



1025. Abrasion of Human and Bovine Enamel After Erosive Challenge *In-Vitro*

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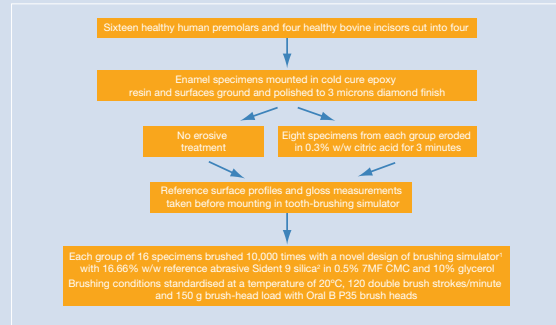


Introduction

Tooth surface gloss and roughness have recently become relevant defining factors in abrasivity research due to the increased interest in oral aesthetics. Identification of alternative sources of enamel and dentine for tooth wear research is becoming more important due to an increasingly limited supply of sound human teeth. Bovine teeth have been used extensively as a substitute for human tissues for *in vitro* abrasion studies, mainly because of their ready availability and larger size. Although the microstructures of human and bovine enamel are similar, there is only limited information available comparing the two species in terms of dietary acid erosion and toothbrush abrasion.

Methods

Specimen preparation and brushing protocol



Surface analysis

- 2D profilometric analysis using an inductive gauge (Tallysurf Series 2) profilometer to assess abrasion depth and roughness (Ra).
- 3D profilometric analysis of enamel specimens for mean surface roughness and visual evaluation.
- Gloss measurement using Novo-Curve small area gloss meter.
- Hardness of unbrushed area measured using a microhardness indenter, using 1.9N HV0.2 for 10 seconds to indent to approximately 6 microns.



Figure 1. CTRL-16 brushing simulator consisting of a specimen bath and brushing rig assembled inside a Jeotech S1300R incubator shaker unit.

Objectives

Characterise and compare the effects of abrasive wear on sound and dietary-acid softened human and bovine enamel in terms of abrasion depth, surface roughness, gloss and hardness.

Results

Abrasion depth, roughness, gloss and hardness

- Three minutes erosion with 0.3% w/w citric acid resulted in the abrasion of human enamel increasing 2.2-fold and bovine enamel increasing 3.7-fold.
- Roughness and gloss values were reduced in eroded specimens after brushing (abrasion).
- Sound and eroded bovine enamel demonstrated lower roughness and increased gloss after brushing compared with human enamel.
- Hardness testing indicated that sound human enamel was hardest, followed by eroded human and sound bovine, which had a similar hardness. Bovine enamel appeared to show greatest susceptibility to erosion in terms of hardness.
- Surface profiles of sound human and bovine enamel appeared similar, although human enamel demonstrated increased bristle grooving.
- Eroded enamel specimens demonstrated an increased surface loss in both species, and evidence of increased bristle grooving in human enamel.

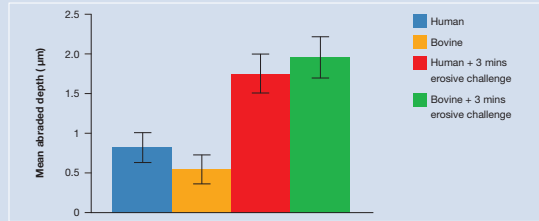


Figure 2. Mean abrasion depths of sound and eroded human and bovine enamel with slurries of Sident 9 silica.

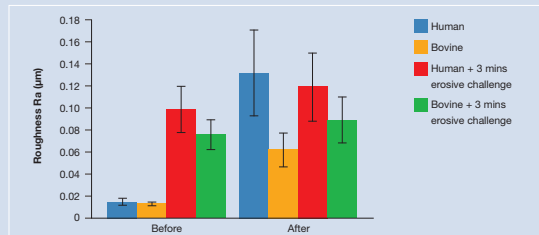


Figure 3. Mean roughness of polished human and bovine enamel, with and without dietary acid erosion, before and after brushing with slurries of Sident 9 silica.

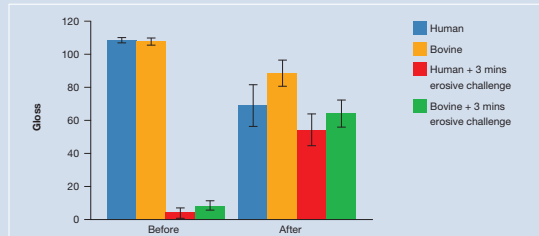


Figure 4. Mean gloss of polished human and bovine enamel, with and without dietary acid erosion, before and after brushing with slurries of Sident 9 silica.

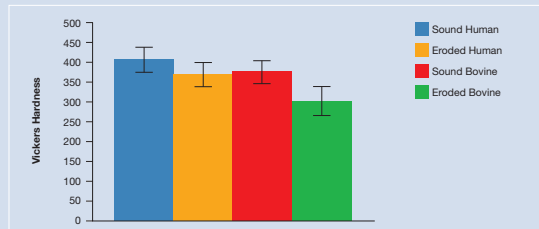


Figure 5. Mean hardness of polished human and bovine enamel, with and without dietary acid erosion.

Profilometric Analysis

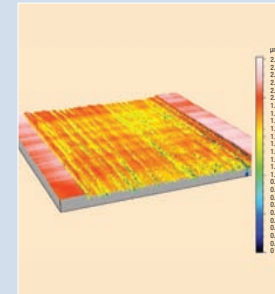


Figure 6. 3D profile of sound human enamel after brushing with Sident 9.

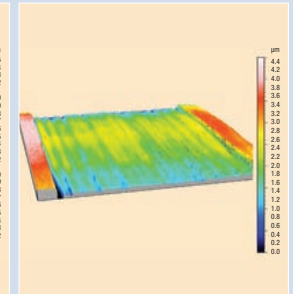


Figure 7. 3D profile of eroded human enamel after brushing with Sident 9.

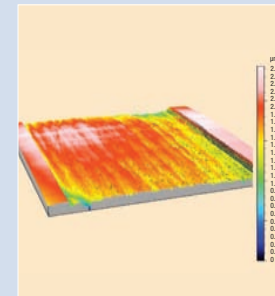


Figure 8. 3D profile of sound bovine enamel after brushing with Sident 9.

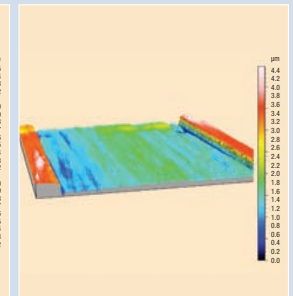


Figure 9. 3D profile of eroded bovine enamel after brushing with Sident 9.

Conclusions

- The susceptibility of human and bovine enamel to both erosion and abrasion was comparable, although bovine enamel may be more susceptible to abrasion following erosive wear.
- Bovine enamel produced a glossier surface compared with human enamel following abrasion alone and following both an erosive and abrasive challenge.
- Bovine enamel may offer a suitable alternative substrate for tooth wear research, but possible increased susceptibility of the tissue to wear following episodes of abrasion and erosion needs to be investigated further.

References

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2. Hefferen JJ, Schemehorn B, Storeck A, Lerch M and Li N. Two-year Stability Data for Silica Used as a Reference for Toothpaste Assessment Methods. *J Dent Res* 82 (Spec Iss A), Abstract 0179, 2003 (www.dentalresearch.org).

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