H50 Chin Form as a Sex Trait: Not a Simple Gradient

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After attending this presentation, attendees will have a better understanding of the morphological variation and sexual dimorphism in chin form present across diverse human populations, and the reliability of skeletal chin traits in adult sex determination methods.

This presentation will impact the forensic science community by providing sex classification rates for overall chin morphologies. In comparison to previous studies, which utilized subjective ordinal scaling methods, this study uses an objective morphometric method to quantitatively analyze sex differences in chin shape.

Chin form is a common non-metric cranial trait used by forensic anthropologists in adult sex determination methods. Traditional sex estimation methods present an ordinal scale of five line drawings, representing a gradient in chin form from more "feminine" to more "masculine" morphologies.[1] Because these observed sex differences are in the form of localized shape changes and complex variations in bony relief, finding a method to quantify sex differences in external chin morphology has presented a great challenge to anthropologists. A recent study published a method to isolate the chin Region Of Interest (ROI) from 3D surface scans, and demonstrated how morphometric methods could then be used to quantify sexual dimorphism in chin morphology.[2]

This study employs their method of isolation and uses sliding semi-landmarks positioned across the surface of the chin ROI to quantify chin morphology in order to objectively test the reliability of external chin form in discriminating between sexes. The accuracy of using quantitative measurements of chin form to correctly sex individuals was evaluated on a pooled sample (n=666), as well as separately on each of the six population groups included in this study: U.S. Whites, U.S. Blacks, Arctic Native Americans, Plains Native Americans, Nubian, and Portuguese. Discriminant function analyses, using a leave-one-out cross-validation method, were performed on the principal components extracted from the morphometric analyses. Traditional ordinal scores were also collected on four of the population groups, and discriminant function analyses were performed on these ordinal scores for comparison to the morphometric results.

Overall, results suggest that external chin morphologies are not reliable indicators of sex and consequently, should be used with extreme caution in forensic anthropological contexts. Discriminant function analyses run on the first 30 principal components, reflecting overall chin morphology, resulted in a correct sex classification rate of 68.2% for the pooled sample. Within individual population groups, accuracy rates ranged from 49.4% for the Nubian population to 70.4% for the arctic Native American population. Only a 50.8% correct classification rate was obtained for the U.S. White population group, while U.S. Blacks displayed slightly higher accuracy rates (65.0%). These results were on par with the accuracy rates obtained from the traditional ordinal scores (65.0% correctly sexed in the pooled sample). Step-wise discriminant function analyses suggest that the shape component reflecting relative chin ROI height compared to breadth was the most sexually diagnostic feature, with males generally displaying relatively taller chin symphyseal heights than females. Principal component plots illustrate a high degree of variance and overlap between sexes and population groups in chin morphologies. In addition, individual chin features, such as degree of "squareness," symphyseal height, overall chin protrusion, midline eminences, and lateral tubercle formations, were observed in various combinations across the sample. These results suggest that specific chin traits may be expressed independently, and that chin form may not be easily categorized into a simple gradient from more "feminine" to more "masculine" forms. The existence of numerous distinct categories of chin morphologies was first presented in the 1930s, but has since been neglected in the anthropological literature.[3,4]

As demonstrated in this study, the external morphology of the chin is much more variable than traditional non-metric studies suggest. Oversimplified gradients may not accurately reflect complete variation in observed chin forms, and the independent expression of individual chin traits should be further investigated. Correct sex classification rates obtained from chin shape components did not exceed 70%, and in two population groups less than 51% of the individuals were correctly sexed from chin morphologies. These results indicate that chin form is not a reliable indicator of sex, and thus is not recommended for use in forensic sex determination methods.

References:

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