



Physical Anthropology Section - 2014

H90 Palate Shape and Depth: A Shape-Matching and Machine-Learning Method for Estimating Ancestry From Skeletal Remains

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After attending this presentation, attendees will have learned the efficacy of palate shape as a skeletal ancestry indicator, the “typical” shape of the palate for individuals of Hispanic ancestry, the potential usefulness of palate depth in assessing ancestry from the human skeleton, and the influence that secular change may have on traditional indicators of ancestry.

The presentation will impact the forensic science community by demonstrating the usefulness of this technique in assessing the ancestry of an unidentified individual. The ultimate goal of forensic anthropology is to identify the dead. This new technique adds to the catalog of techniques available in that pursuit and provides new information regarding the population-based variation of the human skeleton.

The assessment of ancestry from skeletal remains is a vital aspect of the biological profile so often used in forensic anthropology. As such, a plethora of techniques has been developed to examine this aspect of the biological profile. Gross observation of morphological features and reliance on observer experience to correctly interpret those features are traditional methods of analysis. However, as replicability has become more important in both the laboratory and the courtroom, objective, metric techniques of analysis have become increasingly prominent. This study attempts to merge these two areas: by taking a feature that is traditionally examined non-metrically, palate shape, and, by using computer-generated models, evaluate it quantitatively.

Using 3D digitizer technology in conjunction with shape-matching and machine-learning methods common in computer science, palate shape curves were collected from 376 individuals of varying backgrounds from both historic and modern contexts. Additionally, the digitizer was used to capture palate depth (superior to inferior), which is a novel measurement in this study. The crania used in this study came from the Pima County Office of the Medical Examiner (PCOME) in Tucson, Arizona, the William M. Bass Donated Skeletal Collection at the University of Tennessee, Knoxville, and the Roger J. Terry Skeletal Collection, the Smithsonian Institution’s National Museum of Natural History in Washington, D.C.

Computer analysis of the data indicated that palate shape was an accurate indicator of ancestry in the whole sample 58% of the time, which is higher than would be expected from random chance (33%). This number improved slightly when the historic sample was examined on its own (61%). Cluster analysis of the curves revealed that the parabolic, hyperbolic, and elliptical shapes, and by extension the White, Black, and Asian/Native American ancestry groups, are relatively discrete from one another. The only significant overlap in shape was observed between White and Hispanic individuals, both being characterized by a parabolic palate shape.

The results of the depth measurement in this study are preliminary at this stage. However, some interesting findings came to light. Measurements indicated that, at the intersection of the transverse palatine suture and the median palatine suture, palate depth differed among the ancestry groups, with individuals of Hispanic ancestry having the deepest palates.

This study has resulted in several important conclusions. First, the traditional methods of ancestry estimation should be quantified, so that they may continue to be used to identify the unknown in arenas where objective measures are necessary. Second, these results demonstrate that the skeletal anatomy of Hispanic individuals, especially in regard to ancestry, varies in unexpected ways, and warrants further research. Finally, the preliminary results presented here indicate that examining palate depth may be an important tool in the future of the discipline.

Palate Shape, Ancestry, 3D Digitizer