

A topographical approach to dental microwear analysis.

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Although dental microwear analysis shows promise as a source of behavioral information about past populations, current methods have significant limitations. The scanning electron micrographs currently used in most studies provide an imprecise representation of surface topography that varies markedly depending on the techniques and instruments used. There is also an element of subjectivity in the identification of significant features. This leads to a lack of comparability in the results of different investigators. These problems are compounded by inconsistencies in magnification and sampling strategies. Finally, because current techniques are extremely time consuming, little is known about variability in the microwear of teeth at different positions in the dental arcade or the extent of variation within and between populations.

Many of these problems can be avoided using a profilometer to collect high resolution topographical data on tooth surfaces. These instruments, which are used in silicon wafer production, have a sub-nanometer vertical resolution and a horizontal resolution of about 0.10 microns. The main limitation of the profilometer is that surface topography must be reconstructed through the statistical analysis of information on a limited number of tooth transects.

We have addressed this problem through statistical techniques used in stereology. In a series of experiments using artificially abraded surfaces, we scanned a 2mm square area at different orientations to obtain an isotropic uniform random sample. Each 2mm transect produced about 20,000 data points. Profilometer data on surfaces with different scratch-to-pit ratios were analyzed statistically to obtain information on the surface area fraction and anisotropy. The spatial frequency distribution, spatial autocorrelation, and fractal dimension of each surface were also estimated. With these statistics, we can distinguish between different types of microwear.

Using these techniques, it is possible to decompose the topographic relief of a tooth surface into components associated with features that occur at different spatial frequencies. For example, periodicities arising from enamel prisms and perikymata can be separated from those associated with overlying microwear by digital filtering. The filtered data provides information on microwear features ranging in size between 0.1 microns and 0.1 mm.