How three-dimensional surface data can be used to reconstruct fragmentary fossils.

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Semilandmarks make it possible to quantify shape information on curves and surfaces using coordinate-based statistics. They can be used in geometric-morphometric analyses of shape variation as if they were homologous landmarks, and are therefore particularly helpful in regions where osteometric points are sparse (like e.g. the neurocranium). We test whether the additional effort in collecting curve and surface data, rather than traditional landmark points, is warranted. 138 landmark points, 34 curves totaling 299 semilandmarks and 44 patches (frontal, maxilla, zygomatic and two occipital) totaling 661 semilandmarks were collected from forty-nine surface scans of recent human crania from the collections of the AMNH, obtained with a XYZ surface scanner. Our sample comprises ten widespread populations. Six scans of Pleistocene fossil crania were also included. 3D-coordinates of these points were converted to shape-coordinates using Procrustes superimposition. We then standardized each specimen by thin-plate spline unwarping to the Procrustes average of (1) just the landmarks, and (2) landmarks and semilandmarks on curves. Thereby we can visualize the information gained by measuring the curves, and curves and surfaces respectively.

We show that the surface patches are largely redundant with landmark and curve data, providing little additional morphological information. These findings have important implications for reconstructing fragmentary fossil material; such fossils are often neglected because they contain too few landmark points. Curve and patch data can be collected from fragmentary fossil material thereby increasing the sample size.

Supported by the Marie Curie Actions grant MRTN-CT-2005-019564 “EVAN,” the Max Planck Society and NSF 0333415 (NYCEP IGERT).

Geometric morphometric analysis of the ontogeny of canine and craniofacial growth in *Colobus guereza*; implications for its lack of canine dimorphism.

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Canine sexual dimorphism in anthropoid primates is largely the product of sexual selection. Intrasexual competition has selected large male canines in many anthropoids, and maxillary canine dimorphism broadly correlates with polygyny. *Colobus guereza* is perplexing in their male-sized female canines despite a social organization of single (or few) males and multiple females with intense inter-male competition. Only hylobatids (and tamarins) present comparably non-dimorphic canines, while other *Colobus* species and all other anthropoids are dimorphic or have small male canines (humans, marmosets). Delson and others have noted this phenomenon in passing, but without formal analysis of factors producing large female canines. Ontogenetic trajectories influence the expression of sexual dimorphism through bimaturism or differential growth rates. Most anthropoid canine dimorphism is the result of earlier eruption and growth termination in females, with male canines developing later and over a longer period of time. Dental eruption patterns indicate that *C. guereza* follows this pattern, so their large female canines are unexpected. Data on canine dimensions and the craniofacial complex in an ontogenetic sample were collected to test whether differentiation in growth patterns is responsible for large female canines and low rates of dimorphism.

Principal components analysis of three-dimensional landmark data from an ontogenetic sample of *C. guereza* allowed an examination of whether maxillary canine and craniofacial growth patterns differed significantly between males and females. Canines do erupt earlier in females, but there is no canine dimorphism in adults or juveniles, and growth trajectories appear similar in both sexes.

This research was supported, in part, by NSF awards 0333415 (NYCEP) and 0513660.