H35 Assessment of Determination of Handedness Using Standard Osteological Measurements of the Shoulder Girdle and Arm Long Bones from Individuals of Known Handedness

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After attending this presentation, attendees will be able to better evaluate accuracy in determination of handedness in skeletal remains using standard arm bone dimensions.

This presentation will impact the forensic community and/or humanity by presenting the first analysis of the relationship between a number of standard measurements of the upper limb and handedness in a larger sample of individuals of known handedness.

A variety of studies in forensic anthropology have attempted to assess the ability to determine handedness using skeletal markers. Morphological indicators used have included degree of beveling of the glenoid fossa and radial tendon attachment characteristics. Other investigations have worked with long bone size. Based on Wolff's Law, they have assumed that arm bones on the side of handedness will be larger. However, most of these analyses have used only a small subset of the upper limb measurements standardly taken, and have evaluated them in prehistoric skeletal populations with the expectation that about 10% will be left-handed. While a few studies have involved individuals of known handedness, they have had serious limitations. For example, Blackburn and Knusel (2006) primarily looked at only one measurement, epicondylar breadth; Schulter-Ellis (1979) evaluated a few more measurements, but the sample size was ten. This project improves upon these investigations by analyzing all of the measurements suggested in the Standard Osteological Database (Buikstra and Ubelaker 1994) on a larger sample of individuals of known handedness.

Data for 34 individuals (26 right-handed, 8 left-handed) were taken from several sources, including various local forensic cases and the database of donated cases at the University of Tennessee. Both sexes were represented as were African, European, and Hispanic ancestries. Measurements included both length and transverse dimensions of the scapula, clavicle, humerus, ulna, and radius. As with the previous studies, it was hypothesized that dimensions would be greater on the side of handedness.

Bone length differences were addressed first since several studies have suggested they varied by handedness. The humeri were found to be longer on the side of handedness in 38% (10/26) of cases as compared to about 70% for both the radii and ulnae; the mean length differential between sides for the individual bones was 2.1 mm. When the combined radius and humerus lengths were compared bilaterally, the greater sum correlated with side of handedness in 63% (14/22) of individuals with a mean length difference of 2.9 mm. For the combined length of all arm long bones, values were 60% (12/20) and 4.1 mm, respectively.

Results of analysis of transverse measurements were of mixed success. Scapular and clavicular dimensions showed extensive bilateral variation, inaccurately predicting handedness in over half of the cases, especially left-handers. Greater epicondylar breadth correlated with handedness in 18 of 28 (64%) individuals, or just slightly better than that reported in Blackburn and Knusel's (2006) study. When differences were present in the maximum midshaft measurement of the humerus, the side of handedness was larger in 84% of individuals. The minimum diameter measurement was correct in 60%. Transverse measurements of the radius and ulna offered less promise since they were much more likely to be bilaterally symmetrical. When a consistent pattern of differences was seen (at least two of the four measurements varied), it favored the side of handedness in 50% (10/20) of cases; perhaps equally noteworthy, it favored the opposite side in 6 of 20 (30%) cases. Among all of these data, no distinctions by sex or ancestral group were seen.

Overall, use of the standard measurements is not very encouraging in determining handedness. The humeral midshaft dimensions seem to be the most accurate followed by length of the individual forearm bones. In contrast, the other measurements considered had accuracy rates barely higher than those associated with flipping a coin. It is still possible that the basic assumption is not necessarily flawed. Steele and Mays (1995) have argued that variation in bone lengths, and presumably transverse dimensions as well, are primarily related to environmental factors. Furthermore, extensive bilateral asymmetry has been found in many prehistoric populations, but results here may suggest that modern individuals are less likely to perform the strenuous activities necessary to produce size differentials similar to those seen in the past. Therefore, it is recommended that additional means beyond bone asymmetry be developed to more accurately assess handedness.

Handedness, Long Bone Measurements, Bilateral Asymmetry

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