



COMPARATIVE EVALUATION OF THE EFFICACY OF ENDOACTIVATOR, PASSIVE ULTRASONIC IRRIGATION AND SELF-ADJUSTING FILE SYSTEM ON REMOVAL OF DOUBLE ANTIBIOTIC PASTE: AN IN-VITRO STUDY

Endodontic

Vibha Hegde

HOD, Professor, YMT Dental College and Hospital, Navi Mumbai

Saurabh Gotmare*

PG Student, YMT Dental College and Hospital, Navi Mumbai *Corresponding Author

Sharad Kokate

Professor and Guide, YMT Dental College and Hospital, Navi Mumbai

Eshani Yeragi

PG Student, YMT Dental College and Hospital, Navi Mumbai

ABSTRACT

The traditional irrigation techniques have failed to remove Antibiotic pastes completely from root canal system. So, the role of agitation might be crucial in its removal. Aim: To comparatively evaluate the efficacy of the EndoActivator System (EA), Passive Ultrasonic Irrigation (PUI) and Self Adjusting File (SAF) system on the removal of Double Antibiotic Paste (DAP) from the root canals. Methodology: 60 extracted human single-rooted teeth were selected and root canal preparation was performed using ProTaper Universal rotary instruments till F3. The specimens were then split longitudinally, and 2 standardized grooves were prepared in the coronal and apical part of each segment. DAP was placed in the grooves for 4 weeks, and the root halves were reassembled. EA System, PUI and SAF system were used for the removal of DAP. The root segments were disassembled, and the amount of remaining antibiotic pastes was evaluated under a stereomicroscope using a 4-grade scoring system. The data was evaluated using appropriate statistical analysis. Results: Passive UltraSonic Irrigation shows maximum removal while sonic endoactivator shows the least removal of DAP. Conclusion: The newer irrigation systems can be a viable alternative to the conventional syringe irrigation in removing DAP from the root canal.

KEYWORDS

Double Antibiotic Paste, Passive Ultrasonic Irrigation System, EndoActivator System, Self Adjusting File System.

1. INTRODUCTION

The main purpose of cleaning of root canal treatment is to remove microbial source out of the canal and make the canal devoid of any pathology. Antibiotic pastes have been used for endodontic therapy in chronic peri-radicular diseases. To accomplish this goal, various antimicrobial and irritants were used. Intracanal medicament is used to reduce the number of bacteria from the canal. Calcium hydroxide is the most commonly used as it enhance the incidence of bacteria free canals¹. Antibiotic pastes are another example of intracanal medicament, which consist of triple antibiotic paste (TAP) and its modified form double antibiotic paste (DAP). The content of triple antibiotic paste are metronidazole, ciprofloxacin and minocycline except minocycline is eliminated in double antibiotic paste, which is responsible for the discolouration of the tooth^{2,3,4}. Still, the efficacy of both the pastes are equal. Also researchers have shown that remnants of medicaments prevent penetration of sealers or cements into the canal dentine walls, as they act as physical barrier along the sealer / dentin interface as well as showed that both DAP and TAP had detrimental effects on human stem cells in the apical papilla^{5,6}. Thus, the complete removal of medicament from the root canal is an important step in successful root canal treatment.

The most commonly used technique for the removal of medicaments is recapitulation of the root canal with a master apical file at the working length followed by copious irrigation with ethylene diamine tetra acetic acid (EDTA) and sodium hypochlorite. Ultrasonic devices were first introduced in Endodontics by Richman (1957)⁷. Two types of ultrasonic irrigation have been described in the literature: one where irrigation is combined with simultaneous ultrasonic instrumentation (UI) and another without simultaneous instrumentation, so called passive ultrasonic irrigation (PUI)⁸. Passive ultrasonic irrigation (PUI) (Acteon Group Ltd, Merignac, France) uses a stainless steel file to activate the irrigant in the canal, and PUI is able to disrupt the endodontic biofilm, micro- organisms (planktonic or in biofilm) and organic tissue from the root canal facilitating better penetration of irrigants throughout the endodontic dentinal walls. Because of the active streaming of the irrigant its potential to contact a greater surface area of the canal wall will be enhanced. Arslan et.al. showed that Passive Ultrasonic Irrigation (PUI) is more effective than needle irrigation system⁹. A novel instrumentation and irrigation device, the Self Adjusting File system, was introduced by Re-Dent- Nova (Ra'anana, Israel). This method proves efficient in inaccessible areas of root canal where other instruments are ineffective. Moreover, the design if the SAF allows a continuous flow of irrigant through its hollow file while the solution is continuously activated by its vibrating motion. the potential to clean the canal at different level is consider

effective with PUI system¹⁰. However, it is unknown whether the novel technique, if use as irrigation system will remove intracanal medicament.

Hence the aim of the study was to comparatively evaluate the efficacy of the EndoActivator System, PUI and SAF system on the removal of Double Antibiotic Paste from the root canals.

Null hypothesis -

The removal of DAP was not affected by the 1) sections of root canal (third) or the 2) irrigation technique.

2. Material and Methods

The study was conducted by collecting 60 extracted single rooted teeth from the Department of Oral Surgery of Y.M.T. dental college, Kharghar, Navi Mumbai.

The tooth were shaped till F3 protaper universal File. The tooth were sectioned in equal half in longitudinal direction. Grooves were prepared within the canal in Coronal and Apical third of the tooth. DAP in a slurry form is filled in the groove of the root canal. The sections were approximated (joined) back with the help of rubber band and kept in incubator for a period of 21 days at 37° C in 100% humidity.

The teeth samples were randomly divided into 3 groups each having 20 teeth.

Group 1: SAF system with trans-linear motion is used for 4 min in the canal to clean the DAP from the grooves.

Group 2: PUI with ultrasonic motion is used for 10 secs in the canal to clean the DAP from the grooves.

Group 3: EndoActivator with sonic motion is used for 30 secs to clean the DAP from the canal.

The samples were collected and disassembled and observed under stero-microscope to determine the amount of DAP present inside the groove of root canal which is determined by van der Sluis criteria where,

score 0 - No DAP present

score 1 - less than half DAP present in the groove

score 2 - more than half DAP present in the groove

score 3 - gooves filled with DAP

3. Statistical Analysis

Data obtained was compiled on a MS Office Excel Sheet (v

2010). Data was subjected to statistical analysis using Statistical package for social sciences (SPSS v 21.0, IBM).

pvalue of <0.05 was considered to be statistically significant. The data was subjected to Kruskal Wallis Analysis. Independent comparison of the data was done using Mann-Whitney U test.

4. RESULT

The results of the groups for coronal and apical thirds ($P < .001$) are as follows: -

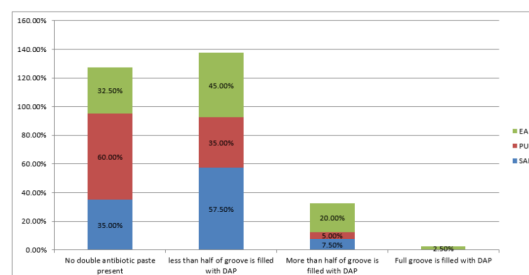
Group A (SAF): - 85% removed from the canal

Group B (PUI): - 90 % removed from the canal

Group C (EA): - 60 % removed from the canal

The Kruskal-Wallis test revealed that since p-value for the Kruskal-Wallis was less than that of 0.05 indicates significant difference between the scores of three systems when compared by considering all data. There was no significant difference between the scores of three systems when compared by considering coronal type while there was

significant difference between the scores of three systems when compared by considering apical type. When Independent comparison was done using Mann-Whitney U test there was statistical significance was found by Endo Activator System and Self Adjusting File; Endo Activator System and Passive Ultrasonic Irrigation System.



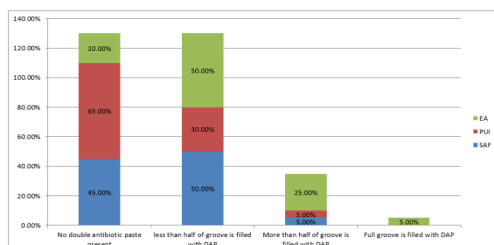
Graph 1: Graph showing comparison of all the data

Table 1:- Comparison of all the data

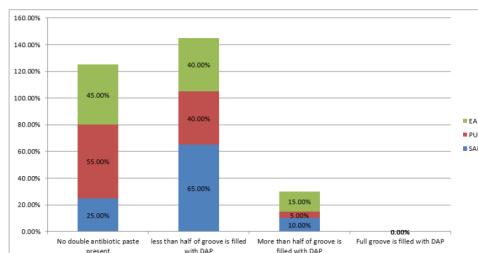
	System					
	SAF		PUI		EA	
	Count	Column N %	Count	Column N %	Count	Column N %
No double antibiotic paste present	14	35.0%	24	60.0%	13	32.5%
less than half of groove is filled with DAP	23	57.5%	14	35.0%	18	45.0%
More than half of groove is filled with DAP	3	7.5%	2	5.0%	8	20.0%
Full groove is filled with DAP	0	.0%	0	.0%	1	2.5%

Table 2: - Apical comparison of the data:

	System					
	SAF		PUI		EA	
	Count	Column N %	Count	Column N %	Count	Column N %
No double antibiotic paste present	9	45.0%	13	65.0%	4	20.0%
less than half of groove is filled with DAP	10	50.0%	6	30.0%	10	50.0%
More than half of groove is filled with DAP	1	5.0%	1	5.0%	5	25.0%
Full groove is filled with DAP	0	.0%	0	.0%	1	5.0%



Graph 2: - Graph showing comparison of apical third



Graph 3: - Graph showing comparison of coronal

Table 3: - Coronal Comparison of the data:

	System					
	SAF		PUI		EA	
	Count	Column N %	Count	Column N %	Count	Column N %
No double antibiotic paste present	5	25.0%	11	55.0%	9	40.0%
less than half of groove is filled with DAP	13	65.0%	8	40.0%	8	40.0%
More than half of groove is filled with DAP	2	10.0%	1	5.0%	3	15.0%
Full groove is filled with DAP	0	.0%	0	.0%	0	5.0%

thirdIndependent comparison using Mann-Whitney U test:

Tukey HSD	(J) System	Mean Difference (I-J)	p-value	Interpretation
SAF	PUI	.20000	.241	Non-Significant
	EA	-.55000*	.026	Significant
PUI	SAF	-.20000	.241	Non-Significant
	EA	-.75000*	.002	Significant

Endoactivator apical and coronal

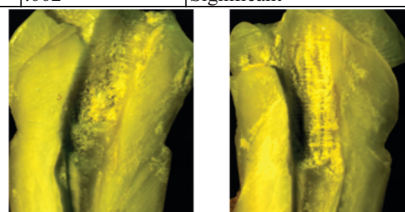
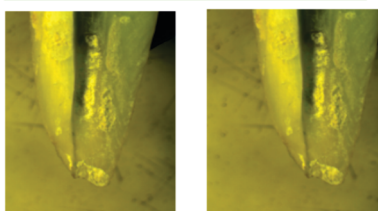


Fig. 1:- Stearomicroscopic Image of Apical and Coronal third using Endoactivator System.

PUI Apical and Coronal

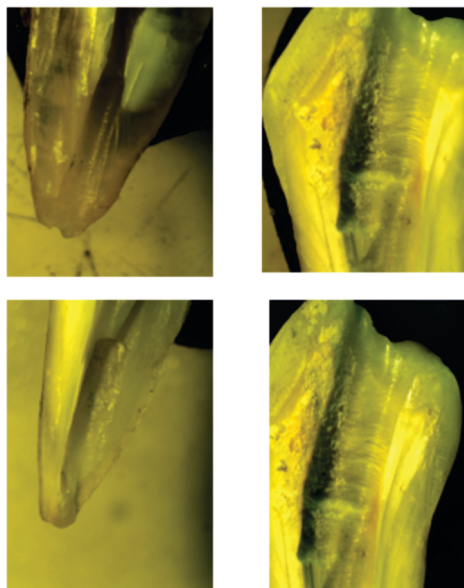


Fig. 2:- Stereomicroscopic Image of Apical and Coronal third using PUI System.

SAF apical and coronal

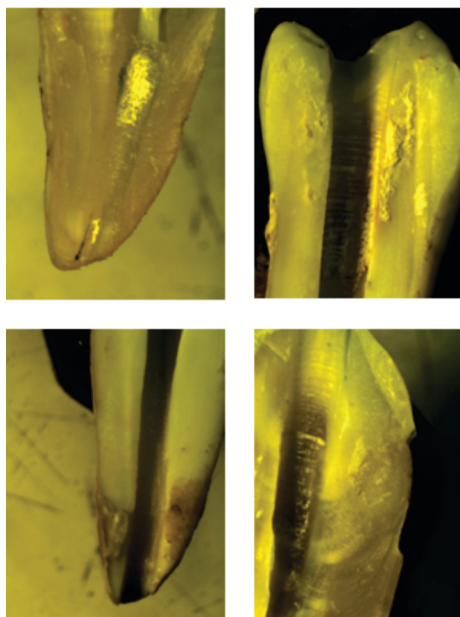


Fig. 3:- Stereomicroscopic Image of Apical and Coronal third using SAF System.

5. DISCUSSION

The aim of the present study was to comparatively evaluate the efficacy of the EndoActivator System (EA), Passive Ultrasonic Irrigation (PUI) and Self Adjusting File (SAF) system on the removal of Double Antibiotic Paste (DAP) from the root canals. In our study, stereomicroscopy was used, and the remnants of DAP on the root canal walls were evaluated similar to the study done by Akman et al. 2015¹¹. The results of this study shows that DAP was least removed when Sonic Endoactivator was used. It was more effective in coronal aspect as compared to the apical third. The reason for this effective irrigation can be attributable to the facts that it has 1) Higher velocity of irrigation solution flow and 2) fresh irrigant replacement properties during the procedure.

The overall results of the groups for coronal and apical thirds ($P < .001$)

showed that Group A i.e. in the (SAF) group :- 85% was removed from the canal, in the Group B (PUI) group :- 90 % was removed from the canal whereas in Group C (EA): - 60 % was removed from the canal. The PUI group showed the highest removal. There are two studies done by **Stamos et al. 1987**, **Sabins et al. 2003**^{12,13} which reports that PUI removed more dentine debris from the root canal than sonic irrigation, in contrast to one study which showed no significant difference **Jensen et al. 1999**¹⁴. In the study by **Jensen et al. 1999**, however, there was no mention of pre-shaping of the files and this may explain their findings¹⁴. The positive relationship between streaming velocity and frequency might be the reason for the higher efficiency of PUI versus sonic irrigation.

In contrast to a study done by **Berkhoff et al. 2014**¹⁵ showed that when TAP was used as an intracanal medicament with different irrigation protocol approximately 88% of the TAP was retained in the root canal system regardless of the irrigation technique used. Furthermore, approximately 50% of the radiolabeled TAP was present circumferentially up to 350 μ m within the dentin, and up to 98% of the radiolabeled intracanal calcium hydroxide was removed, and most residual medicament was found present in the initial 50 mm of dentin. Thereby they concluded that current irrigation techniques were ineffective in removing TAP from root canal systems, possibly because of its penetration and binding into dentin.

In a similar study done by **Gokturk et al. 2016**¹⁶ showed that when different irrigation protocols were used such as conventional syringe irrigations, passive ultrasonic irrigation (PUI), Vibringer, CanalBrush, XP-endo Finisher, and laser-activated irrigation (LAI) systems in removing double antibiotic paste (DAP) from root canals none of the protocols were able to completely remove the DAP from the grooves. In another study by **Arslan, et al. (2014)**⁹ investigated the effectiveness of different irrigants with or without ultrasonic activation in removing TAP from simulated root canal irregularities. They reported that PUI with 1% NaOCl was superior to other irrigation techniques in removing TAP. These results are similar to the results obtained in this study. **Akçay, et al. (2014)**⁶ investigated the effectiveness of PIPS and an EndoActivator System in removing DAP and TAP from root canal irregularities in the coronal and apical parts of a root canal system. They reported that PIPS was superior for the removal of DAP and TAP, regardless of the groove location, when compared with the EndoActivator and needle irrigation groups.

SAF shows translinear motion with continuous irrigation facilitates the removal of DAP. In the present study the overall result of apical and coronal third showed that 85% of DAP was removed from the canal. When Independent comparison was done using Mann-Whitney U test there was statistical significance was found by Endo Activator System and Self Adjusting File; Endo Activator System and Passive Ultrasonic Irrigation System. In a study by **Akman et.al.**¹¹ shows that SAF significantly improved the removal of TAP from root canals compared to conventional syringe irrigation. The design of the file allows the mesh to adapt the canal wall in three dimension, thus improves removal of DAP. **Capar et. al.**¹⁷ showed that SAF is more effective than needle irrigation in apical third to remove Calcium Hydroxide. EndoActivator has sonic vibrations used to remove the DAP from the root canal. This is more effective in the coronal aspect than in the apical aspect.

However, this is an in vitro study and does not depict the intra oral condition which might play a major role which is the major limitation of this study. Hence further more in vivo studies must be carried out in future in this aspect so as to confirm the results of in vitro study in clinical conditions.

6. CONCLUSION

PUI shows maximum removal of DAP while least with EndoActivator. Within the limitations of this study, it can be concluded that the use of irrigation activation regimen significantly improved the removal of DAP.

7. Compliance with ethical standards

Ethical approval:- This study does not contain any studies with human participants or animals performed by any of the authors.

8. Conflict of interest

The authors certify that they have no commercial or associative interest that represents a conflict of interest in connection with the manuscript.

REFERENCES

- [1] Law A, Messer H (2004) An evidence-based analysis of the antimicrobial effectiveness of intracanal medicaments. *Journal of Endodontics* 30, 689–94.
- [2] Hoshino E, Kurihara-Ando N, Sato I, et al. (1996) In-vitro antibacterial susceptibility of bacteria taken from infected root dentine to a mixture of ciprofloxacin, metronidazole and minocycline. *Int Endod J*;29:125–30.
- [3] Kim JH, Kim Y, Shin SJ, et al. Tooth discoloration of immature permanent incisor associated with triple antibiotic therapy: a case report. *J Endod* 2010;36:1086–91.
- [4] Miller EK, Lee JY, Tawil PZ, et al. Emerging therapies for the management of traumatized immature permanent incisors. *Pediatr Dent* 2012;34:66–9.
- [5] Ruparel NB, Teixeira FB, Ferraz CC, et al. Direct effect of intracanal medicaments on survival of stem cells of the apical papilla. *J Endod* 2012;38:1372–5.
- [6] Akcay M, Arslan H, Yasa B, Kavrik F, Yasa E. (2014) Spectrophotometric analysis of crown discoloration induced by various antibiotic pastes used in revascularization. *J Endod*;40:845-8.
- [7] Richman RJ. (1957) The use of ultrasonics in root canal therapy and root resection. *Med Dent J*;12:12–8.
- [8] van der Sluis LWM, Versluis M, Wu MK, Wesselink PR.(2007). Passive ultrasonic irrigation of the root canal: a review of the literature. *International Endodontic Journal*, 40, 415–426.
- [9] Arslan H, Capar ID, Saygili G, Uysal B, Gok T, Ertas H, et al.(2014) Efficacy of various irrigation protocols on the removal of triple antibiotic paste. *Int Endod J* ;47:594-9.
- [10] Ruddle CJ, Machtou P, West JD (2013). The shaping movement: Fifth-generation technology. *Dent Today*, 32:94, 96-9.
- [11] Akman M, Akbulut MB, Aydinbelge HA, Belli S. (2015). Comparison of different irrigation activation regimens and conventional irrigation techniques for the removal of modified triple antibiotic paste from root canals. *J Endod*, 41:720-4.
- [12] Stamos DE, Sadeghi EM, Haasch GC, Gerstein H. (1987) An in vitro comparison study to quantitate the debridement ability of hand, sonic, and ultrasonic instrumentation. *J Endod*;13:434–40.
- [13] Sabins RA, Johnson JD, Hellstein JW. (2003) A comparison of the cleaning efficacy of short-term sonic and ultrasonic passive irrigation after hand instrumentation in molar root canals. *J Endod*;29:674–8.
- [14] Jensen SA, Walker TL, Hutter JW, Nicoll BK. (1999) Comparison of cleaning efficacy of passive sonic activation and passive ultrasonic activation after hand instrumentation in molar root canals. *J Endod*;25:735–8.
- [15] Berkhoff JA, Chen PB, Teixeira FB, Diogenes A. (2014) Evaluation of triple antibiotic paste removal by different irrigation procedures. *J Endod*;40:1172-7.
- [16] Gokturk H, Ozkocak I, Buyukgebiz F, Demir O. (2016) An in vitro evaluation of various irrigation techniques for the removal of double antibiotic paste from root canal surfaces. *J Appl Oral Sci. Nov-Dec*;24(6):568-574.
- [17] Capar ID, Ozcan E, Arslan H, Ertas H, Aydingelge HA. (2014) Effect of different final irrigation methods on the removal of calcium hydroxide from an artificial standardized groove in the apical third of root canals. *J Endod*;40(3):451-4.