SMEAR LAYER IN ENDODONTICS- A REVIEW

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ABSTRACT

The objective of this compilation is to bring forward the pros and cons of smear layer. Smear layer, which consist of inorganic particles of calcified tissue and organic material. Smear layer has been a topic of importance and debate. The presence and absence of smear both in restorative dentistry and endodontic has been put together and critically evaluated. Also the methods of its removal and there effects have been discussed.

Key Words: Smear layer, manual, debris, micro organism, Micro leakage

The success of root canal therapy depends on the method and the quality of instrumentation, irrigation, disinfection and three dimensional obturation of the root canal. Different types of hand or engine – driven instruments and irrigation solutions have been employed for the instrumentation of root canals. The aim of instrumentation and irrigation is to prepare clean, debris – free canal for obturation. However, current techniques may not cleanse the entire root canal system, especially in irregular and / or curved canals. Presence of smear layer has been observed on the walls of instrumented root canals and reported that it was similar in appearance to coronal smear layer. Smear layer should be removed or retained is controversial. It has both the merits and demerits of retaining the smear layer[10].

SMEAR LAYER A PHYSICAL BARRIER FOR BACTERIA AND DISINFECTANTS

It has been observed that bacteria could remain in the smear layer and in the dentinal tubules despite instrumentation of the root canal and thus they may survive and multiply and can grow into dentinal tubules[5]. It has also been shown that removal of smear layer facilitates passive penetration of bacteria. The extent of this bacterial invasion is dependent on the type of bacterial species on time. It has been found that pseudomonas aeruginosa penetrates even thicker dentin slices, by removing the smear layer itself and by opening the orifices of dentinal tubules after possible collagenase production[3].

It has also been shown that bacterial byproducts may penetrate through freshly cut dentin and that smear layer itself is permeable even to large molecules such as albumin. This layer is therefore not a strict barrier to bacteria. After degradation of the smear layer by proteolytic enzymes released by certain bacteria, a gap will develop between the filling material and the canal wall permitting the leakage of other bacterial species and their byproducts along the canal walls into dentinal tubules and the periradicular tissues. It was also emphasized on the possibility of degradation of smear layer as a cause in the failure of retrograde filling.[12]

Even after chemo mechanical instrumentation of root canal, some bacteria still remain in the canal and dentinal tubules. For this reason, chemo mechanical cleansing is often supported by the use of disinfectants. Few other believe in the fact that the presence of the smear layer may block the antimicrobial effects of intracanal disinfectants into the tubules[9, 11]. It was found that in absence of smear layer, liquid camphorated monochlorophenol disinfected the dentinal tubules rapidly and completely but calcium hydroxide failed to eliminate Enterococcus faecalis even after 7 days of incubation. They also concluded that the smear layer did delay, but not abolish the action of the disinfectants. However, following the removal smear layer, bacteria in dentinal tubules can be easily destroyed and in this way, it may be beneficial to use lower concentrations and / or amounts of antibacterial agents since all of these agents show some degree of toxicity of viable host cells.[4]

SMEAR LAYER AND MICROLEAKAGE

Another important consideration in endodontics is the ultimate seal of root canals in

order to prevent possible microleakage which may be the cause of the future failure of the root filling. Prepared dentin surfaces should be very clean to increase sealing efficiency of obturation. Smear layer on root canal walls acts as an intermediate physical barrier and may interfere with adhesion and penetration of sealers into dentinal tubules. It was found out that zinc oxide eugenol based root canal sealer failed to enter into dentinal tubules in the presence of smear layer [9, 13]. In two consecutive studies observed that plastic filling materials and sealers penetrated into dentinal tubules after removal of smear layer[13]. It was also found that smear layer obstructed the penetration of filling materials; while no tubular penetration of the sealers was observed in the control groups. It may be concluded that such tubular penetration may increase the interface between the filling and the dentinal structures, and this process may improve the ability of a filling material to prevent leakage.[14]

Microleakage in root canals is a more complicated subject as many variables may contribute such as anatomy and instrumented size of the root canal, irrigating solutions, root filling techniques, physical and chemical properties of the sealers, and the infectious state of the canal[8]. When the smear layer is not removed, the durability of the apical seal should be evaluated over a long period. Since this layer is a non homogenous and weakly adherent structure, it may slowly disintegrate, dissolving around a leakage filling material, thus creating a void between the root canal wall and the sealer.

EFFECT OF SMEAR LAYER ON PENETRATION OF ROOT CANAL MEDICAMENTS AND SEALERS INTO THE DENTINAL TUBULES

The importance of removal of the smear layer and the presence of patent dental tubules for decreasing the time necessary to achieve the disinfecting effect of intracanal medicaments has been established[1]. It was also shown that the presence of a smear layer can inhibit or significantly delay the penetration of antimicrobial agents such as intracanal irrigants and medications into the dentinal tubules[2]. Studies have shown better adhesion of obturation materials to the canal walls after removal of smear layer. Pitt Ford and Roberts have suggested that the failures of glass ionomer retrograde fillings after apical surgery may result from degradation of the smear layer. It was shown that the most commonly used zinc oxide eugenol sealers have the particle size more than 1um. They could penetrate into the dentinal tubules to provide the hermetic seal but the diameter of the dentinal tubules becomes less than 1 um near the apex[15]. Therefore these sealers do not penetrate into the dentinal tubules near the apex resulting in a questionable seal at apex even after the removal of the smear layer[7]. Other investigators assessed the penetration depth of different sealers including Tubliseal, AH26, Sealapex, Rosin, Roth's 811, and CRCS into dentinal tubules. They found the penetration to be 10 to 80 µm after removal of the smear layer, whereas no penetration was observed with the smear layer intact. In another work it was found that 4% TiF4 resulted in the increase in the thickness of the smear layer from 0.72-4.2 um in the control group to 5.64-8.18um in the experimental group. This modified smear layer is acid stable and has antibacterial properties against different types of bacteria.[6]

CONCLUSION

There are widely varying results regarding the smear layer removal and retention in the literature. Smear layer in it self has varying advantages and disadvantages which cannot be overlooked. Also with introduction of thermoplasticised Gutta Percha and various new methods of smear layer removal, further studies are needed to open the facts of anatomical complexities of the root canal system.

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