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ENAMAEL PROTECTION BY HYDROXYAPATITE TOOTHPASTE

Aimee A. Coleman,[1] Benjamin J. Hardy,[2] Zeynep A. Güçlü,[3] Nichola J. Coleman[4]
[1] Department of Physics, University of Bath, [2]School of Biochemistry, University of Bristol,
[3]Faculty of Dentistry, Erciyes University, [4]Faculty of Engineering & Science, University of Greenwich
Corresponding author: ac2206@bath.ac.uk – BSc student (2nd year)

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Introduction

Tooth enamel comprises ~90% substituted hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_2$), HAP, which is continually subjected to consecutive cycles of dissolution and recrystallisation [1]. Initial dental caries is denoted by non-cavitated white spot lesions (WSLs) when net demineralisation occurs [1]. Commercial products such as toothpastes, mouthwashes and chewing gums that release bioavailable calcium, phosphate and/or fluoride species have been shown to facilitate the remineralisation and repair of initial WSLs [1]. In this respect, synthetic HAP particles can be incorporated into toothpastes to exploit both their abrasive and remineralising properties [2]. The present study investigates the potential of a toothpaste containing micron-sized HAP particles (mirasensitive hap+®, Hager Werken, Germany) to repair WSLs in human enamel under optimum pH-neutral conditions and to protect the enamel exposed to an aggressive acid-challenge regime *in vitro*.

Materials and Methods

Ten extracted human molars were randomly assigned to two groups and coated with acrylic nail varnish leaving a 2 x 3 mm window on the buccal surface. WSLs were created on each tooth by exposure to acidic demineralising solution at pH 4 for 24 h [1]. The roots were removed, the teeth were sectioned longitudinally through the WSLs, de-pulped and re-varnished, leaving only the WSLs exposed. Group I was subjected to an optimum remineralisation protocol in which the 'control' and 'treated' halves of each tooth were immersed in artificial saliva at pH 7 for 24 h at 37 °C [1]. The 'treated' teeth were brushed with 1 cm^3 of mirasensitive hap+® for 2 min at 0, 6 and 9 h. Group II was subjected to an aggressive acid-challenge remineralisation regime, similar to that of Group I but with exposure to acidic demineralising solution (for 1 h) at 1, 3, 4 and 6 h. The surfaces of the original enamel, 'control WSLs' and 'treated WSLs' for each tooth were observed by scanning electron microscopy (SEM) using secondary electrons (at a magnification of x5000).

Results and Discussion

Figures 1a, b and c respectively show the original enamel, control WSL and treated WSL of a random tooth from Group I. The enamel of the treated tooth (Fig. 1c) presents regions of remineralisation, indicating that brushing with hydroxyapatite toothpaste can partially repair the eroded surface of the WSL under optimum conditions. Figures 1d and e show that the original enamel surface of the Group II tooth is significantly eroded and cracked during the acid-challenge regime; whereas, brushing with hydroxyapatite toothpaste is seen to mitigate this damage to some extent (Fig. 1f).

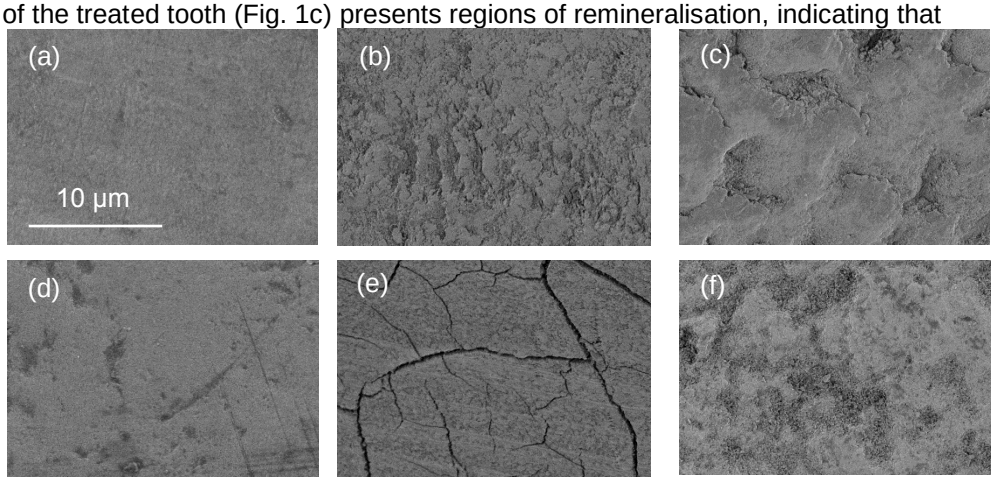

Fig. 1 SEM images of a Group I tooth (a) original enamel, (b) control WSL, (c) treated WSL, and a Group II tooth (d) original enamel, (e) control WSL, (f) treated WSL.

Conclusions

Brushing with hydroxyapatite toothpaste afforded significant, yet incomplete, remineralisation under optimum conditions at neutral pH. Under aggressive acid-challenge conditions, the HAP was able to dissolve to release calcium, phosphate and hydroxide ions which provided some protection from further enamel erosion.

References

1. Güçlü ZA *et al*. Acta Physica Polonica A 131: 571-575, 2017.
2. Coceska E. *et al*. Journal of Microscopy 262: 232-244, 2016.