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X-RAY MICROTOMOGRAPHIC STUDY OF TRANSPORT INTO HUMAN DENTINE FOLLOWING DEMINERALISATION

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INTRODUCTION: Dentine is a mineralised oral tissue characterised by numerous fluid filled dentinal tubules running from the pulp to the dentine-enamel or dentine-cementum interface. Healthy dentine is covered by gingival tissue or enamel, but frequent ingestion of acidic food and drink, particularly when gum recession is apparent, may expose cervical dentine to the oral environment, thereby initiating hypersensitivity [1]. If external stimulation, *e.g.* thermal, tactile and/or evaporative, is applied to exposed open dentinal tubules, the consequent change in fluid flow triggers mechanoreceptors in the tubules eliciting a pain response [2]. It is therefore proposed that transport into the dentinal tubules would be increased in demineralised dentine. We have developed an X-ray microtomography (XMT) technique to monitor transport into dentine using an externally applied contrast medium. The aim was to use 3D XMT imaging to monitor changes in transport of caesium ions in human cervical dentine *in vitro* following demineralisation.

METHODS: Caries-free human premolars, with a probable history of gum recession, were initially perfused with Earle's solution. An initial XMT scan was carried out to measure mineral concentrations at 15µm resolution in the cervical dentine region. The specimens were then immersed in 0.50 M caesium acetate solution for 3 hours, followed by a second XMT scan. Caesium acetate was then purged from the specimens. The specimens were demineralised for 24 hours using 1.0 w/w % citric acid (pH= 3.75), rescanned by XMT, and then re-immersed into 0.50 M caesium acetate solution for a further 3 hours, after which they were again scanned by XMT.

RESULTS: Clinical appearance of selected teeth had an evidence of gum recession. Very little caesium penetration was detected and FESEM demonstrated that dentinal tubules were not exposed. Demineralisation removed 100-150 µm dentine, with an abrupt step apparent at the dentine-enamel junction (DEJ) (Figures 1A and 1C), and a significant increase in caesium transport into the cervical dentine was seen (Figures 1B and 1D).

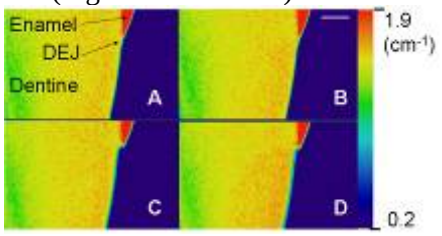

Fig. 1: XMT images showing sound dentine before (A) and after exposure to Cs acetate (B); demineralised dentine before (C) and after exposure to Cs acetate (D). Scale bar is 0.5 mm.

DISCUSSION & CONCLUSIONS: XMT can be used to monitor ion transport into and out of dentine. In this study, although gum recession had taken place, the cervical dentine was still covered by an occlusive layer of cementum which inhibited the ingress of caesium ions. The overlying cementum was removed by demineralisation with a dietary acid. This resulted in an increase in dentine permeability and a consequent increase in the uptake of caesium ions into the tissue. The *in vitro* use of XMT to monitor dentine permeability is likely to have utility in evaluating the efficacy of occlusion-based actives for hypersensitivity, and provide useful insights into the clinical management of dentine hypersensitivity.

REFERENCES:

[1]M. Addy **(2000)** Dentine hypersensitivity: definition, prevalence, distribution and aetiology in *Toothwear and sensitivity* Martin Dunitz Ltd, pp 239-248. [2] M. Brännström, L.A. Linden and A. Astrom **(1967)** The hydrodynamics of the dental tubule and of pulp fluid. *Caries Res* **1**: 310-317.

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