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Tubule Occlusion by Stannous Fluoride-Containing Toothpastes for Sensitivity Treatment

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Objectives To investigate dentine tubule occlusion of an experimental Sensodyne toothpaste formulation containing stannous fluoride (SnF_2) versus other commercially available formulations with SnF_2 using focused Ion Beam Scanning Electron Microscopy (FIB-SEM) and Serial Block Face-SEM (SBF-SEM).

Methods 12 Polished human dentine discs were divided into 3 treatment groups and 1 control group (n=3). A toothpaste slurry was prepared by mixing 0.3 g of toothpaste with 1 ml of artificial saliva (AS). The dentine discs were then brushed with the slurry for 30 seconds and left immersed in it for 90 seconds. Subsequently, they were rinsed with deionized water for 1 minute and placed in AS in a culture well, where they were kept for 12 hours at 37.5 °C. Following this incubation period, the discs were removed from the AS, dried overnight, and prepared for scanning. For SBF-SEM 0.5 by 0.5mm blocks were cut out from each disc by a low-speed diamond saw and were embedded in resin and glued to a pin and placed in the SBF-SEM where 1000 slices (with a thickness of 60nm) were cut by a diamond knife in a microtome. Backscattered electron images were taken simultaneously producing an imaging depth of approximately 60µm. The rest of the discs were FIB-sectioned to reveal the cross-sections of the tubules using a FEI Helios 650 I FIB/SEM instrument.

Results Analysis of occlusion depths using FIB-SEM sections and SBF-SEM revealed that the experimental Sensodyne toothpaste exhibited superior tubule occlusion at a depth of 50µm compared to the other SnF_2-containing formulations. Analysis from SBF-SEM data along with top-down SEM imaging demonstrated that it had occluded more than half of the tubules at the surface following a single application.

Conclusions This in vitro study has shown that the Sensodyne formulation containing SnF_2 produces significantly higher occlusion at the surface and at 50µm depth compared to other SnF_2-containing formulations.