Comparison of Methods for the Characterization of Tooth Wear Susceptibility

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ABSTRACT

Objectives: This study reports on a 3D profilometry method (3DP) developed to assess tooth wear phenomena and compares abrasivity assessment values with those obtained by microhardness indentation loss (IL) and standard radiotracer methodologies. **Methods:** A V-8 brushing machine was used to brush flattened enamel or dentin samples for 10,000 (3DP) or 1,500 (IL) strokes. 3DP samples had a masked control surface throughout brushing. Combining pre- and post-brushing surface maps generated by a Taylor-Hobson Form Talysurf Series 2 profilometer and a computer algorithm designed to reposition the surfaces based on aligning demarcations on the protected surface permitted volume tooth substrate lost assessment from brushing which converted into an average delta z-axis mineral loss. For IL studies, measuring the post-brushing Vickers Hardness indent change permitted average delta z-axis mineral loss evaluation. **Results:** Dentin wear for low (DCPD), mid (silica) and high (alumina-silica blend) RDA dentifrices measured: 11.7±4.2; 45.2±5.2; 55.5±5.8 microns respectively under standardized conditions after 10,000 strokes; while enamel wear measured: 0.32±0.16; 0.71±0.12; 1.13±0.16 microns after 1,500 strokes. There were significant linear correlations between developed methodologies and RDA and REA assessments from historical accounts. **Conclusions**: **Tested methodologies demonstrated enamel wear at <10% dentin values, following enamel 'conditioning'. Both 3DP and IL methods provide useful substitutes for standardized radiotracer techniques. The 3DP method worked more reliably on dentin, while the IL method worked more reliably on enamel. These methods may be ideal in applications to wear related testing including assessments of additive or synergistic contributions of dietary or chemical treatment effects to dentition or in in vivo applications of wear related testing.**

INTRODUCTION

Increased lifetime of a functional dentition demands renewed understanding of tooth and restorative wear processes, including development of improved assays for assessing tooth wear. Recent studies have explored profilometry and microhardness indentation loss methods for evaluating wear related phenomena. It is hoped that these techniques allow detailed investigation of combinatory oral care phenomena with hard tissue abrasion.

PURPOSE

This study investigated using 3d profilometry and microhardness indentation loss in an effort to correlate new techniques with RDA and REA assessments of three dentifrices, as well as assess the relative effectiveness of the techniques on enamel and dentin.

MATERIALS AND METHODS

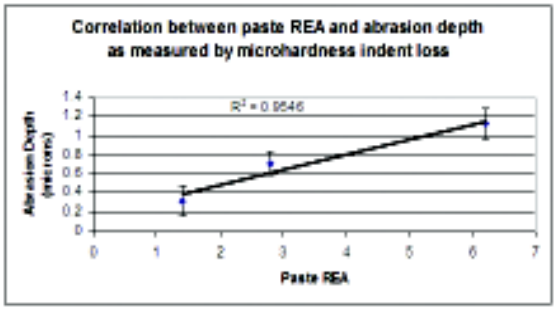
Test Products: Colgate Cavity Protection, Crest Cavity Protection, Ultra Brite

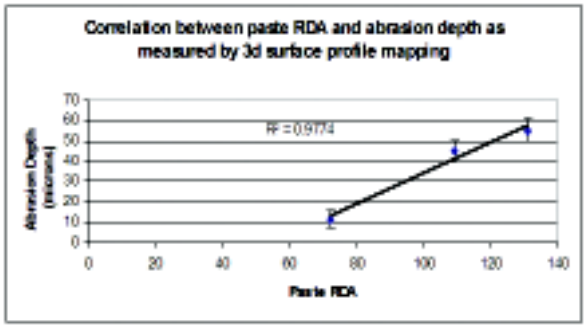
Test Substrates: Dentin and enamel blocks cut 3.5mm x 3.5mm mounted in a hard acrylic resin that is used for mounting oral restorations

Methods:

1. *Surface profilometry* – With four mounted dentin substrates in hand per treatment group, two holes are drilled in the left hand portion of the sample. These holes are used to align the surfaces, if necessary, for later numerical computation to determine average depth. After the holes have been drilled, a pre-treatment surface profile is taken. The left hand side of the surface is then masked using an adhesive tape that will adhere to the surface throughout the treatment regimen. In this case, the surface is brushed for 10,000 strokes in a V-8 brushing machine, the tape removed, the sample cleansed gently with an alcohol swab, and rinsed. The post-treatment profile is taken. The surface data are exported to a text file for import into Matlab. The surfaces are aligned, a volume integral is found over the brushing area between the two surfaces which is translated into an average depth of material removed.
2. *Microhardness indentation loss* – This method is an in vitro adaptation of an in situ model described by Joiner et al. (2002). With four mounted enamel substrates in hand per treatment group, four surface indents are made diagonally across the surface using a microhardness tester and a Vickers diamond pressed by a 500g weight. The size of the indent is measured at the edges of the crosshairs that run through the indent using the hardness tester and the hardness is recorded (this hardness can be used to stratify samples in later experiments). The surface is brushed for 1,500 strokes in a V-8 brushing machine after which the size of the indents are measured and the average depth of brushing is calculated based on the change in geometry of the indent.

DATA





CONCLUSION

Both methods provide a useful alternative to the radiotracer technique for measuring oral hard tissue abrasion. During the course of the study, it became obvious that measuring microhardness indentation loss on dentin was not possible and using the profilometry technique on enamel was equally as difficult.