluconate (2%)
Group 3	5	Hydrogen peroxide (3%)

Table-1: Representatives of Each Group

Group	Irrigant	Mean Weight Before CMP	Mean Weight After CMP	AED
Group 1	Control Group (No irrigant)	4.57108	4.58666	0.01558
Group 2	Chlorhexidine gluconate (2%)	4.59734	4.6274	0.03006
Group 3	Hydrogen peroxide (3%)	4.61748	4.62862	0.01114

Table-2: Apically Extruded Debris (AED) in Each Group

Group	Mean	SD	Std. Error	ANOVA
Group 1	0.00298	0.000335	0.0001497	p <0.0001 (Highly Significant)
Group 2	0.03327	0.011869	0.0030645	
Group 3	0.01139	0.003527	0.0009106	

Table-3: One Way ANOVA

Comparison	Mean Difference	P value	Significance
Group 1 vs Group 2	-0.03029	<0.001	Highly Significant
Group 1 vs Group 3	-0.00841	0.289	Not Significant
Group 2 vs Group 3	0.02189	<0.001	Highly Significant

Table-4: Intra Group Comparison using Post Hoc Tukey HSD Test

DISCUSSION

The main purpose of root canal instrumentation is to remove pulp tissue, noxious microorganisms and provide a space for delivery of root canal irrigants, medicaments, and finally root-filling materials. Many investigations focused on the antibacterial activity of the root canal irrigants, the shaping properties of various hand and rotary instruments, or the amount of apically extruded debris (AED).[12-15]

The present study was undertaken to evaluate the amount of apically extruded debris after chemo-mechanical preparation using two different root canal irrigants (2% CHXg and 3% H_2O_2). The methodology of the study was on the lines of the work of Myers et al[16] and Gawdat S et al.[17] Within the limitations of the study, it was observed that although all the experimental groups produced AED, maximum extrusion was seen in the 2% chlorhexidine gluconate and least by 3% hydrogen peroxide group whereas insignificant AED was seen in the control group.

In the present study only single rooted teeth with straight canal were used as factors like root canal anatomy, instrument size, type, canal preparation technique, apical enlargement, apical stop, irrigation solutions, techniques, and devices, in addition to canal curvature and the presence of more than one canal influence apical extrusion of debris and irrigants.[18,19] Mature anterior teeth were used for the study as teeth with immature apex are more susceptible to wear causing increased extrusion.[7] The length of root canals was standardized by sectioning the crowns in a trial to homogenize the canal preparation and amount of irrigants placed in all teeth.

In the present study, canal preparation was done using rotary protaper files. The results from the existing studies shed less light on the type of engine-driven system causing lesser apical extrusions. Few studies indicated that continuous rotational movement extruded a lesser amount of debris.[20-22] Depth of needle placement also affects the extrusion of irrigants. Coronally placed needle develops less apical pressure thereby compromising the delivery of irrigant.[23] For standardization purpose, the needle was placed 1 mm short of the WL in all groups resulting avoidance of needle binding into the root canal walls thereby prevent pushing material into the periapex.

Conflicting results from other studies can be due to difference in the canal preparation techniques, type of file system, type of irrigant, the protocol of irrigant delivery and the type of teeth used for the study.

CONCLUSION

Under the conditions of this in vitro study, both the irrigants significantly extruded debris apically. It may be concluded that the amount of debris extrusion was greater in 2% chlorhexidine gluconate and less by 3% hydrogen peroxide group. The limitation of the present study is that this study is in vitro in nature which may not exactly replicate the intraoral conditions.

REFERENCES

1. Desai P, Himel V. Comparative safety of various intracanal irrigation systems. J Endod 2009;35:545–549.
2. Imura N, Zuolo ML. Factors associated with endodontic flare-ups: a prospective study. Int Endod J

1995;28(5):261-265.
3. Walton R, Fouad A. Endodontic interappointment flare-ups: a prospective study of incidence and related factors. J Endod 1992;18(4):172-177.
4. Seltzer S, Naidorf IJ. Flare-ups in endodontics: I. Etiological factors. J Endod 1985;11(11):472-478.
5. Torabinejad M, Kettering JD, McGraw JC, et al. Factors associated with endodontic interappointment emergencies of teeth with necrotic pulps. J Endod 1988;14(5):261-266.
6. Bürklein S, Benten S, Schafer E. Quantitative evaluation of apically extruded debris with different single-file systems: Reciproc, F360 and OneShape versus Mtwo. Int Endod J 2014;47:405–409.
7. Tanalp J, Güngör T. Apical extrusion of debris: a literature review of an inherent occurrence during root canal treatment. Int Endod J 2014;47:211–221.
8. Mehdipour O, Kleier DJ, Averbach RE. Anatomy of Sodium Hypochlorite Accidents. J Calif Dent Assoc 2004;32(10):665–71.
9. Zehnder M. Root canal irrigants. J Endod 2006;32(5):389–98.
10. Martin H, Cunningham WT. The effect of endosonic and hand manipulation on the amount of root canal material extruded. Oral Surg Oral Med Oral Pathol 1982;53(6):611-613.
11. Kalra P, Rao A, Suman E, et al. Evaluation of conventional, Protaper hand and Protaper rotary instrumentation system for apical extrusion of debris, irrigants and bacteria–An in vitro randomized trial. J Clin Exp Dent 2017;9(2):e254-e258.
12. Yazdi KA, Sabeti M, Motahhary P, et al. Subcutaneous tissue responses to three endodontic irrigants: a comparative study. Iranian Endod J 2012 ;7(3):144-8.
13. Parirokh M, Jalali S, Haghdoost AA, et al. Comparison of the effect of various irrigants on apically extruded debris after root canal preparation. J Endod 2012;38(2):196-9.
14. Vande Visse JE, Brilliant JD. Effect of the irrigation on the production of extruded material at the root apex during instrumentation. J Endod 1975;1(7):243–6.
15. Brown DC, Moore BK, Brown CE, Newton CW. An in vitro study of apical extrusion ofsodium hypochlorite during endodontic canal preparation. J Endod 1995;12(2):587–91.
16. Myers GL, Montgomery S. A comparison of weights of debris extruded apically by conventional filing and canal master techniques. J Endod 1991;17:275–279.
17. Gawdat S, El Asfouri H. Comparison of the effect of XP-endo Finisher file, passive ultrasonic irrigation and conventional syringe irrigation on the apical extrusion of debris. Egypt Dent J. 2016;62(10):5107-14.
18. Caviedes-Bucheli J, Castellanos F, Vasquez N, Ulate E, Munoz HR. The influence of two reciprocating single-file and two rotary-file systems on the apical extrusion of debris and its biological relationship with symptomatic apical periodontitis. A systematic review and metaanalysis. Int Endod J. 2016;49(3):255-70.
19. Gummadi A, Panchajanya S, Ashwathnarayana S, Santhosh L, Jaykumar T, Shetty A. Apical extrusion of debris following the use of single-file rotary/ reciprocating systems, combined with syringe or ultrasonically-facilitated canal irrigation. J Conserv Dent. 2019;22(4):351-5.
20. Surakanti JR, Venkata RC, Vemisetty HK, et al. Comparative evaluation of apically extruded debris during root canal preparation using Protaper™, Hyflex™ and Waveone™ rotary systems. J Conserv Dent 2014;17(2):129-132.
21. Nayak G, Singh I, Shetty S, et al. Evaluation of apical extrusion of debris and irrigant using two new reciprocating and one continuous rotation single file systems. J Dent (Tehran) 2014;11(3):302-309.
22. Bürklein S, Schäfer E. Apically extruded debris with reciprocating single-file and full-sequence rotary instrumentation systems. J Endod 2012;38(6):850-852.
23. Boutsioukis C, Lambrianidis T, Verhaagen B, Versluis M, Kastrinakis E, Wesselink PR, et al. The effect of needle-insertion depth on the irrigant flow in the root canal: evaluation using an unsteady computational fluid dynamics model. J Endod. 2010;36(10):1664-8.

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