

Physical and chemical characterisation of dentine surface following treatment with NovaMin technology

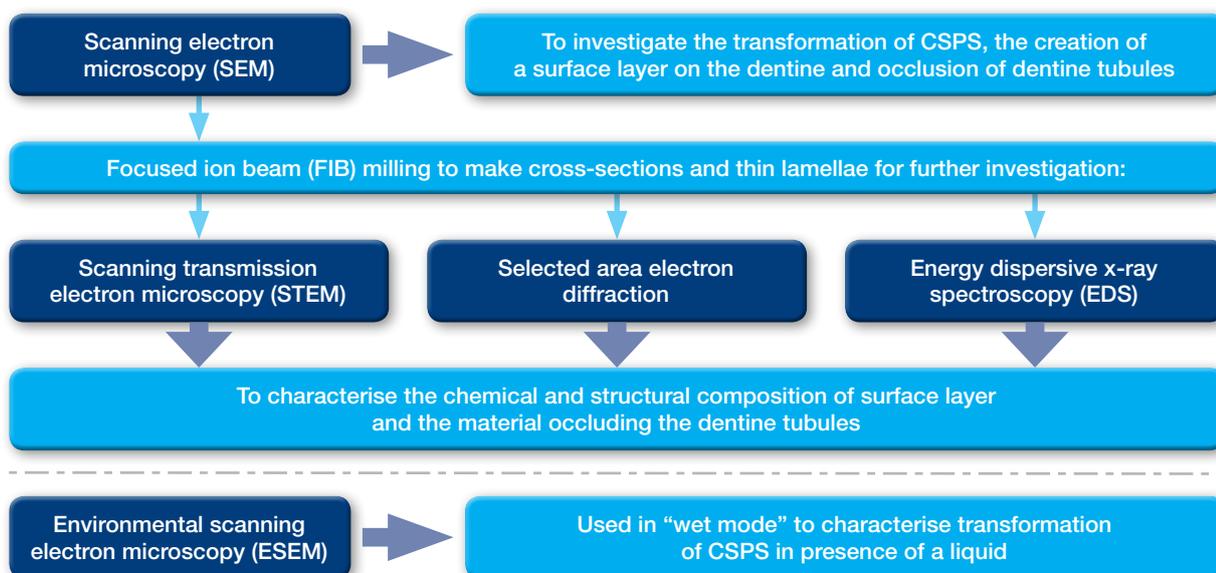
Earl JS, Leary RK, Muller KH, Langford RM, Greenspan DC. *J Clin Dent* 2011;22 (Spec Iss):62-67

Aim

To use *in vitro* studies to characterise visually and chemically how NovaMin technology occludes dentinal tubules for the purpose of treating dentine hypersensitivity.

Method

A simple *in vitro* model was set up using calcium sodium phosphosilicate (CSPS) powder (as opposed to toothpaste), water or artificial saliva and standardised human dentine discs. A variety of examination techniques were employed, as summarised in the diagram below.



Sample preparation for microscopy studies:

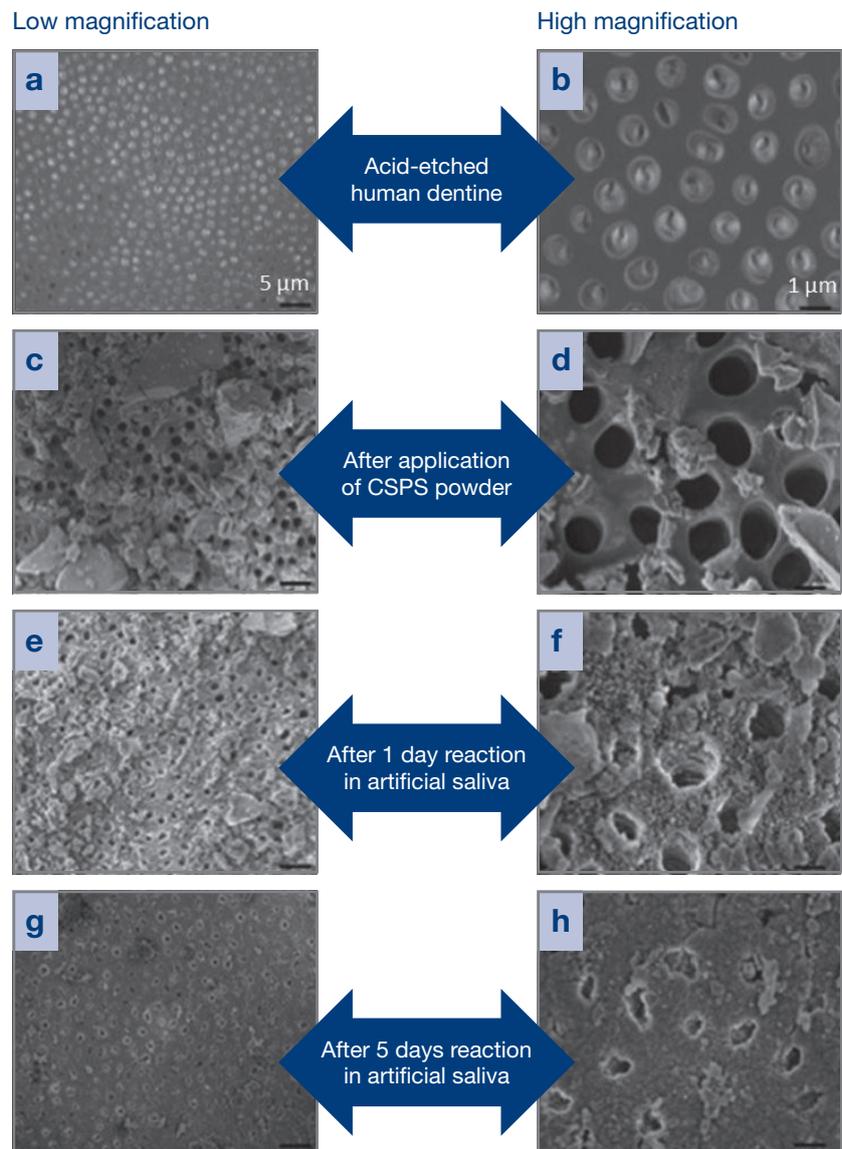
- The CSPS powder was distributed on the surfaces of prepared dentine discs, and artificial saliva applied over a period of 1-5 days.
- Control discs underwent the same process, but with no application of CSPS.
- At the end of each of the 5 days, samples allocated to that time point were removed, washed with deionised water, and allowed to dry overnight at 20°C prior to examination.

Sample preparation for wet mode ESEM:

- The CSPS powder was dispersed onto thinly sliced dentine and artificial saliva was micro-pipetted onto the slices prior to examination.

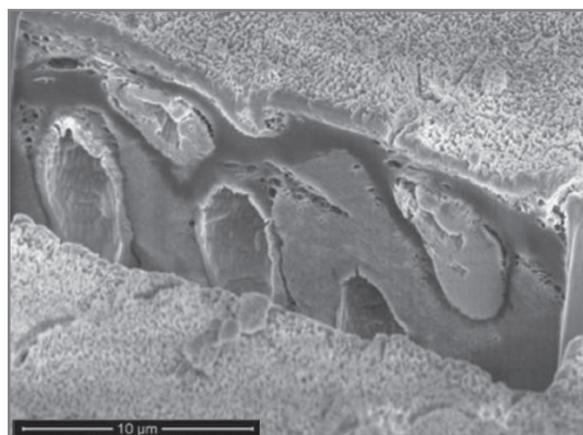
Results

SEM imaging revealed that a layer had been formed on the treated dentine samples and that this layer occluded open dentine tubules.



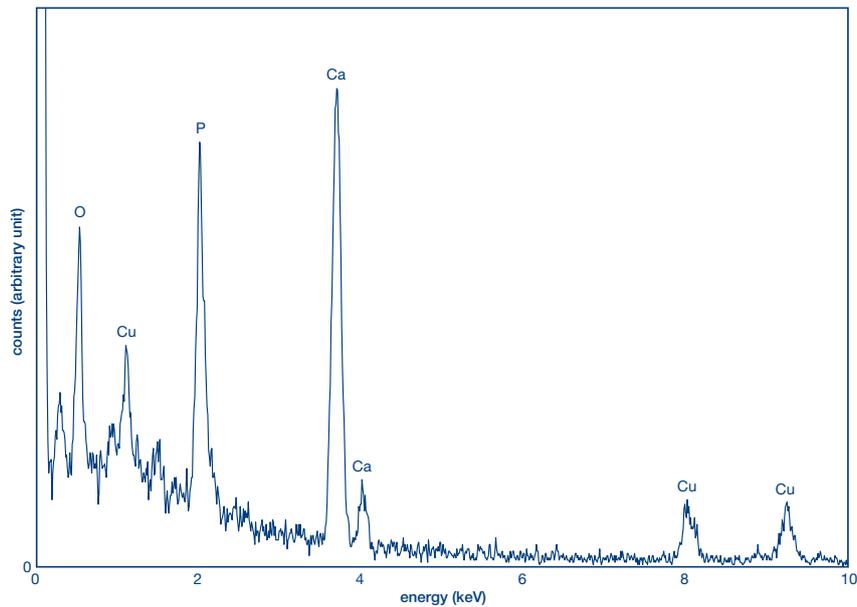
Hydroxyapatite-like layer across the dentine surface and occluding the dentine tubules

Secondary electron SEM images of a FIB-prepared cross section showed that the material covering the dentine was $\sim 1\mu\text{m}$ thick and that dentine tubules were occluded to at least the depth of the FIB cut.



Chemical and structural analyses showed the layer and the material occluding the tubules to be composed predominantly of calcium and phosphorous. Its similarity to the dentine matrix confirmed that it is hydroxyapatite-like.

Point EDS spectrum taken from within the occluded tubule



Wet-mode ESEM demonstrated that this technique was able to be used to follow the transition from CSPS to the crystalline hydroxyapatite-like materials.

Conclusion

The use of modern imaging techniques has demonstrated, *in vitro*:

- The reaction of CSPS from an amorphous material to a crystalline hydroxyapatite-like material.
- The formation of a layer on the dentine and that this layer occluded open dentine tubules.

These experiments confirm that the mode of action for CSPS in the treatment of dentine hypersensitivity is via occlusion.