

2841. Monitoring of caries lesions in enamel by Terahertz Pulsed Imaging

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Objective

The aim of the present study was to evaluate the non-destructive imaging technique; Terahertz Pulsed Imaging (TPI) to quantify the depth of caries lesions in vitro after demineralisation and subsequent remineralisation.

Methods

Ten enamel specimens (5x5mm) were prepared from bovine incisors. The samples were mounted in epoxy resin and polished using silicone carbide paper (2500grit). For the demineralisation study, specimens (n=5) were immersed in a 0.1M lactic acid buffer (pH 4.5) containing 1% CMC, 3mM CaCl₂ and 1.8mM KH₂PO₄ for 1, 3, 7, 14 and 21 days. For the remineralisation study, samples with 50µm caries lesions (n=5) were placed into artificial saliva (Ca/P ratio 0.25) containing 0.02ppm sodium fluoride for 1, 2, 3, 6, 10 and 16 days. All samples were imaged using a TPI Imaga 1000 system (Teraview Ltd). Each sample was positioned at the focus of the THz beam, and the optics raster scanned in the x-y plane to collect a grid of data points with a spacing of 100µm.

Results

TPI analysis of the demineralised specimens calculated average lesion depths of 16, 38 and 72µm after 1, 3 and 7 days in the demineralisation solution. However, after 14 days, surface erosion was clearly visible. This data was consistent with X-ray Micro CT analysis of the lesions. Upon remineralisation, an increase in the magnitude of the reflected THz pulse from the lesion surface, and a decrease from the lesion/sound enamel interface was observed (78% with respect to day 0 at day 16). This was consistent with a refractive index change as a result of the increasing mineral content of the lesion.

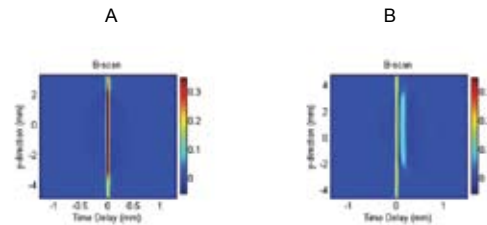


Figure 1. Terahertz B-scan images of sound enamel (A) and carious enamel (72µm lesion) (B)

Conclusions

The data suggests that TPI is a potentially useful, non-destructive imaging technique to quantify both the depth of caries lesions, and the subsequent changes in mineral content due to remineralisation.