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Smear Layer Removal Efficacy of Custom Made Water Pik Power Flosser as an Irrigant Activating Device

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Abstract: ***Context: The aim of the present study is to evaluate and compare the effectiveness of different irrigant activation systems on smear layer removal in the apical third of root canal dentin. Irrigant activation systems used in this study are endoactivator, intra canal brush and modified tip of an interdental waterpik power flosser and conventional syringe irrigation. Aims: To evaluate and compare the effectiveness of different irrigant activation systems on smear layer removal in the apical third of root canal dentin. Methods and Material: 40 single rooted teeth were used in the study. They were decoronated to a standard length of 15mm and were instrumented up to protaper F2. The samples were divided into 4 groups according to the irrigant activation systems and the final irrigation was done with calsept EDTA. The analysis of the root canal dentin at the apical third was performed with scanning electron microscope. Statistical analysis used: The results of this study are statistically significant and pair wise comparison was done using Mann Whitney U-Test. Results: Endoactivator significantly removed more smear layer when compared to the other irrigant activation systems. Custom made tip was more or less comparable to endoactivator. Conventional syringe activation failed to remove the smear layer completely. Conclusions: Sonic irrigation through endoactivator system and custom made tip of a water pik power flosser resulted in better removal of smear layer when calsept EDTA was used as a final irrigant than the conventional syringe irrigation***

Keywords: Endoactivtor, water pik power flosser, intracanal brush, smear layer

1. Introduction

The root canal is shaped with hand and rotary instruments under constant irrigation to remove the inflamed and necrotic tissue, microbes and bio films and other debris from the root canal space [1]. These techniques produce an irregular granular and amorphous layer called the smear layer which covers the root canal dentin. Smear layer removal requires the use of irrigating solutions that can dissolve both organic and inorganic components to eliminate the microorganisms [2] and thus the hermetic sealing of the root canal system. In addition, the smear layer also might decrease the antimicrobial effectiveness of medicaments by inhibiting their effective penetration into the dentinal tubules. Irrigation is an essential part of root canal debridement. It creates a microbe free environment in the root canal by eliminating the smear layer and providing better penetration of the root canal irrigants into the dentinal tubules [3,4, 5]. Many studies have shown that the use of sodium hypochlorite in combination with EDTA is effective in removing the smear layer during the root canal irrigation [2]. For many days irrigation of the root canal space was carried out with a syringe that is, the conventional hand irrigation which was proved to be ineffective in eliminating the smear layer from the apical part of the canal[2]. After conventional needle irrigation inaccessible canal extensions and irregularities are likely to harbor debris and bacteria, thereby making canal debridement difficult [6]. During conventional needle irrigation, replenishment and fluid exchange donot extend much beyond the tip of the irrigating needle [3]. Vapour lock that results in the trapped air in the apical third of the root canals may also hinder the exchange of irrigants and affect their debridement efficacy [3, 7]. Hence mechanical activation of these chemical agents have been developed to improve the penetration and effectiveness of irrigation. Mechanical activation of the irrigant can be done with rotary brushes, continuous irrigation during rotary instrumentation, sonic and ultrasonic activation of the irrigant and pressure alteration devices. Mechanical activation results in disruption of smear layer and thus helps to increase the flow and distribution of irrigating solutions with in the root canal system. The purpose of the present study was to compare different mechanical irrigant agitation devices in eliminating smear layer and analyze it under the scanning electron microscope

2. Subjects and Methods

Sample preparation

Forty single rooted freshly extracted human teeth were used in this study. The specimens were decoronated to obtain a standardised root length of 15mm by using a diamond disk. The working length was determined with a #10 k- file. The biomechanical preparation of the root canal was done with protaper files till F2. The root canal were flushed with 3% of 1ml NaOCl solution between the files by using a plastic syringe with a closed end needle inserted as deep as possible into the root canal without binding

Calcept EDTA was used as the final irrigant and teeth were randomly divided into 4 groups based on the irrigant agitation device used.
Group I: Plastic needle and a syringe
Group II: Intracanal brush
Group III: Endoactivator
Group IV: Modified waterpik power flosser (Custom made activator tip)

Scanning Electron Microscopy Evaluation

After instrumentation the teeth were grooved vertically on the buccal and lingual surfaces, using water cooled diamond bur and taking care to avoid touching the root canal. Thereafter the teeth were split along their axis in a buccolingual direction using a chisel and a mallet. The specimens were mounted on metallic stubs, and subjected to gold sputtering. Then the samples were examined under

observed under scanning electron microscope. The scoring procedure was carried out by two independent examiners by using the criteria reported by Torabinejad who measured the presence of smear layer as follows:
Score 0: No smear layer, absence of smear layer on the surface of the root canal, all the tubules are clear and open
Score 1: Moderate smear layer, no smear layer on the surface of the root canal but the tubules contain debris
Score 2: Heavy smear layer, smear layer covers the root canal surface and the dentinal tubules.

3. Results

Results of the present study show that the group III [figure 3, table 1, graph 1] and group IV [figure 4]showed cleaner canal with no smear layer on the dentinal surface as well as in the dentinal tubules. The results of this study are statistically significant and pair wise comparison was done using Mann Whitney U-Test. The samples of group II[figure 2] showed moderate to heavy smear layer and this comparison was done with chi - square test where moderate smear layer with score 1 was present in about more than half of the samples that were treated with intracanal brush. In group I [figure 1]all the samples showed heavy smear layer in which the smear layer is present both on the dentinal surface as well as in the dentinal tubules.

4. Discussion

Thorough debridement of the root canal system is claimed to be essential for successful long-term endodontic therapy. Chemo mechanical preparation of root canal aims to remove debris and the smear layer [8]. Removal of smear layer during or after root canal instrumentation requires the use of irrigants that can dissolve both organic and inorganic components [4,5,9]. These chemical agents when combined with the mechanical agitation devices helped in the effective removal of smear layer which aided in the better penetration of the intracanal medicament and the sealer which in turn aided in the successful endodontic therapy [10, 11]. The advantages and disadvantages of the presence of smear layer, whether it should be removed or left intact is still the subject matter of controversy.

In the present study the final irrigation was done with calsept EDTA, which has EDTA as its major constituent. EDTA solutions have chelating properties which can chelate with the hydroxyapatite crystals of the dentin that is it reacts with the calcium ions in dentine and forms soluble calcium chelates. It has been reported that EDTA decalcified dentine to a depth of 20–30 µm.[6]Thus EDTA as the final irrigating solution aided in the effective removal of smear layer. Along with EDTA as the final irrigating solution four different irrigant agitation devices were used. Group 1 where the final irrigant was agitated with endoactivator, a sonic system was effective in the removal of the smear layer. Recently, the endoactivator System (Dentsply Tulsa Dental Specialties, Tulsa, OK) was introduced to improve the irrigation phase. It is a sonically-driven canal irrigation system that comprises a portable handpiece and 3 types of disposable flexible polymer tips of different sizes that do not cut root dentin[12]. Its design allows for the safe activation of various intracanal reagents and could produce vigorous intracanal fluid agitation. In the present study, the endoactivator System has shown to better aid in the removal of smear layer due to its cavitation and acoustic streaming and the use of EDTA as the final irrigant further resulted in the patent dentinal tubules

Simple modification has been made to the waterpik power flosser (Custom made activator tip) which is nothing but a inter dental flossing device , by attaching the shank of a protaper file to the power flosser system whose action is similar to that of endoactivator and is based on sonic vibration. This also resulted in the effective removal of smear layer both in the dentinal tubules as well as on the surface of the dentin. In my study this is considered to be effective because of its cost effectiveness as well as the cleansing ability.

Intracanal brush on the other hand is a machine assisted rotary brushes that facilitated debris and smear layer removal from the instrumented canals [7, 12]. Brush includes a shaft and a tapered brush that has multiple bristles extending radially from the central core. It rotates at around 300 rpm, causing bristles to deform into the irregularities of the preparation to displace residual debris out of the canal in a coronal direction. In the present study intracanal brush resulted in obliterated dentinal tubules and the smear layer was present on the root dentin surface.

The other group in which the final irrigant was agitated with the conventional syringe irrigation failed completely in removal of smear layer both in the dentinal tubules as well as on the surface of the root dentin. This can be attributed to the fact of creating a vapour lock effect in the apical part of the canal which prevented further passage of the irrigant [8, 13]. Also the mechanical flushing action created by the needle irrigation is too weak that it failed in removal of the smear layer [14].

5. Conclusion

Hence within the limitations of the study the custom made tip of a water pik power flosser besides being economical resulted in cleaner canals and is more or less comparable to the endoactivator, but further investigation is required to evaluate its efficacy in the coronal, middle and apical thirds.

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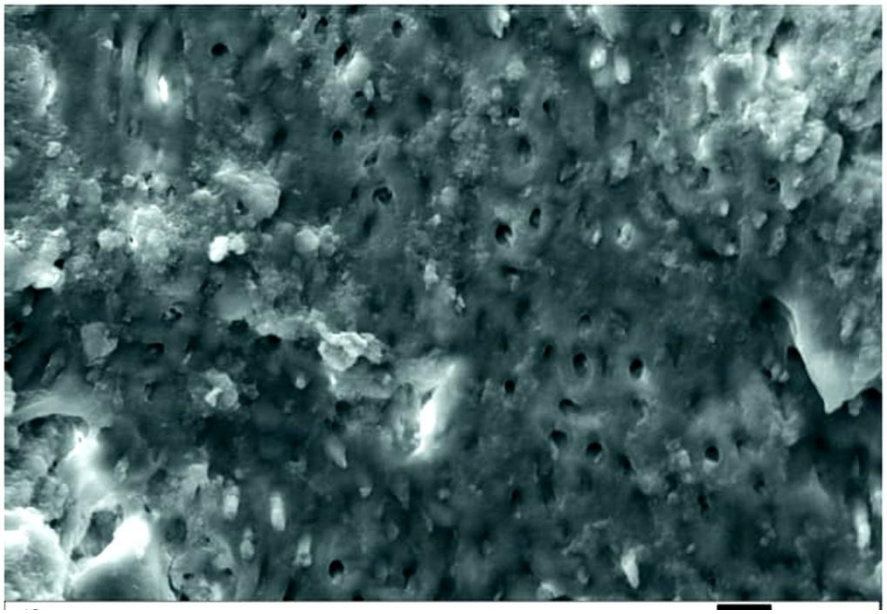

Figure 1: Group I Conventional needle

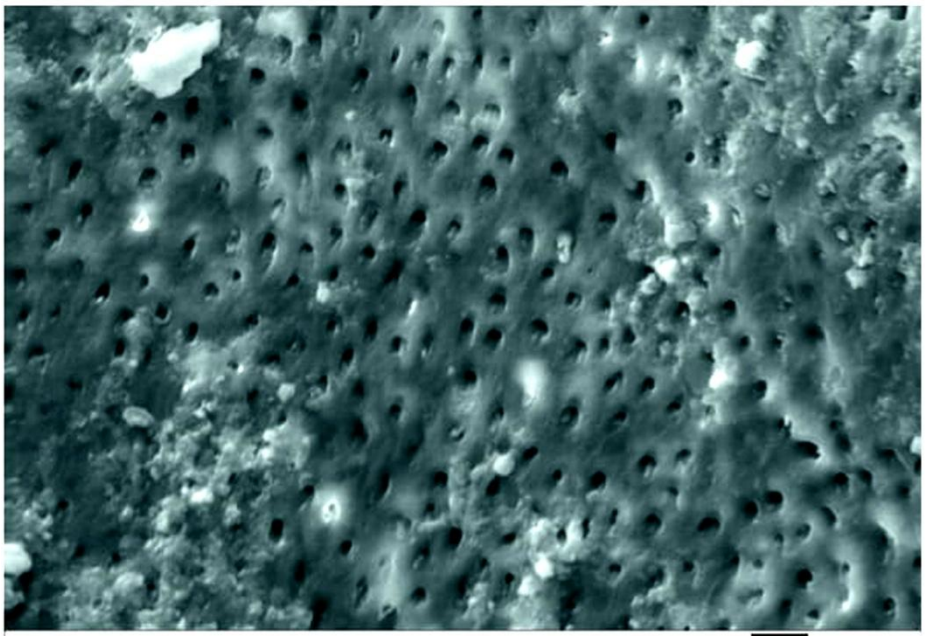

Figure 2: Group II Intracanal brush

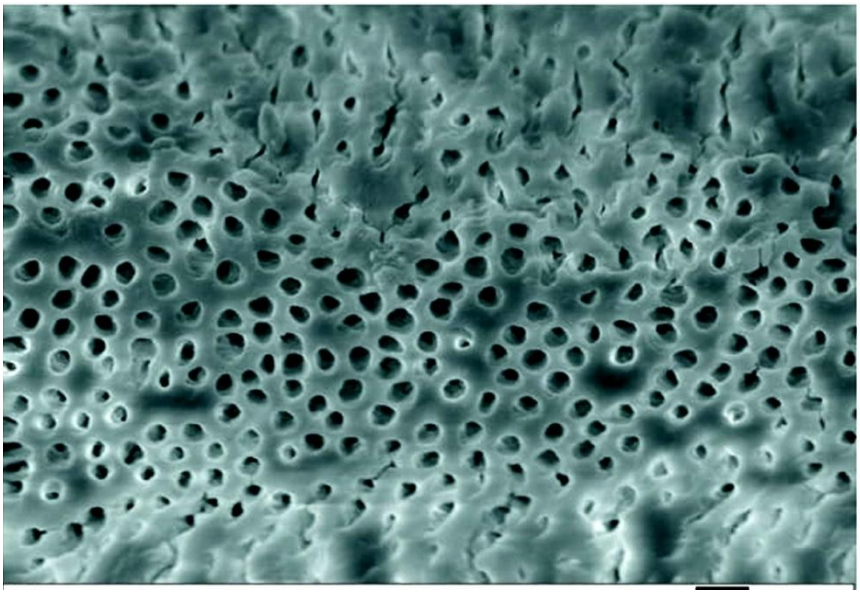

Figure 3: Group III Endoactivator

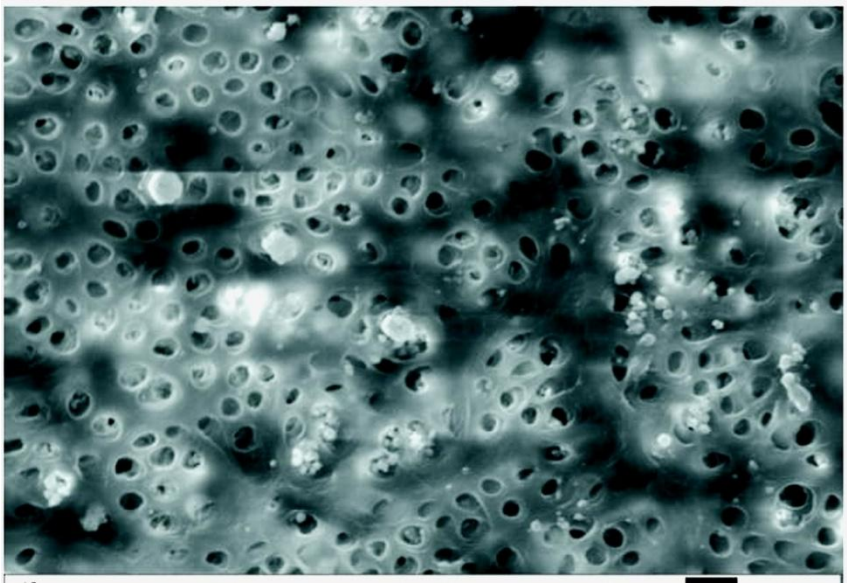

Figure 4: Group IV Modified waterpik power flosser

Table 1: Mean, SD and Range values and comparision among the groups using Mann Whitney U-test. Statistically significant if P<0.05

Clinical Parameters	Mean	SD	Range (Maximum-Minimum)	U value	P value
Endoctivator group	0.50	0.53	1.00	40.00	0.374 Not significant
Custom made tip	0.70	0.48	1.00		
Endoctivator group	0.50	0.53	1.00	15.00	0.003 Significant
Intracanal brush	1.40	0.52	1.00		
Endoctivator group	0.50	0.53	1.00	0.00	0.000 Significant
Conventional syringe	2.00	0.00	0.00		
Custom made tip	0.70	0.48	1.00	21.00	0.010 Significant
Intracanal brush	1.40	0.52	1.00		
Custom made tip	0.70	0.48	1.00	0.00	0.000 Significant
Conventional syringe	2.00	0.00	0.00		
Intracanal brush	1.40	0.52	1.00	20.00	0.004 Significant
Conventional syringe	2.00	0.00	0.00		