H15 Discriminant Function Analysis as Applied to Mandibular Morphology to Assess Population Affinity

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After attending this presentation, attendees will be able to use mandibular morphological data as a tool to potentially diagnosis the biological affinity of an unknown individual.

This presentation will impact the forensic community and/or humanity by informing the forensic community of another potential tool for use in the identification process.

Determination of population affinity using the mandible has been gaining attention. Researchers have commonly used mandibular metric data to classify American Whites and Blacks, but analyses using three or more populations (either mandibular metrics or morphology) are rarely undertaken. While mandibular morphological state frequencies can be found for three (or more) groups in the same study, complex statistical modeling of these frequencies is rarely encountered. This paper examines the ability to correctly classify an unknown individual using mandibular morphology through discriminant function analysis.

Seven morphological traits of the mandible are utilized. They include the lower border shape, chin shape, ascending ramus shape, ascending ramus profile, gonial angle flare, mandibular torus, and posterior ramus edge eversion. Categorical scoring of these traits has been previously described, though in the present study, a modification to the scoring of the lower border was made. Here, the border has been scored as either straight, undulating, partial rocker, or rocker. Categorical assessments were converted to an ordinal score for each trait. The ordinal scores were assigned in step-wise fashion based on a perceived complexity of each trait. For example, the mandibular border was scored as a one for straight to a four for rocker, assuming that a curved form is more complex than a straight form.

Some statisticians have argued that ordinal or binary variables can be used in linear discriminant functions instead of metric variables. Recently, several researchers have applied this type of analysis to cranial non-metric traits. Using linear discriminant functions, 90% classification rates were achieved between populations from just a few variables. In depth statistical analysis of their data did not yield substantial objections concerning the application of the generated discriminant functions.

The presented analysis concentrates on male individuals from approximately ten different populations that include American Whites and Blacks, Cambodians, Vietnamese, Central American Hispanics, and Native Americans. The sample size is in excess of 1000 individuals; all individuals are assumed to have from late 19th to 20th century birth years. Linear discriminant function analysis was undertaken not only using two group comparisons, but also three, four, and five group comparisons. Each analysis was cross-validated using a leave-one-out method for accuracy assessment. The only variable to continuously fall out of the analyses was the ascending ramus profile shape.

Five population comparisons yielded a 54% cross-validated accuracy rate, approximately three times better than the expected accuracy if based on chance alone. Two group comparisons fared better, some in excess of 83%, while three group comparisons approached 70% accuracy rates. Further, two group comparisons of closely related populations (Cambodian, Vietnamese) also appeared to function well, with a 74% accuracy rate. As a means of comparison, FORDISC 2.0 was used to determine classification rates for six or seven craniofacial/vault measurements, using three populations. In these analyses, classification rates of 62-87% were generated, depending on the populations and measurements selected. Vault measurements faired better than craniofacial measurements in these comparisons. Based on these results, the use of discriminant functions to assess population affinity via mandibular morphology is argued to be a valuable tool for the forensic anthropologist.

Mandibular Morphology, Population Affinity, Statistics

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