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Original Research

Efficacy of passive ultrasonic irrigation system with conventional needle irrigation system in smear removal- An *in vitro* study

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ABSTRACT:

Background: The present study was conducted to compare the efficacy of PUI system with CNI system in smear removal.

Materials & Methods: 60 single-rooted mandibular premolars were divided into 3 groups of 20 each. Group I teeth were irrigated with conventional needle irrigation (CNI) system and group II teeth were irrigated with passive ultrasonic irrigation (PUI) system and group III had negative control. The remaining smear layer was analyzed using SEM. **Results:** The mean smear layer score was significantly less in CNI group as compared to PUI and control group ($P < 0.05$). **Conclusion:** Conventional needle irrigation was found to be better as compared to passive ultrasonic irrigation in smear layer removal.

Key words: Conventional needle irrigation, Passive ultrasonic irrigation, Smear layer.

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INTRODUCTION

Root canal treatment usually involves the chemo-mechanical removal of bacteria and infected dentine from within the root canals. The process is often followed by an intracanal dressing and a root filling.¹

Amongst important factors affecting the prognosis of root canal treatment is the seal created by the filling against the walls of the canal. Considerable effort has been made to understand the effect of the smear layer on the apical and coronal seal.²

During mechanical instrumentation, a smear layer is created on the root canal surface. It loosely adheres to the root canal surface and is comprised of organic materials, which may contain bacteria and their by-products, and inorganic materials such as dentin debris.³ Therefore, it is necessary to remove the smear layer to obtain a good seal between the root canal

surface and the filling material and to decrease the number of bacteria and leakage after the canals are filled using ethylenediaminetetraacetic acid (EDTA) and then sodium hypochlorite (NaOCl) solution for the optimal result.⁴

Conventional needle irrigation (CNI) has been used for root canal irrigation, but one of the limitations is a restricted flow of irrigant in the root canal, especially in the apical third. The passive ultrasonic irrigation (PUI) system is one of the most widely used root canal irrigation systems. The PUI system can increase the efficacy of root canal debridement when compared with the CNI system.⁵ The present study was conducted to compare the efficacy of PUI system with CNI system in smear removal.

MATERIALS & METHODS

The present study was conducted in the department of Endodontics. It comprised of root canals of 60 single-rooted mandibular premolars which were extracted due to orthodontic treatment. Institutional ethical clearance for the study was obtained before starting it.

Teeth were mechanically prepared, and the teeth were then randomly divided into 3 groups of 20 each. Group I teeth were irrigated with conventional needle irrigation (CNI) system and group II teeth were

irrigated with passive ultrasonic irrigation (PUI) system. 20 specimens were used as a negative control (Group III). After irrigation, the teeth were split longitudinally and examined under scanning electron microscopy at 1 mm, 3 mm, and 5 mm from the working length. The remaining smear layer was analyzed to assess the efficacy of each irrigation system. Results were tabulated and subjected to statistical analysis. P value less than 0.05 was considered significant.

RESULTS

Table I Distribution of teeth

Groups	Group I	Group II	Group III
System	Conventional needle irrigation	Passive ultrasonic irrigation	Control
Number	20	20	20

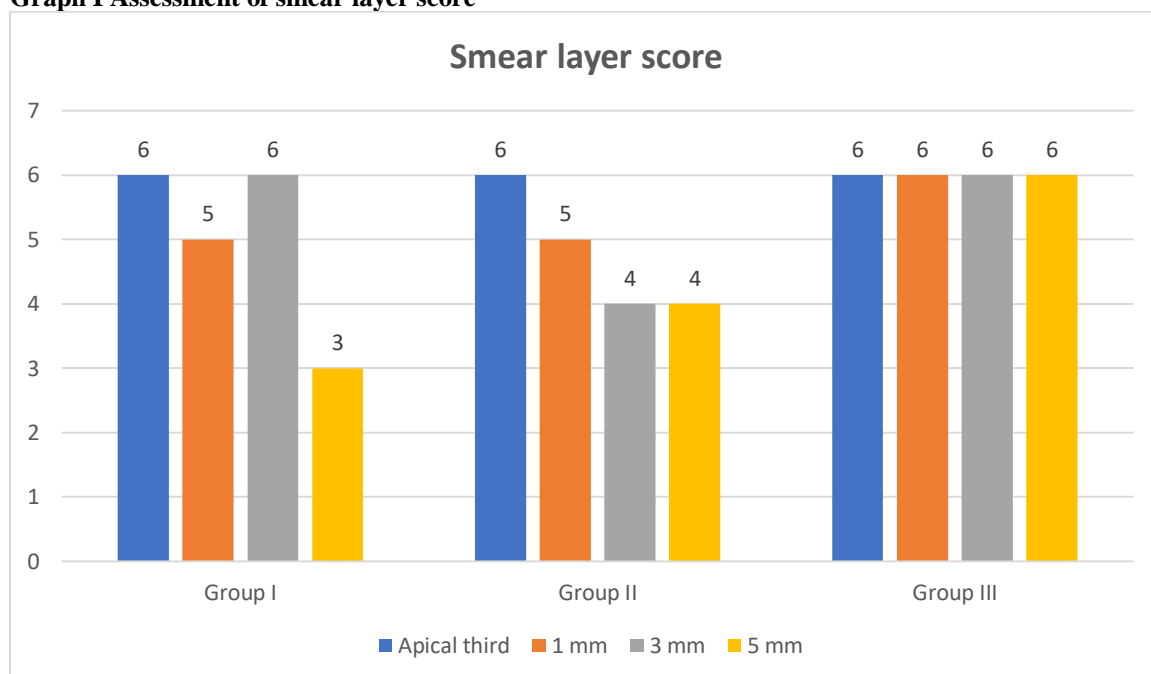
Table I shows that group I used CNI, group II PUI and group III was control with 20 teeth in each group.

Table II Assessment of smear layer score

Groups	Apical third	1 mm	3 mm	5 mm	P value
Group I	6	5	6	3	0.04
Group II	6	5	4	4	
Group III	6	6	6	6	

Table II, graph I shows that mean smear layer score was significantly less in CNI group as compared to PUI and control group (P< 0.05).

Graph I Assessment of smear layer score



DISCUSSION

Workers have reached different conclusions, with current knowledge of interactions between the smear layer and factors such as filling technique and sealer type being limited. In addition, the methodology of

studies, the type and site of leakage tests, and the sample size should be taken into account and consideration given to these variables before conclusions are reached.⁶ Some authors suggest that maintaining the smear layer may block the dentinal

tubules and limit bacterial or toxin penetration by altering dentinal permeability.⁷ Others believe that the smear layer, being a loosely adherent structure, should be completely removed from the surface of the root canal wall because it can harbour bacteria and provide an avenue for leakage. It may also limit the effective disinfection of dentinal tubules by preventing sodium hypochlorite, calcium hydroxide and other intracanal medicaments from penetrating the dentinal tubules.⁸ The present study was conducted to compare the efficacy of PUI system with CNI system in smear removal.

In present study, Group I teeth were irrigated with conventional needle irrigation (CNI) system and group II teeth were irrigated with passive ultrasonic irrigation (PUI) system. 20 specimens were used as a negative control (Group III). Upara et al⁹ assessed the efficacy of a simple irrigation kit, employing the apical negative pressure principle on smear layer removal from the apical third of the root canal surface. The root canals of forty single-rooted mandibular premolars were mechanically prepared, and the teeth were then randomly divided into three groups to be irrigated with conventional needle irrigation (CNI) system, passive ultrasonic irrigation (PUI) system, and the simple apical negative pressure (ANP) kit. Four specimens were used as a negative control. The least remaining smear layer was observed in the ANP group at all three distances from the working length ($P < 0.001$). Furthermore, significantly less remaining smear layer was observed in the PUI group 3 mm and 5 mm from the working length than the CNI group ($P < 0.01$), whereas there was no significant difference between the use of PUI and CNI 1 mm from the working length.

We found that mean smear layer score was significantly less in CNI group as compared to PUI and control group ($P < 0.05$). The PUI system functions by creating acoustic microstreaming and cavitation.¹⁰ These two phenomena cause shear stress and force on the root canal walls, resulting in the removal of bacteria and debris. Acoustic microstreaming and cavitation can occur only when the instrument is activated in a liquid phase. In the past, it was believed that air bubbles entrapped in the root canal could be dislodged using any instrument. A new study has proven that files or other instruments pass through the bubbles into the apical third of the canal without dislodging the bubbles.¹¹ Therefore, the use of the PUI system without the tip of the instrument being in the liquid phase does not create any acoustic microstreaming or cavitation, resulting in an inefficient cleaning of the apical third of the root canal system. The result is different with the ANP system, where there is a constant and continuous flow of new irrigant at the working length.¹²

CONCLUSION

Authors found that conventional needle irrigation was found to be better in terms of smear layer removal as compared to passive ultrasonic irrigation.

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