H99 Asymmetry of the Deltoid Tuberosity and the Possible Impact on Osteometric Sorting

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After attending this presentation, attendees will gain an understanding of how individual asymmetry may affect the sorting of humeri in a commingled assemblage.

This presentation will impact the forensic science community by emphasizing the variability in skeletal elements and how such variability and individuating characteristics related to asymmetry need to be taken into account when using osteometric sorting to segregate individuals from a commingled assemblage.

This research investigates whether asymmetry of the humerus, specifically the deltoid tuberosity, can be great enough to cause elements to be determined an unsuitable match when utilizing osteometric sorting. Osteometric sorting is used to assist in the evaluation of associating human skeletal elements based on size.[1] The sorting of skeletal elements from a commingled assemblage into individuals is potentially adversely impacted by varying degrees of asymmetry in individuals. Asymmetry is the degree of variability between the contralateral sides of the body, and occurs naturally due to the exertion of various forces over time. Since these forces vary on an individual level, based on factors affecting the growth and muscularity of elements, further evaluation of the methods used to associate contralateral elements in an individual was conducted.

Osteometric sorting, a sorting method created by Byrd and Adams, was produced to provide an objective use of size to sort through commingled skeletal assemblages. This method is currently being used in the sorting of a large, commingled assemblage at the Joint POW/MIA Account Command – Central Identification Laboratory (JPAC-CIL) that involves U.S. losses in the Korean War. This assemblage is largely fragmented and has been heavily sampled for DNA, which limits the number of measurements that can be obtained. Due to the nature of the remains, measurements recommended by Byrd and Adams for use in osteometric sorting will typically comprise the overall number of measurements that can be taken. One of the humeral measurements(maximum diameter of diaphysis at the deltoid tuberosity), is often one of the only measurements that can be taken on a humerus due to survivability. This measurement is strongly influenced by individual muscularity. The measurement includes the attachment site of the deltoid muscle. As the muscle increases in size, the tuberosity changes shape and often enlarges.

The reference data utilized for osteometric sorting at the JPAC-CIL was used as the reference sample for this study, and data collected from JPAC-CIL reference skeletons was added to this dataset. The total sample size used in this analysis is 59 individuals. The measurements were added to a spreadsheet and the osteometric sorting formulae for pair matching elements were utilized.[1] This method, which utilizes multiple measurements on the humerus, was used to assess asymmetry by assigning as a cut-off-any *p-value* less than 0.10, and declaring any individuals below the cutoff to be asymmetrical. Of the 59 individuals, 37 had larger right side measurements. Five individuals (8%) had significant *p-values*, which rejected the element, implying they were not from the same individual due to their dissimilarity in size. Note that this number falls below the expected Type I error rate of 10%. The analysis of the maximum diameter at the deltoid tuberosity combined with the maximum epicondylar breadth of the humerus resulted in 10% of the individuals having significant *p-values*. However, the analysis of the maximum diameter at the deltoid tuberosity combined with the maximum length of the humerus resulted in 21% of the individuals having significant *p-values*. In this case, 10 of the 11 individuals with significantly small *p-values* had larger right measurements. These results suggest that the asymmetry of the humerus as reflected in the deltoid tuberosity must be taken into account in order to mitigate the potential errors stemming from varying degrees of asymmetry on an individual level when sorting large comingled assemblages.

Reference:

1. Byrd JE. Models and methods for osteometric sorting. In: Adams BJ, Byrd JE, editors. Recovery, analysis and identification of commingled human remains, Totowa: Humana Press, 2008: 199-220.

Osteometric Sorting, Deltoid Tuberosity, Asymmetry

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