Comparative Evaluation of Different Irrigation Techniques with Conventional Irrigation Technique for the Removal of Double Antibiotic Paste from Root Canal-An in vitro study

Samrudhi Khatod*, Anuja Ikhar, Pradnya Nikhade, Manoj Chandak, Kaustubh Khatod, Akshay Jaiswal, Madhulika Chandak, Chanchal Rathi, Nidhi Motwani

Department of Conservative Dentistry And Endodontics, Sharad Pawar Dental College and hospital, Datta Meghe Institute of Medical Sciences (Deemed to be University), Sawangi (m), Wardha, Maharashtra, India

Article History:
Received on: 13 May 2020
Revised on: 14 Jun 2020
Accepted on: 15 Jun 2020

Keywords:
Double antibiotic paste, Passive ultrasonic irrigation, EndoVac, Conventional syringe irrigation

ABSTRACT

Complete removal of infection, rendering root canal free of an organism is the prime aim of endodontic treatment. It cannot be achieved alone by biomechanical preparation due to the complexity of root canal treatment. Therefore the use of intracanal medicament is a must. The antibiotic paste is frequently used intracanal medicament, usually in regenerative cases. Hence the aim of the is to compare different irrigation technique for removal of double antibiotic paste from root canal through a stereomicroscope. 36 single-rooted were standardized to root length of 12mm then instrumented by Protaper rotary file up to size F4. Irrigation was done using sodium hypochlorite in between instrument change. The root canal was dried using paper point and filled by DAP and then randomly allocated to 3 groups(n=12) according to irrigation system used: conventional syringe irrigation (CSI), Passive ultrasonic irrigation(PUI), EndoVac (EV). Roots were then longitudinally sectioned using the diamond disk and studied under a stereomicroscope using a scoring scale. Data were evaluated using one way ANOVA and Tukey test. Among all experimental group CSI was least efficient. PUI and EV showed greater efficiency but no significant difference between PUI and EV, but a significant difference between CSI and PUI, EV (p< 0.05). Use of irrigation activation system results in efficient removal of DAP compared to CSI.

INTRODUCTION

Endodontic regeneration has proved to be a boon in the treatment of immature permanent teeth. (Diongenes et al., 2013; Kriplani et al., 2013) The prime protocol of this procedure is the complete canal disinfection, which is achieved by intracanal medicament. (Kamble et al., 2017; Khatod et al., 2020) TAP formulated by Hoshino et al. (1996) is most commonly used medicament for a regenerative procedure. (Hoshino et al., 1996) Use of TAP has been discontinued because of its property of discolouring the tooth structure. (Trope, 2010) Thus use DAP can be done. After complete canal disinfection removal of medicament followed by placement of MTA plug root canal (Thibodeau and Trope, 2007; Tawfik et al., 2013). Ruparel et al. (2012); Kim et al. (2010) founded that antibiotic paste has a detrimental effect on stem cell in the apical papilla. Therefore, complete removal of medica-
ment is must to avoid detrimental effect on stem cells. And to inhibit its result on sealer penetration and discolouration. (Zhu et al., 2013; Villas-Bôas et al., 2011) Conventional syringe irrigation is the most commonly practised method for removal of medicament but is not efficient enough for complete removal of it. (Mukherjee et al., 2017; Reddy et al., 2019) Therefore use of different irrigation activation system for efficient supply of irrigating solution and removal from the canal. (Khubchan-dani et al., 2017; Patni et al., 2016) EndoVac (EV) is based on apical negative pressure. (Chandak et al., 2018; Schoeffel, 2008) Developed for delivering irrigants at the apical third of canal, for cleaning of the root canal. (Ahmad et al., 1987) Passive ultrasonic irrigation (PUI) uses U file for irrigant actuation in the root. And allow removal of biofilm, permitting efficacious penetration of irrigants in canal walls. (Schoeffel, 2008; Sluis et al., 2007) Therefore the aim of to “evaluate the efficacy of different irrigation activation system for removal of Double Antibiotic Paste from root canal”.

MATERIALS AND METHODS

36 single-rooted teeth were collected at decoronated to simulate 12mm root length of each tooth (Figure 1). Then instrumented up to F4 using pro taper rotary files (Figure 2). 1ml of 3% sodium hypochlorite was used in between every change of file. The double antibiotic paste was prepared by mixing metronidazole and ciprofloxacin in 1:1 ratio in distilled water to make a slurry-like paste (Figure 3). Using leptospiral medicament was placed in canal up to orifice and sealed using cavit for seven days and stored at 100% humidity for 7 days. Randomly teeth were allocated in each group such that 12 in each group

Group 1 (CSI)

24 gauge needle was used and placed as apically as possible such that it does not adhere to the canal wall. 10 ml/min of 3% NaOCl was used as an irrigating solution (Figure 4).

Group 2 (PUI)

#15 U file was placed 1mm short of working length without adhering canal wall. The file was activated with a power setting of 6 and 10ml/min 3% NaOCl was agitated using it (Figure 5).

Group 3 (EV)

Initially 5ml of 3%NaOCl for 30 sec using microcannula was delivered in canal (Figure 6) followed by 5ml of 3%NaOCl for 30 sec using microcannula (Figure 7). After this final wash using 1 ml of NS to remove remaining NaOCl, the canal was dried using paper point, and longitudinal cuts were placed on root using diamond disk deep enough but not penetrating the canal. Using chisel root was split into two halves (Figure 8). And then evaluated under stereomicroscope 25X (Zeiss) using scoring scale by Sluis et al. (2007). (Shin et al., 2010) score 0 - the canal was empty; score 1- DAP was present in less than half of the canal; score 2 -DAP covered more than half of the canal, and score 3 - the canal was filled with DAP (Figure 9, Figure 10, Figure 11).

“Statistical analysis was done by descriptive, inferential statistics using one way ANOVA and multiple comparisons Tukey test and software used in the analysis were SPSS 24.0 version and EPI-INFO 7.0 version, p<0.05 is considered as the level of significance”.

RESULTS AND DISCUSSION

Mean intracanal medicament left in conventional syringe irrigation was 2.41±0.51, in passive ultrasonic irrigation it was 1.25±0.45, and in EndoVac it was 1.41±0.51 (Table 1). By using one way ANOVA statistically significant variation was found in mean intracanal medicament removal in three groups (F=16.60,p=0.0001). By using multiple comparisons, Tukey Test statistically significant difference was found in mean intracanal medicament removal between conventional syringe irrigation and passive ultrasonic irrigation (p=0.001) and between traditional irrigation of syringe and Endovac (p=0.0001) and no significant difference was found between passive ultrasonic irrigation and Endovac (p=0.690) (Table 2).

Figure 1: Single rooted specimen collected
Table 1: Descriptive Statistics

| Removal techniques                  | Sample size | Mean | Std. deviation | Std. error | 95% confidence interval for mean-lower bound | 95% confidence interval for mean-upper bound | Minim | Maximum |
|-------------------------------------|-------------|------|----------------|------------|---------------------------------------------|---------------------------------------------|-------|---------|
| Conventional syringe irrigation     | 12          | 2.41 | 0.51           | 0.14       | 2.08                                        | 2.74                                        | 2.00  | 3.00    |
| Passive ultrasonic irrigation       | 12          | 1.25 | 0.45           | 0.13       | 0.96                                        | 1.53                                        | 1.00  | 2.00    |
| EndoVac                             | 12          | 1.41 | 0.51           | 0.14       | 1.08                                        | 1.74                                        | 1.00  | 2.00    |

Table 2: Comparison between different groups

| Removal technique                                      | Mean difference | Std.error | p-value     | 95% confidence level lower bound | 95% confidence level upper bound |
|--------------------------------------------------------|-----------------|-----------|-------------|---------------------------------|---------------------------------|
| Conventional syringe irrigation compared to passive ultrasonic irrigation | 1.16            | 0.20      | 0.0001 (significant) | 0.67                            | 1.66                            |
| Conventional syringe irrigation compared to EndoVac    | 1.00            | 0.20      | 0.0001 (significant) | 0.50                            | 1.49                            |
| Passive ultrasonic irrigation compared to EndoVac      | -0.16           | 0.20      | 0.690 (not significant) | -0.66                          | 0.32                            |

Figure 2: Specimen instrumented upto F4

Figure 3: Freshly prepared double antibiotic paste

Figure 4: Specimen irrigated by syringe irrigation

Figure 5: Specimen irrigated by passive ultrasonic irrigation
During PUI, acoustic microstreaming and cavitation resulting in efficient removal of debris or medication from canal compared to CSI and EV. But no significant difference compared to EV. Transmission of energy from ultrasonically oscillating file to irrigant in the canal is a principle of PUI. (Shin et al., 2010; Kenee et al., 2006) PUI was found to be efficient enough for removal of medicament in many studies, and suggestive of improved cleanliness of canal walls. (Ricucci and Langeland, 1997; Jiang et al., 2011) PUI leads to increased velocity of irrigant flow which might result in its efficiency. Results of the current study for PUI group are the same as that of other studies in which maximum of Ca(OH)2 was removed but not totally. It can be because of lowest power intensity of the ultrasonic device. Jiang et al. (2011); Desai and Himel (2009) have seen cleaning efficiency increases following the output of the ultrasonic device. In future studies, a positive result might be gained using the increased output of ultrasonic activation. EV offers safe delivery of irrigant up to the apex of root and effective cleansing, especially in the apical region of the root canal. (Ahmetoglu et al., 2013; Gu et al., 2009) The EndoVac System showed efficient cleaning of the canal compared to CSI but no significant difference between PUI. Other studies were also following the above result. EV comprises of macro and microcannula. Cannula connected to a high-speed suction produces negative pressure which drags irrigant up to the apex of the cannula and evacuates the irrigant with debris through small holes. However, in our study, total success for removal of DAP was not attained. It might be because microcannulas and microcannulas might get obstructed by particles of DAP paste, which could have caused less irrigation solution to reach the apical region. (Gu et al., 2009)
CONCLUSION

Within confinement of study, it can be stated that the use of irrigation activation system results in meliorate removal of medicament compared to CSI. Use of Passive ultrasonic irrigation showed promising results in removal of intracanal remedy compared to routinely followed syringe irrigation. Thus, the use of irrigation activation system might result in improved seal post obturation.

ACKNOWLEDGEMENT

The authors acknowledge this study was supported by the Department of conservative dentistry and Endodontics, Sharad Pawar Dental College. (DMIMS)

Source(s) of support

The authors do not have any financial interest in the companies whose materials are included in this article

Conflict of Interest

The authors declare that they have no conflict of interest for this study.

Funding Support

The authors declare that they have no funding support for this study.

REFERENCES

Ahmad, M., Ford, T. R. P., Crum, L. A. 1987. Ultrasonic debridement of root canals: Acoustic streaming and its possible role. *Journal of Endodontics*, 13(10):490–499.

Ahmetoglu, F., Keles, A., Simsek, N. 2013. Effectiveness of the Severel Irrigation Techniques for Removal of Calcium Hydroxide-based Intracanal Medication from an Artificial Standardized Groove in the Apical Root Canal. *Marmara Dental Journal*, 1(2):53–56.

Chandak, M. G., Modi, R. R., Rathi, B. J., Gogiya, R. J., Bhatada, P. 2018. In Vitro Comparative Assessment of Diffusion of ION from Calcium Hydroxide with Three Different Phytomedicine pastes through Dentin. *World Journal of Dentistry*, 9(5):366–371.

Desai, P., Himel, V. 2009. Comparative Safety of Various Intracanal Irrigation Systems. *Journal of Endodontics*, 35(4):545–549.

Diogenes, A., Henry, M. A., Teixeira, F. B., Hargreaves, K. M. 2013. An update on clinical regenerative endodontics. *Endodontic Topics*, 28(1):2–23.

Gu, L. S., Kim, J. R., Ling, J. 2009. Review of contemporary irrigant agitation techniques and devices. *J Endod*, 35(6):791–804.

Hoshino, E., Kurihara-Ando, N., Sato, I., Uematsu, H., Sato, M., Kota, K., Iwaku, M. 1996. In-vitro antibacterial susceptibility of bacteria taken from infected root dentine to a mixture of ciprofloxacin, metronidazole and minocycline. *International Endodontic Journal*, 29(2):125–130.

Jiang, L.-M., Verhaagen, B., Versluis, M., Langedijk, J., Wesselink, P., van der Sluis, L. W. 2011. The Influence of the Ultrasonic Intensity on the Cleaning Efficacy of Passive Ultrasonic Irrigation. *Journal of Endodontics*, 37(5):688–692.

Kamble, A. T., Kamble, M. K., Abhishek, P. 2017. A Comparative Study on Wound Healing Using Placentrex, Collagen, Vitamin C and Insulin. *Journal of Evolution of Medical and Dental Sciences*, 6(29):2366–2371.

Kenee, D. M., Allemang, J. D., Johnson, J. D., Hellstein, J., Nichol, B. K. 2006. A Quantitative Assessment of Efficacy of Various Calcium Hydroxide Removal Techniques. *Journal of Endodontics*, 32(6):563–565.

Khatod, S., Agrawal, D., Ikhar, A., Jaiswal, P. 2020. Reattachment of complex tooth fracture : A Boon in dentistry. *Medical Science*, 24(103):1392–1396.

Khubchandani, M., Baliga, M., Rawlani, S., Rawlani, S., Khubchandani, K., Thosar, N. 2017. Comparative evaluation of different obturation techniques in primary molars: An in vivo study. *European Journal of General Dentistry*, 6(1):42–42.

Kim, J. H., Kim, Y., Shin, S. J. 2010. Tooth discoloration of immature permanent incisor associated with triple antibiotic therapy: a case report. *J Endod*, 36(6):1086–1091.

Kriplani, R., Thosar, N., Baliga, M. S., Kulkarni, P., Shah, N., Yeluri, R. 2013. Comparative Evaluation of Antimicrobial Efficacy of Various Root Canal Filling Materials Along with Aloevera Used in Primary Teeth: A Microbiological Study. *Journal of Clinical Pediatric Dentistry*, 37(3):257–262.

Mukherjee, P., Patel, A., Chandak, M., Kashikar, R. 2017. Minimally Invasive Endodontics a Promising Future Concept: A Review Article. *International Journal of Scientific Study*, 5(1):245–251.

Nielsen, B. A., Baumgartner, J. C. 2007. Comparison of the EndoVac System to Needle Irrigation of Root Canals. *Journal of Endodontics*, 33(10):611–615.

Patni, P. M., Chandak, M., Jain, P., Patni, M. J., Jain, S., Mishra, P., Jain, V. 2016. Stereomicroscopic evaluation of sealing ability of four different root canal sealers-an invitro study. *Journal of clinical and...*
Reddy, K. V., Jadhav, A., Bhola, N., Mishra, A., Dakshinkar, P. 2019. Is 0.75% ropivacaine more efficacious than 2% lignocaine with 1:80,000 epinephrine for IANB in surgical extraction of impacted lower third molar? *Oral and Maxillofacial Surgery*, 23(2):225–231.

Ricucci, D., Langeland, K. 1997. Incomplete calcium hydroxide removal from the root canal: a case report. *International Endodontic Journal*, 30(6):418–421.

Ruparel, N. B., Teixeira, F. B., Ferraz, C. C., Diogenes, A. 2012. Direct Effect of Intracanal Medicaments on Survival of Stem Cells of the Apical Papilla. *Journal of Endodontics*, 38(10):1372–1375.

Schoeffel, G. J. 2008. The EndoVac method of endodontic irrigation, part 2-efficacy. *Dent Today*, 27(1):82–87.

Shin, S. J., Kim, H. K., Jung, I. Y. 2010. Comparison of the cleaning efficacy of a new apical negative pressure irrigating system with conventional irrigation needles in the root canals. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*, 109(3):479–484.

Sluis, L. W. M. V. D., Wu, M. K., Wesselink, P. R. 2007. The evaluation of removal of calcium hydroxide paste from an artificial standardized groove in the apical root canal using different irrigation methodologies. *International Endodontic Journal*, 40(1):52–57.

Taşdemir, T., Çelik, D., Er, K., Yildirim, T., Ceyhanli, K. T., Yeşilyurt, C. 2011. Efficacy of several techniques for the removal of calcium hydroxide medicament from root canals. *International Endodontic Journal*, 44(6):505–509.

Tawfik, H., Abu-Seida, A. M., Hashem, A. A., Nagy, M. M. 2013. Regenerative potential following revascularization of immature permanent teeth with necrotic pulps. *International Endodontic Journal*, 46(10):910–922.

Thibodeau, B., Trope, M. 2007. Pulp revascularization of a necrotic infected immature permanent tooth: case report and review of the literature. *Pediatr Dent*, 29(1):47–50.

Trope, M. 2010. Treatment of the Immature Tooth with a Non–Vital Pulp and Apical Periodontitis. *Dental Clinics of North America*, 54(2):313–324.

Villas-Bôas, M. H., Bernardineli, N., Cavenago, B. C., Marciano, M., del Carpio-Perochena, A., de Moraes, I. G., Duarte, M. H., Bramante, C. M., Ordinola-Zapata, R. 2011. Micro–Computed Tomography Study of the Internal Anatomy of Mesial Root Canals of Mandibular Molars. *Journal of Endodontics*, 37(12):1682–1686.