H38 Investigating Between Group Differences in Zygomaxillary Suture Form Using Fourier Analysis

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After attending this presentation, attendees will better understand how the zygomaxillary suture can be used for differentiating human groups and how 3D-model based analysis can enhance the capabilities of forensic anthropologists for human identification.

This presentation will impact the forensic science community by re- evaluating the validity of widely perceived criterion of race determination and presenting a way to minimize its interpretive element. Moreover, this quantitative approach to zygomaxillary suture form signifies a larger trend in forensic anthropology towards computer-based methods, which can offer considerable advantages in terms of precision, repeatability, and objectivity.

The zygomaxillary suture is commonly viewed as one of the racial attributes of the human skeleton. Formed by the intersection of the zygomatic and maxillary bones of the skull, the suture can occur in "angled" or "curved" forms which have been associated with Caucasoid and American Indian crania respectively. It has even been suggested that Caucasoid and American Indian crania can be differentiated by zygomaxillary suture form alone. However, the dichotomous nature of this typology does not adequately describe the continuous scale of variation exhibited within and among crania of different groups, nor does it account for the ambiguity that may result from bilateral asymmetry in individuals. Furthermore, these distinctions in suture form are based on qualitative characteristics that require a subjective assessment of each skull. Such subjectivity can be problematic in a legal context, where the credibility of expert testimony requires highly reliable methods of analysis.

In this study, a quantitative approach was used to investigate between-group differences in zygomaxillary suture morphology. A sample of 120 human crania from northern European (n=60) and California Indian (n=60) populations were recorded with a three- dimensional (3D) laser scanner, and the complete digital models were analyzed with 3D data analysis software. Each model was oriented in standard alignment with the Frankfurt horizontal and midline planes, using published protocols. The zygomaxillary sutures of the models were then traced with digital tools for defining a 3D contour. As a result, each suture was represented by a contour with a density of three equally- spaced Cartesian coordinates per millimeter, with endpoints at the craniometric landmarks of *zygoorbitale* and *zygomaxillare*. Both the right and left sutures of each cranium were traced, which yielded a total of 240 contours. Using an in-lab computer program, the projections of the contours along the XY and XZ planes were scaled to uniform length

and subjected to Fourier analysis. Fourier coefficients were used to create discriminant functions that most effectively separate the European and American Indian crania in the sample by side and by sex, and the validity of the functions were tested with the leave-one-out technique.

The purpose of this study was to test the hypothesis that a quantitative analysis of zygomaxillary suture form is equally effective in discriminating European and Native American crania as a qualitative analysis. Thus, the results of the discriminant analysis were compared with the results of a traditional visual assessment, in which both evaluations identified "angled" or "curved" suture forms in the sample and calculated the within-group frequencies of each type. Based on these comparisons, it was possible to evaluate the relative merits of these methods of purposes of human identification. In addition, new information was obtained on the diagnostic capabilities of the zygomaxillary suture in males versus females and in the right side of the skull versus the left side, which has not previously been investigated.

Zygomaxillary Suture, Fourier Analysis, 3D Models

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