A12 The Impact of Asymmetrical Leg Lengths on Adult Stature Estimation

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After attending this presentation, attendees will have learned that left/right total leg length asymmetries are commonly encountered in forensic anthropological casework. Guidance will be provided on how best to estimate stature when asymmetries are present to avoid the production of inaccurate estimates and the erroneous exclusion of decedents as matches to their skeletal remains.

This presentation will impact the forensic science community by encouraging bilateral measurement taking whenever possible and selection of a 99% Prediction Interval (PI) when total leg length asymmetry reaches ≥0.7mm. This practice can prevent inaccurate stature estimates and the erroneous exclusion of decedents from their skeletal remains.

The skeletal elements required to execute Fully's anatomical method of stature estimation are often not present, are incomplete, or are damaged, precluding its use. Thus, forensic anthropologists often use regression formulas to estimate stature from limb bones. As previous research has revealed that: (1) stature estimates calculated from two or more long bones are superior to those calculated from one; (2) lower limb bones correlate more strongly with stature than upper limb bones; and, (3) asymmetry between sides is relatively minor, the left (by convention) femur and fibula (highest r-squared value combination in FORDISC®) are often used to estimate stature at the Defense POW/MIA Accounting Agency (DPAA) laboratory.

A review of recent DPAA identifications reveals that stature estimations using the left femur and left fibula are occasionally slightly inaccurate due to total length asymmetries between the left and right legs. In extreme cases, estimates calculated from one limb match an identified individual's reported stature, while estimates calculated from the opposite limb exclude the remains as a match. Realizing that conventional selection of the left leg could be resulting in inaccurate stature estimations in cases of asymmetry, this research was undertaken to investigate: (1) if statistically significant asymmetries exist between left and right total leg lengths; and, (2) if the longer total leg length more accurately reflects measured stature as it represents an individual's greatest height potential when standing up straight.

To address these questions, stature data was collected from adult individuals identified at the DPAA Laboratory between 2001 and 2017. Ultimately, this sample was composed of 70 males of European, African, Native American, and Hispanic descent ranging in ages at death from 18 to 40 years (average=21.9 years, standard deviation=3.66 years). Twenty-two individuals served in World War II and 48 in the Korean War. To be included, the remains must have had left and right femora and fibulae present for analysis, the remains must be atraumatic and complete, and both left and right sides must have been measured by the assigned forensic anthropologist.

Using element lengths documented in the case notes, each individual's stature was estimated using FORDISC® 3 and the appropriate Trotter MStats male database. First, the maximum lengths of the left femur and left fibula were used to calculate a 95% Prediction Interval (PI). Second, the maximum lengths of the right femur and right fibula were used to calculate a 95% PI. These PIs were then assessed for absolute difference and checked against the individual's antemortem stature (obtained by healthcare professionals during military medical evaluations) for accuracy. Stature estimates that did not include the identified individual's antemortem stature were run again using 99% PIs and checked to see if the identified individual's antemortem stature was captured.

Although left/right total leg length asymmetries up to 16mm were observed in 61/70 cases, results indicate that: (1) mean total leg lengths are not significantly different; (2) when there are left/right total leg length asymmetries, the taller leg does not consistently produce the more accurate stature estimate; and, (3) when a disparity between left and right legs ≥7.0mm is encountered, increasing the PI from 95% to 99% ensures the individual's living stature is captured. Implementing this practice among the current sample improved stature estimate accuracy (90% to 100%).

Overall, these findings reinforce the idea that although mean total leg lengths are not significantly different, bilateral asymmetry can be significant enough to affect stature estimates.

Biological Profile, Stature, Bilateral Asymmetry

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