H78 Can Bilateral Joint Asymmetry Be Used as an Estimation of Handedness?

Kathryn R.D. Driscoll, MA, University of Tennessee, 250 South Stadium Hall, Knoxville, TN 37996*

After attending this presentation, attendees will understand whether bilateral asymmetry of the humeral, femoral and tibial joints should be used to estimate handedness.

This presentation will impact the forensic community by examining the statistical validity of using joint asymmetry as an estimation of handedness.

In order to develop a comprehensive biological profile, forensic anthropologists depend on the ability to identify skeletal characteristics. Determining handedness from skeletal material is one tool that would enhance the effectiveness of the biological profile. While bilateral asymmetry has traditionally been used as an indicator of handedness, the statistical significance of this practice needs to be examined. This research examined the statistical significance of bilateral joint asymmetry as an indication of handedness or hand dominance.

Bilateral asymmetry of the long bones has historically been used as a possible indicator of handedness. Longer right humeri were thought to indicate right handed dominance as were longer left lower limbs (specifically the tibiae). Differential use was assumed to manifest in bilateral asymmetry. Kerley (1972) also indicated that the clavicles could be used in handedness determinations. In 2007, the statistical significance of length and weight asymmetry was examined using a skeletal sample of known handedness. Results indicated that asymmetry existed in the sample; however, only the clavicles were clearly correlated with handedness. In 2004, Plochocki examined differential loading of the joints as a result of differential hand dominance; he concluded that environmental activity does result in asymmetry; however, the handedness was unknown for the individuals in Plochocki's sample. In an effort to further examine the relationship between bilateral asymmetry, joint asymmetry, and handedness, the current study examined the proximal and distal epiphyses of the humeri, femora and tibiae of a sample with known handedness.

The William M. Bass Donated Skeletal Collection housed at the University of Tennessee in Knoxville was utilized for the 2007 study as well as for this study. Whenever possible, a biological questionnaire is completed when an individual is donated. These include a question related to handedness. This information in conjunction with the skeletal remains presented a good opportunity to examine the actual statistical correlation between handedness and bilateral asymmetry.

For this study, the humeral head diameter, humeral epicondylar breadth, femoral head diameter, femoral epicondylar breadth, tibial proximal epiphyseal breadth, and tibial distal epiphyseal breadth were measured. The measurements of 107 individual donations with known (self-reported) handedness were examined. When the sample was pooled, paired t-tests of each individual's measurements indicated significant (α =0.05) asymmetry *sans* the femoral head diameter and distal tibial epiphyseal breadth. When the samples were grouped by handedness, the lefties were only asymmetrical in the humeral epicondylar breadth and proximal tibial epiphyseal breadth while the righties were asymmetrical in the same measurements as the pooled sample. Statistically significant differences favored the right skeletal element in each case. Therefore, when both groups were asymmetrical, they were asymmetrical in the same direction. This was not particularly supportive of the handedness-use hypothesis.

While asymmetrical significance was difficult to tease apart, the results of discriminant analyses testing the six measurements' classification ability were promising. Preliminary results indicated that discriminant analyses correctly classified 74% of individuals into handedness groups when utilizing all of the measurements. When the groups were separated by sex, the classification rates improved to 88% for females and 80% for males. The percentage of directional asymmetry {DA = (right-left)/(average of left and right) *100 } was also calculated for each individual. The results of these calculations supported those calculated using the paired t-tests.

Significant bilateral asymmetry is present, but simply using one measurement fails to adequately classify an individual. However, preliminary classification results using all of the measurements are cautiously optimistic. Of note, there is a sampling bias that is present in the sample which may be the cause of apparently conflicting results. Of the 107 individuals, only 15 individuals were classified as left handed; however, this ratio does mimic that found in the general population.

Bilateral Asymmetry, Handedness, Joints

 ** Presenting Author*