



Physical Anthropology Section – 2009

H74 Bilateral Asymmetry in Historic Versus Modern Skeletal Remains: Activity and Identification

Shannon E. May, MA*, 250 South Stadium Hall, Department of Anthropology, University of Tennessee, Knoxville, TN 37966

The goal of this presentation is to determine the presence of bilateral asymmetry in two temporally and geographically diverse skeletal collections, and to compare and contrast these values. Levels of lateralization are then considered in terms of activity, sex, and age.

This presentation will impact the forensic community by demonstrating the utility of bilateral asymmetry in modern forensic casework and in skeletal biological contexts. Furthermore, the population-specific nature and sexual dimorphism of side-dominance is addressed.

Bilateral asymmetry is defined as metric and morphological differences in paired biological structures, and may be used to infer various forms of environmental and mechanical stress imposed upon the skeletal system.^[1] Directional asymmetry, also termed lateralization or side-dominance, is observed most often in human skeletal remains, and occurs when unimanual loading induces bone modification on a particular side. This typically results in larger size, cortical thickness, and greater robusticity of bones from the side receiving the greater stress. Anthropological studies have used bilateral asymmetry to establish activity patterns,^[2] differentiate between the sexes,^[3] and assign handedness to an unknown set of skeletal remains.^[4]

The current study investigates the level of asymmetry in two diverse skeletal collections: (1) The New Lisbon Collection sourced from Lisbon, Portugal, representing a historic European sample, and (2) The William M. Bass Skeletal Collection, sourced primarily from the southeastern United States, representing a modern skeletal set born during the twentieth-century. Equal sample sizes of 250 individuals from each collection were used. Postcranial long bone measurements were taken on each sample according to standards created by Moore-Jansen et al.^[5] A total of seventeen measurements were taken, evaluating maximum and minimum length, diameter, and areas of muscle attachment. Both right and left elements were measured, using an osteometric board and digital calipers. An asymmetry index was also calculated as the difference between right and left elements of a pair, standardized by the mean of both components: $[(R - L) \times 100] / [(R + L)/2]$. This formula preserves both direction and magnitude of asymmetry, while standardizing for size, thus allowing comparison between skeletal areas and individuals. Extensive biographic information has been documented for each skeletal sample, allowing additional demographic analysis.

Paired T-tests revealed significant side-difference ($p \leq 0.05$) in twelve measurements in the New Lisbon Collection but only five variables in the Bass Collection. While the Lisbon samples demonstrated significant side discrepancy in variable dimensions, Bass samples were primarily bilateral in terms of maximum length. The New Lisbon Collection also showed a greater sex-specific concentration in asymmetry: female asymmetry located in the mid-arm (measurements of the elbow-joint) and male asymmetry concentrated in the shoulder girdle. Sexes were separated for between-collection comparisons, and only shared asymmetrical variables were utilized. Multivariate Hotellings 2-sample T-tests showed Lisbon males having significantly higher levels of asymmetry in all variables except ulna length ($p = 0.002 - 0.01$), as did Lisbon females ($p = 0.001 - 0.04$). In two measurements, the average Bass male asymmetry fell within the range of the Lisbon females, underscoring the importance of source/context when investigating sex and asymmetry in unknown remains. Additional analysis on the New Lisbon Collection reveals that Portuguese juvenile remains demonstrate lateralization by ten years age-at-death, with subadult males having higher asymmetrical values.

It may be concluded that bilateral asymmetry is population-specific and most likely related to the amount and degree of mechanical loading experienced by the group. Modern groups like the Bass Collection represent a more sedentary lifestyle, resulting in less activity-induced modification. Conversely the historic Portuguese represent a group habitually engaged in heavy labor. While sexual dimorphism in asymmetry exists for each group, it is crucial to discern the potential sample populations and the inherent levels of asymmetry before assigning sex or handedness to an unknown set of remains. Finally, analysis of juvenile remains indicates that lateralization in long bones may be apparent at a young age, particularly in highly active groups. This may provide another approach to the difficult task of determining sex in subadult remains.

References:

- ¹ Dangerfield PH. 1994. Asymmetry and Growth. In: Ulijaszek SJ, Mascie-Taylor CGN, editors. Anthropometry: The Individual and the Population. United Kingdom: Cambridge University Press, 1994;7-29.
- ² Fresia AE, Ruff CB, Larsen CS. Temporal decline in bilateral asymmetry of the upper limb on the Georgia coast. Anthropological Papers of the American Museum of Natural History 1990;68:121-135
- ³ Stirland AJ. Asymmetry and activity-related change in the male humerus. Int J Osteoarcheol 1993;3:105-113.
- ⁴ Steele J. Handedness in past populations: Skeletal markers.



Physical Anthropology Section – 2009

Laterality 2000;5:193-220.

- ⁵ Moore-Jansen PM, Ousley SD, Jantz RL. 1994. Data Collection Procedure for Forensic Skeletal Material. Knoxville, TN: Forensic Anthropology Center, University of Tennessee.

Asymmetry, Handedness, Mechanical Loading