A9 The Impact of Antimeric Leg Length Asymmetry on Adult Stature Estimation: A Validation Study

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Learning Overview: After attending this presentation, attendees will understand that antimeric leg length asymmetry is commonly encountered in forensic anthropological casework. Guidance is provided regarding how to estimate stature when asymmetry is present to avoid inaccurate stature estimates and erroneous exclusion of a decedent as a match to skeletal remains.

Impact on the Forensic Science Community: This presentation impacts the forensic science community by: (1) encouraging bilateral measurement-taking whenever possible to identify asymmetry; (2) cautioning against combining leg bone lengths from different sides to avoid compounding proportional antimeric asymmetry; (3) recommending the use of measurements from the right side; and (4) proposing selection of a 99% Prediction Interval (PI) when total leg length asymmetry equals 5.0mm. This practice can prevent inaccurate stature estimates and the erroneous exclusion of decedents from their skeletal remains.

Review of Defense POW/MIA Accounting Agency (DPAA) Laboratory identifications revealed that stature estimations are occasionally inaccurate due to the occurrence of antimeric total leg length asymmetry. Preliminary research presented at the American Academy of Forensic Sciences in 2018 specifically found: (1) antimeric total leg length asymmetries, up to 16mm, occurred in 68/78 (87%) cases, indicating asymmetry is common; (2) significant differences (5.0mm average) exist between antimeric total leg lengths; (3) the longer or shorter leg does not consistently produce a more accurate stature estimate; (4) when asymmetry is present, right leg measurements are consistently more accurate; (5) the left leg demonstrates reduced accuracy with elevated asymmetry; and (6) when a disparity between legs of ≥5.0mm is encountered, increasing the PI from 95% to 99% ensures living stature will be captured (100% correct classification).

To validate these findings, stature data were collected from an independent sample of 20 adult individuals identified at the DPAA Laboratory in 2018. This sample includes males of European, African, Asian, and indeterminate ancestries, with ages at death between 18 and 43 years (mean=24.5 years, SD=3.7 years). Each individual had atraumatic and complete femora and fibulae present for analysis. Stature was estimated for everyone using FORDISC® 3 and the appropriate Trotter MSTATS male database. Maximum lengths of the left femur and fibula, and then the right femur and fibula, were used to calculate 95% stature PIs. These PIs were 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 assessed to see if the identified individual's antemortem stature was captured.

Results: (1) Total leg length asymmetries, up to 11mm, were observed in 90% of cases; (2) there is a statistically significant difference (mean=5.0mm) between antimeric leg lengths (p <0.00; t=6.5); (3) use of the longer or shorter leg does not consistently produce more accurate stature estimates; (4) when asymmetry is present, the right leg is consistently more accurate in predicting living stature; (5) the left leg demonstrates reduced accuracy with elevated asymmetry; and (6) when a disparity between left and right legs of ≥5.0mm is encountered, increasing the PI from 95% to 99% ensures the individual's living stature is captured (100%).

Overall, these results reinforce the preliminary findings that asymmetry is common between left and right total leg lengths, and that these asymmetries can be large enough to affect stature estimates and, therefore, identifications.

Biological Profile, Stature, Antimeric Asymmetry