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Passive vs Sonic Assisted Irrigation—Effect on Smear Layer

The ultimate goal of endodontics is to eliminate the bacterial bio-load in the complex root canal system, especially in the critical apical one third. We achieve this objective by a combination of instrument based mechanical preparation and chemical irrigation of the prepared root canal system.

Sodium hypochlorite (NaOCl), at a concentration of 3% or 5%, is the gold standard for chemical sterilization. NaOCl is a proven killer of all the bacteria associated with endodontic infections. Not only does it reduce bacterial bio-burden but it also efficiently and effectively removes organic tissue from the many fins, cul de sacs, and lateral canal anatomy.

NaOCl does not, unfortunately, remove the calcified debris that occurs during mechanical canal preparation, the so-called ``clean, white dentin``. The leftover debris lining the canal walls, which we now refer to as the smear layer, has sparked considerable debate in the endodontic clinical and research community over the last few years. A multitude of scanning electron microscopic (SEM) studies have shown bacteria within the dentinal tubules of cleaned and shaped root canal systems. These bacteria are walled off from the NaOCl irrigant by the smear layer and can, much to our dismay, be cultured and hence are a potential source of re-infection.

To address the smear layer barrier, cleaning and shaping protocols during the last decade have evolved to include irrigation with 17% EDTA. EDTA is an effective and proven smear layer remover. Once EDTA removes the smear layer the tubules are exposed to a final anti-bacterial rinse of NaOCl. Problem solved.

Well, further *in vivo* studies have shown that in the narrow apical and middle thirds of the canal, smear layer removal is inconsistent and clearly not as effective as in the coronal third. What we now understand is that both NaOCl and EDTA act in a typical stoichiometric chemical reaction that is quickly exhausted in the apical one third. The small volume of the apical one third combined with the inherent surface tension of the irrigants and oxygen bubble production when NaOCl acts on organic debris means that only limited quantities of fresh irrigant are present in that crucial zone at any one time. These realities have generated a push to find ways to increase the volume and replenishment rate of active irrigant in the root canal system.

Pierre Machtou *et al*, JOE 36:8, looked at the effectiveness of different irrigation adjuncts designed to increase the amount of fresh, biologically active irrigant in the root canal system. Fifty mandibular mesial roots were cleaned and shaped to a 10% taper (ProTaper F2) with apical patency in the presence of copious amounts of 3% sodium hypochlorite and finished to a 25 file at the apical foramen. Four groups of ten teeth each were studied: the *No Activation Group* received 1 ml of 17% EDTA for 1 minute followed by 30 seconds of 3% NaOCl delivered passively with a 27 gauge needle; the *Manual-Dynamic Activation Group* followed the previous protocol but added manual up and down pumping with a medium gutta percha cone fitted to the apical foramen for each irrigant; the *Automated-Dynamic Activation Group* followed the same protocol but instead of passive irrigation with the 27 gauge needle used the RinseEndo system which actively delivers fresh irrigant in close proximity to the apical foramen at a flow rate of 6 ml per minute and suction the excess; the *Sonic Activation Group* once more followed the *No Activation Group* protocol but used Cliff Ruddle's EndoActivator to agitate the solutions. The EndoActivator uses a sonic handpiece to activate strong, highly flexible, non-cutting, polymer tips which reach to the apical terminus at a frequency of 10 kHz. The remaining teeth were split between positive and negative controls. The teeth were sectioned and evaluated for residual debris with SEM and evaluated on a scale of 1 (no smear layer) to 5 (complete smear layer coverage).

Machtou's results showed that the EndoActivator *Sonic Activation Group* consistently produced statistically cleaner dentinal walls in all segments of the root canal system (debris score of 1.75) compared with the other study groups. The dentinal tubules were open with minimal amounts of attached debris particles.

This is a study which we can take directly to our practice. The EndoActivator is relatively cheap (US \$305) and easily adapts to your existing cleaning and shaping protocol. I have been using the EndoActivator for 2 years without any problems in all non-surgical cases. For a short video on the EndoActivator check out the following link: https://store.tulsadental.com/catalog/EndoActivator_main.htm

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