H98 Sex Estimation Using Complete and Fragmentary Cuboid Bones

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After attending this presentation, attendees will understand how the cuboid bone can be used to aid in the estimation of sex of unknown individuals.

This presentation will impact the forensic science community by providing an additional means for sex estimation of incomplete and fragmentary skeletal remains.

Sex estimation is a vital step in the correct identification of unknown individuals. Expanding sexing methods to include unused and under-used bones will increase the accuracy of this assessment, especially in cases where the remains are incomplete or fragmentary. In 1976, Steele was one of the first researchers to examine sexual dimorphism of the talus and calcaneus.[1] Since then, other researchers including Barrett *et al.*, Bidmos and Asala, Bidmos and Dayal, Gualdi-Russo, Murphy, and Wilbur have repeated Steele's research and established techniques based upon the talus and calcaneus as useful tools in sex estimation with accuracies as high as 96%.[2-10] Additionally, they have shown that these techniques can be applied to various populations from both the past and present. However, little research has been done on the remaining five tarsals. In 2009, using the William M. Bass Skeletal Collection and a mini-osteometric board, Sheena Harris measured the maximum length and width of all seven tarsals.[11] Her measurements required the bones to be in their complete form and the study did not examine the smaller segments of the bones. In 2011, Schmuhl demonstrated that the three cuneiforms, regardless of their completeness, can be just as useful in sex estimation.[12] These results indicate that other tarsals may be of value as tools for sex estimation.

This study looks at the cuboid from 100 adult skeletons (50 male and 50 female) from the William M. Bass Skeletal Collection for their usefulness in sex estimation. The study first examines the maximum length that was used by Harris from complete cuboid bones and then examined additional original measurements (such as specific articular surfaces) that divide the bone into smaller segments.[11] Digital sliding calipers were used to take 12 measurements (1 following Harris and 11 new measurements) of the left cuboid.[11]

FORDISC® 3.0, was used to perform Discriminant Function Analysis (DFA) to test multiple measurements for their ability to discriminate by sex.[13] With an overall accuracy of 86.8%, this study shows that the cuboid has value as a sexing instrument. This study further shows that only a small portion of the cuboid needs to be present to be useful. Following the baseline suggested by Scheuer and Elkington, measurements (univariate) with accuracies equal or greater than 80% were considered to be useful in this study.[14] Five out of the 12 univariate measurements taken in this study meet or exceed that baseline. When various multivariate approaches are taken into account, the accuracy of the cuboid rises even higher. While some of the individual variable accuracy rates fell below 80%, that rate increased above 80% when combined with at least one other measurement. Another multivariate approach taken into account involves relative weight. For instance, when all 12 measurements are used in a DFA, the overall accuracy rate is 86.8%. However, if only the measurements with the highest relative weights of these 12 measurements are considered and the lowest relative weights are dropped, the accuracy rises to 93.5%. In conclusion, although the cuboid is one of the smaller bones of the body, it should be considered a useful tool for estimating sex regardless of its completeness.

References:

1. Steele DG. 1976. The estimation of sex on the basis of the talus and calcaneus. Am J Phys Anthropol 1976;45:581-88.
2. Barrett C, Cavallari W, and Sciulli PW. Estimation of sex from the talus in prehistoric Native Americans. Colleg Anthropolo 2001;25(1):13-19.
3. Bidmos MA, and Asala SA. Discriminant function sexing of the calcaneus of the South African Whites. J Forensic Sci 2003;48:1213-18.
4. Bidmos MA, and Asala SA. Sexual dimorphism of the calcaneus of South African Blacks. J Forensic Sci 2004;49:446-50.
5. Bidmos MA, Dayal MR. Discriminant function sexing of the calcaneus of the South African Whites. J Forensic Sci 2003;48(6):1213-18.
6. Bidmos MA, Dayal MR. Further evidence to show population specificity of discriminate function equations for sex determination using the talus of South African Blacks. J Forensic Sci 2004;49:1165-70.
7. Gualdi-Russo E. Sex determination from the talus and calcaneus measurements. Forensic Sci

 ** Presenting Author*

Int 2007;171:151-56.
8. Murphy AMC. The talus: Sex assessment of prehistoric New Zealand Polynesian skeletal remains. Forensic Sci Int 2002;128:155-158.
9. Murphy AMC. The calcaneus: Sex assessment of prehistoric New Zealand Polynesian skeletal remains. Forensic Sci Int 2002;129:205-208.
10. Wilbur AK. The utility of hand and foot bones for the determination of sex and the estimation of stature in a prehistoric population from West Central Illinois. Int J Osteology 1988;8:180-191.
11. Harris SM. Sexual dimorphism in the tarsals: Implications for sex determination. Master's Thesis. North Carolina State University. Raleigh, NC: 2009.
12. Schmuhl AY. 2011. Sex determination: A study of sexual dimorphism in complete and fragmented tarsals. Unpublished Undergraduate Thesis, Middle Tennessee State University. TN: 2009.
13. Jantz RL, Ousley SD. FORDISC 3.1: Computerized forensic discriminant functions. University of Tennessee. Knoxville, TN: 2010.
14. Scheuer JL, Elkington NM. Sex determination from metacarpals and the first proximal phalanx. J Forensic Sci 1993;38(4):769-78.

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