

SMEAR LAYER IN ENDODONTICS TO KEEP OR REMOVE; A REVIEW

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Abstract

During root canal instrumentation, a smear layer were formed while using hand or rotary instruments which shields the walls of the prepared canal. The main components in this layer are organic and inorganic constituents such as remains of odontoblastic processes, bacteria and necrotic debris. Different investigators concluded different judgements on the significance of eliminating or preserving this layer. The smear layer removal permits the root canal wall in cleaning, disinfecting and improved adaptation of root canal filling materials. Yet, the smear layer existence also allowed to act as a seal to the dentinal tubules and reduce the bacteria capability and its toxins diffusing through the dentinal tubules. Thus, demand for keeping or eliminating this layer remains still controversial.

Key Words: Chemo mechanical instrumentation, Smear layer, bacterial penetration, root canal sealers.

INTRODUCTION

In root canal treatment, the success basically depends on the technique and quality of instrumentation, disinfection, irrigation and on permanent obliteration of the root canal by a nontoxic material. During biomechanical preparation, different types of hand or rotary files are used for instrumentation which leads to the creation of substantial amount of debris called as smear layer.^{1,2}

Smear layer was identified firstly by **Eick et al** using scanning electron microscope (SEM). He found that this layer is prepared from different size of elements below 0.5 to 15 µm.³

Primarily, McComb & Smith in 1975 described this layer on the walls of instrumented root canals. They proposed that the smear layer encircles dentine, remains of odontoblastic processes, bacteria and pulp tissue.¹

The smear substantial are divided into two parts by **Cameron and Mader et al** :-

1. The superficial smear layer roughly attached to the underlying dentine,
2. The material filled inside the dentinal tubules.

The smear debris was filled inside the tssubules with a depth of 40 µm.^{4,5} Mader et al. disclosed that the superficial smear layer comprises of a thin layer of mineralized tissue with a thickness of 1–2 µm.⁵ Goldman et al also reported that the smearlayer is about 1 µm.⁶ Bränström and Johnson reported that the thickness of smear layer could range between 2 and 5 µm in thickness.⁷ Difference in the thickness of smear layer depends on whether the dentin was instrumented in wet or dry field and the type and sharpness of the cutting instruments.^{8,9} A thicker layer was formed after the movement and the proximity of the instrument to the dentine wall with an increased centrifugal forces and more hard to remove with chelating agents.¹⁰ During motorized preparation, the quantity formed with GatesGlidden or post drills, has been conveyed as greater in capacity than that produced by the hand filing.¹¹ The smear layer components can also be forced into the

dentinal tubules to variable distances to form smear plugs.^{12,13,14} Bränström and Johnson and Mader et al. also conveyed that smear plug occurred due to the rotational movement of the burs and rotary instruments.^{7,5} However, Cengiz et al. anticipated that the diffusion of smear substantial inside the dentinal tubules can also be due to the capillary action through the adhesive forces between the material and the dentinal tubules.¹³

Importance of smear layer

During root canal treatment, bacteria and infected dentine are removed from the root canals using the chemo mechanical method followed by an intracanal dressing and a root filling.¹⁵ Another significant concern in endodontics is the final seal of root canal wall so as to inhibit the probable micro leakage which can lead to the upcoming failure in root filling.¹ Many investigators proposed that the dentinal tubules may be blocked if the smear layer is kept and might alter the dentinal permeability with lesser amount of bacterial or toxin penetration.¹⁶⁻¹⁸ Few investigators conveyed that the smear layer should be removed as it is a loosely attached on the root canal wall and it can act as a reservoir of microbial irritants, where bacteria can survive, multiply and proliferate inside the dentinal tubules.¹⁹⁻²¹

Influence on diffusion of root canal medicaments and sealers inside the dentinal tubules

Örstavik and Haapasalo disclosed the significance of the smear layer presence or absence of the patent dentinal tubules used in reducing the time to attain the disinfecting effect of intracanal medications.²² White et al. also reported that the smear layer absence leads to effective diffusion of different endodontic sealers and root filling materials inside the dentinal tubules. They also reported that in absence of smear layer, Roth 801, AH26, pHEMA, and silicone sealers extended consistently inside the dentinal tubules.^{23,24} However, Saleh et al. disclosed that the smear layer removal did not require any improvement of bacterial resistance to penetrate along different types of sealers.²⁵

DISCUSSION

Investigators had concluded different opinions on eliminating or leaving this layer. Some authors also supported the significance of removing the smear layer since it contains necrotic tissue, bacteria, and its by-products.^{1,26} Keeping this layer might also inhibit the irrigants and medicaments penetration inside the dentinal tubules and the sealing capability of obturation materials could also be decreased.²⁷ Bränström found that these microorganisms inside the dentinal tubules can easily be destructed once the smear layer is removed.²⁸

Haapasalo & Ørstavik in their studies concluded that liquid camphorated monochlorophenol disinfected the dentinal tubules completely when the smear layer was removed from the canals, while calcium hydroxide was not able to remove Enterococcus faecalis. Thus, smear layer can delay but did not completely eliminate the effect of disinfectant agent or intracanal medicament.^{22,29} Okşan et al. also suggested that the sealers diffusion inside the dentinal tubules are stopped by this layer, yet in case of control groups there was no penetration of sealer observed.³⁰ Gençoğlu et al. stated that smear layer reduces the gutta-percha capability inside the canal wall for appropriate fitting irrespective of condensation techniques used; cold lateral or thermoplastic vertically.³¹ Several authors encouraged that smear layer is a loosely nonhomogeneous adherent structure that can easily dislodged from the underlying dentin and potentially lead to bacterial contaminant and leakage between the filling material and the dentinal walls.^{5,32} In contrast, this layer also acts as a wall to avoid bacterial passage inside the dentinal tubules.¹⁸ Pashley proposed that the smear layer existence ends the bacterial attack in the infected canal entering through the dentinal tubules in case of inadequate canal disinfection or recontamination of the canal between treatment sessions.³³

Williams and Goldman conveyed that this layer cannot act as a complete obstacle and its presence only postponed the bacterial invasion.³⁴ Madison and Krell in their study concluded that the smear layer made no variance in terms of leakage when ethylenediaminetetraacetic acid (EDTA) solution was used in a dye penetration study.¹⁵ Chailertvanitkul et al. also established that the smear layer existence or absence made no changes in leakage properties, while the time period was short in that study. If the smear layer is not removed, the durability of the apical seal should be estimated for a longer period.³⁵ A systematic review by Shahrvan et al estimated that the smear layer removal diminishes the outflow of obturated teeth in vitro and also conveyed that its absence increases the close-fitting of the root canal wall irrespective of the obturation technique or the sealer, which does not yield important effects.³⁶

CONCLUSION

A deposit of organic and inorganic substantial termed as the smear layer are created during root canal instrumentation containing bacteria and their by-products. The diffusion of irrigants and intracanal medicaments into the dentinal tubules may be reduced by this layer as it shields the instrumented walls and can also affect the adaptation between filling materials and the root canal walls. Taking in consideration all the important points, the smear layer elimination should always be considered in day-to-day practice of endodontics.

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