A36 The Accuracy of Nutrient Foramen Versus Midshaft Measurements of the Tibia for Sex Determination

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After attending this presentation, attendees will understand the utility of nutrient foramen and midshaft measurements of the tibia for sexing by discriminant function analyses.

This presentation will impact the forensic science community by providing usable discriminant function analyses for sex determination using the tibia.

The postcranial skeleton has been used for sex determination of an individual for more than a century. These methods have been developed and re-assessed to find the most accurate methods. In the tibia, discriminant function analysis has been employed, including measurements of diameter taken at the nutrient foramen. The location of the nutrient foramen varies from person to person and can be located in different areas of the bone from the right to left tibia in the same individual. This inter- and intra-individual variation has led some standards to adopt midshaft measurements in place of, or in addition to, the existing nutrient foramen located measurements.

To understand the implications this variation may have on the accuracy in sex determination, comparative consideration of midshaft measurements in place of nutrient foramen level measurements were tested with the following questions: Is intra-person variation in the location of the nutrient foramen great enough to cause significant mismatching of tibias left applied to left, left applied to right? Is there a significant advantage to using measurements collected at the midshaft in addition to, or in place of, measurements collected at the level of the nutrient foramen? It is hypothesized that there will be no significant difference in correct sex classification between the two measurements.

A sample of 400 individuals were measured from the Robert Terry Anatomical Skeletal Collection. Measurements of the tibia were taken via standard osteometric protocols. Because of discrepancies in the standards, medial-lateral diameter at the nutrient foramen was collected both in a 90° rotation from the anterior posterior measurement and from the interosseous crest.

Data were randomly divided into a testing set and a training set, each consisting of 200 individuals. Discriminant function analyses were run in the statistical programming environment R, using only left measurements or left and right measurements from the training set. Initial tests of ancestry differences determined no significant differences, and thus ancestry groups were pooled. The resulting discriminant functions were applied to classify individuals from the testing set using left and right measurements combined. Three variables, maximum length and proximal and distal epiphyseal breadth, were tested.

Results indicate breadth measurements of the proximal and distal epiphyses were consistently good predictors with high loading values higher in all combinations. Of the medial lateral measurements of the diaphysis, the measurement taken from the crest to a point directly opposite was a better predictor of sex than measurements taken at a 90° rotation from the anterior posterior measurement (90% versus 91.5%). Of the measurements taken at the midshaft, minimum diameter and circumference were both considered good predictors (89% correct). In the

combined analysis medial-lateral diameter at the nutrient foramen, minimum at the midshaft and circumference at the midshaft were the best predictors (89% correct). There is no significant difference in accuracy between a discriminant function created with only lefts and applied only to lefts and the same function applied to lefts and rights (always a <1% difference in accuracy).

This investigation identifies that there is no significant advantage of sex determination based on measurements taken at the nutrient foramen compared to those taken at the midshaft. In cases involving fragmented remains, measurements taken at the level of the nutrient foramen would, of course, have more utility. It would be most valuable to collect both midshaft- and nutrient foramen-based measurements.

Tibia, Discriminant Function Analysis, Sexing