Micro-Computed Tomography of Primate Molars

A Dissertation Presented

by

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Abstract of the Dissertation

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Primate molar enamel thickness has played an important role in the taxonomic, phylogenetic, and dietary assessment of fossil teeth for nearly 90 years. Despite the frequency with which enamel thickness is discussed in paleoanthropological discourse, methods used to attain information about enamel thickness are destructive (limiting sample sizes), recording information from only a single plane of section (ignoring dimensional data that may be culled from the entire length of a tooth). In light of a growing body of published two-dimensional data on enamel thickness in primates, the dissertation presented here aims to develop a non-destructive technique capable of accurately measuring the thickness of dental enamel from a whole-crown three-dimensional perspective using modern medical imaging technology (i.e., micro-computed tomography).

Enamel thickness measurements based on microtomographic imaging are accurate (within 3.0%) compared to manually produced molar sections. The processing of radiographic images, however, introduces complications (i.e., image artifacts) into the process of measuring enamel thickness. It is demonstrated here, however, that an image filtration protocol may be applied to microtomographic dental radiographs which preserves the accuracy of the representation of dental structures, and makes these images measurable in a semi-automated fashion. Moreover, optimal scanning parameters (e.g.,

slice thickness) may be deduced for each specimen *a priori*, such that image accuracy is largely a function of tooth size and morphology.

The techniques described here were applied to primate molars (genera represented: *Hylobates*, *Symphalangus*, *Alouatta*, and *Ateles*), and several aspects of enamel morphology were recorded. Results show that 3D data are less prone to variance introduced in the preparation of specimens (i.e., section obliquity) than 2D data. Primary folivores have relatively thinner enamel than primary frugivores, and ceboids have relatively thinner enamel than hominoids. Hylobatid primates have long been considered a thin-enameled group, but this study shows that hylobatid molars are of intermediate enamel thickness. Both 2D and 3D data indicate that traditional interpretations of the enamel thickness in primate evolution should be reconsidered. The transition from thin to thick enamel in hominoid evolution has been used to diagnose great apes in the fossil record, but this demarcation is not as clear as previously thought given intermediate thickness enamel in successive outgroups (Hylobatidae and Cercopithecoidea). Enamel thickness is a reliable indicator of taxonomic affiliation when distinguishing closely-related species, but this character must be considered in light of other features of tooth morphology (e.g., the shape of the enamel-dentine junction) in order to better understand its taxonomic and phylogenetic signals.