A10 Quantitative Population Differences in Anterior Zygomatic Projection (ZP)

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After attending this presentation, attendees will better understand the variation of anterior ZP within modern populations and its use in identifying unknown individuals of Asiatic/Native American ancestry.

This presentation will impact the forensic science community by expanding the knowledge of craniofacial trait variability used during ancestry estimation. Additionally, this presentation will demonstrate the value of updating traditional methods by incorporating contemporary technology, such as 3D virtual models.

Within forensic anthropology, qualitative methods have historically been favored for estimating the ancestry of unknown individuals. This leaves room for subjectivity when assessing traits and can potentially lead to misclassifications. Anteriorly projecting zygomas have traditionally been viewed as a trait indicative of Asiatic heritage (including Native Americans), but the trait is poorly defined and recent validation studies have demonstrated its vulnerability to high interobserver error.[1,2] In an effort to reduce subjectivity in describing ZP, two non-metric methods have been proposed to measure this projection, one commonly referenced to Rhine and the other from Bass.[3,4] In Rhine, the angle of projection is measured by dropping a line "from the middle of the upper margin of the orbit to the middle of the lower margin [that] produces an angle … with the Frankfort plane" using a 90° sectioning point to define projecting, vertical, or receding zygomas. In the Bass method, the observer holds the skull with the occipital region in their hand and the facial area up. A pencil is then placed across the nasal aperture and the observer inserts their index finger between the zygomatic and the pencil. If the observer cannot fit their finger in that space, the zygomatics are considered projecting. The Rhine method is qualitatively assessing an angle, while Bass is visually assessing an absolute distance, yet both use the terminology "zygomatic projection." The current study investigates the applicability of the available methods of assessing ZP and quantitatively examines the relationship between ancestry and ZP.

For both the Rhine and Bass techniques, two interpretations of each method were metrically assessed utilizing 3D virtual cranial models. All analyses were conducted via the use of Geomagic® studio software and ImageJ. This allowed for the crania to be automatically aligned to standardized orientations for viewing and facilitated the incorporation of inter-planar distance measurements, which are necessary to quantitatively test the original qualitative methods. The sample consists of 231 3D cranial models of United States White (*n*=73), United States Black (*n*=38), Arctic Native American (*n*=79), and Plains Native American (*n*=41) individuals.

Two interpretations of the ZP angle were tested following Rhine and two inter-planar distances between the nasal aperture and the zygoma were tested following the text and figures presented in Bass. To test for differences in group means, Analyses of Variance (ANOVAs) were run on all measurements of ZP, with two-way ANOVAs then conducted to examine the effects of ancestry and sex on each measurement. Tukey's post hoc tests were then performed to identify which groups displayed differences. Lastly, to provide more details on group differences and evaluate group classification rates, logistic regression was performed on all measurements of ZP that yielded significant ancestry differences ($p < 0.05$).

In each assessment, the Arctic Native Americans demonstrated the most anteriorly projecting zygomas, providing support to the general assumption that individuals of Asiatic ancestry have more anteriorly projecting zygomas than other populations, although significant differences were not always obtained. Of the interpretations tested, the inferior zygomatic inter-planar distance performed best at classifying between Arctic Native Americans and other groups when using binary logistic regression. This yielded correct classification rates between 70% and 98%. ZP was also found to be mildly sexually dimorphic, with females having more projecting zygomas than males within the same population. This study demonstrates that quantitatively modifying the current methods of ZP assessment through the use of 3D software can lead to information gains unobtainable through existent qualitative methodologies. Furthermore, this study examines the use of standardized terminology within the field of forensic anthropology and highlights the benefits of investigating alternative interpretations to traditional methodologies.

Reference(s):

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Biological Profile, Ancestry Estimation, Cranial Traits

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