H80 Long Bone Ratios for the Bosnian Male Population

Alexandra M. Klonowski, MS, and Tal Simmons, PhD, University of Central Lancashire, Maudland Building, Preston, Lancashire PR1 2HE, United Kingdom*

After attending this presentation, attendees will understand how to use the long bone ratio method for re-association of commingled human remains in situations where there is no physical connection between the upper and lower parts of the skeleton.

This presentation will impact the forensic community and/or humanity by demonstrating procedures of examination (re-association) of commingled human remains conducted by forensic anthropologists and exhumed from primary and secondary mass graves. The method might possibly lower the cost of DNA matching for identification purposes.

The 1992-1995 war in Bosnia and Herzegovina left the country with estimated 250,000 dead, and more than 30,000 individuals were considered missing or unaccounted for as their whereabouts were not known. The majority of the exhumed individuals in Bosnia and Herzegovina represent severely commingled or incomplete skeletons, which causes great problems in the identification process in Bosnia and Herzegovina.

Human remains can become commingled as the result of natural taphonomic processes or human postmortem activities. Natural, taphonomic commingling occurs in primary gravesites, such as caves, where bones commingle as the soft tissue decomposes. Surface remains or shallow graves can also undergo commingling due to animal scavenging and dispersal by humans, vehicles, and gravitation. Man-made commingling can be the result of poor exhumation procedures, frequently compounded by the removal and transfer of remains from original graves into new graves, in an attempt to hide evidence of the crimes committed. In the latter, heavy equipment was used to remove remains from original (primary) burial sites and re-deposit them into remote new mass graves, so-called secondary or tertiary graves. Human remains in secondary graves are severely commingled and dismembered, and body parts are often missing as bodies have been separated during removal and transportation. Presumably they could have been left behind in the original grave or deposited into one or more secondary graves.

Methods used for sorting commingled remains are mainly morphological, where bones are assembled by visual examination of morphological similarities such as the size and shape, articulation of adjacent bones, patterns of muscle attachments, and age-related changes. This morphological method can be useful for pairing bones or re- associating them with incomplete skeletons missing bones from either side of the body. However, such re-association is only possible for remains recovered from primary graves, where all unassociated bones were recovered. Since there is no morphological similarity between bones from the lower and upper extremities, the visual approach fails to be sufficient when applied to commingled remains where bones are missing and the connection between the upper and lower parts of the skeleton has been compromised. Osteometric analysis is another method used for sorting and re-association of commingled remains. It is based on using bone measurements for the entire assemblage (Byrd and Adams 2003). Osteometric methods used in the identification process in Bosnia and Herzegovina are mostly based on data from the North American population. Therefore, due to the large quantity of exhumed individuals and to the severe commingling of remains, it is important to establish population specific osteometric standards for the Bosnian population.

Long bone measurements used in this study are derived from males exhumed in Krajina, the north-west part of Bosnia, in the period 1998- 2005. Comparison of lengths of right and left long bones was conducted on 150 individuals with all twelve long bone measurements, and 719 individuals with measurements for one or more of the long bone pairs. Results obtained for the upper extremity showed that all bones of the right arm are significantly longer than bones from the left arm, thus confirming the majority percentage of right handed individuals in any population. For bones of the lower extremity, left femur and left fibula were found to be significantly longer then the respective bones from the right side of the body, while left tibia is on average longer than the right tibia, although this difference was not statistically significant.

Long bone ratios were established from a sample of 1217 individuals with more then two long bones present from the left side of the body, and 878 representing bones from the right side. Additionally, regression equations were established for all long bones. The ratios for humerus/femur, humerus/tibia and tibia/femur are presented in the table below.

 ** Presenting Author*

	Left Humerus / Left Femur	Right Humerus / Right Femur	Left Humerus/ Left Tibia	Right Humerus / Right Tibia	Left Tibia/ Left Femur	Right Tibia/ Right Femur
Mean	0.717	0.721	0.877	0.881	0.817	0.819
Minimum	0.639	0.632	0.766	0.794	0.744	0.747
Maximum	0.818	0.802	0.985	0.997	0.904	0.895
Count	929	606	783	701	963	706

The use of long bone ratios in the identification and re-association process of incomplete and commingled human remains may lower the cost of DNA supported re-associations in Bosnia and Herzegovina, by narrowing down the number of DNA samples required through the process of elimination of possible matches.

Reference:

1 Byrd, J. and Adams, B.J. 2003. Osteometric sorting of commingled human remains. *Journal of Forensic Sciences*. 48: 717-724

Identification, Commingled Remains, Bone Ratios

 ** Presenting Author*