

A16 A Pilot Study of Geomorphometric Sex Estimation on the Pelvis

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Learning Overview: After attending this presentation, attendees will better understand the applicability of the Decker et al. method to a modern, American sample for sex estimation.¹

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating the utility of sex estimation of the metric methods of the innominate utilized in the Decker et al. method.¹

The os coxae have proven to be the most reliable skeletal elements for sex estimation. However, most forensic anthropological sex estimation methods that utilize the pelvic girdle are qualitative and highly subjective. Quantitative measurements can offer *Daubert* compliance, lower error rates, better statistical backing, and reduced bias. Decker et al. proposed a quantitative method based on 20 measurements of the articulated pelvic girdle from computed tomography scans, reporting a 100% accuracy rate and low inter-observer error, using a four-variable formula.¹ In this study, the applicability of the Decker et al. method on dry bone is investigated, with bone preservation and articulation taken into consideration.¹ Additionally, this study proposes the addition of a rarely utilized measurement with variables from Decker et al.: the distance between the superior pubic symphysis and apex of the auricular surface.^{1,2} This measurement was chosen due to variability in preservation. When skeletal remains are recovered, it is common to recover only one innominate. For these purposes, the correlation of the proposed variable with the Decker et al. measurements, as well as the effect of its addition on accuracy and precision, is examined.¹ From the validation study of Decker and the implementation of the new measurement, the goal is to improve necessary, quantitative analyses while simultaneously shedding light on how and why new estimation methods can be continuously improved. It is hypothesized that the Decker et al. method will prove to be less accurate when applied to skeletal remains due to concerns regarding preservation and articulation.¹ The added measurement will show correlation with other measurements to create a new formula with considerations on which landmarks preserve best.

A preliminary sample size of 32 modern individuals from the Mercyhurst University Collection is utilized in this sample. Either the left os coxa, right os coxa, or the entire pelvic girdle were used for data collection. All measurements from Decker et al. were taken when possible.¹ The sample is from Mercyhurst University's donation program, with the majority of individuals originating from the Northeastern area of the United States. Most individuals had known demographic information associated with their donation, particularly sex. For those whose sex was unknown, the Klales qualitative method was used to estimate sex.³

Results reveal low collinearities between the variables in the Decker et al. method, suggesting that most included variables contribute relevant information to the diagnosis, and their model does not appear to suffer from overfitting¹. Multivariate analyses further support the validity of the Decker et al. method, indicating that the variables in the original method capture a large proportion of size-free shape variation, with large variances explained in most variable combinations, a number of significant roots exceeding 4–5 in all multivariate combinations and methods, and size explaining a proportion of the variance only in the 30%–40% range.¹ However, the application to this collection sample revealed many of the required landmarks in the method are frequently missing in forensic cases, resulting in a decrease in accuracy inversely proportional to the number of preserved variables. Certain variables also displayed larger inter-observer errors, which could affect accuracy. Within this framework, the newly proposed variable demonstrated to be easily and consistently measurable, frequently preserved, and a useful addition to the variables in the original method.

Reference(s):

1. Decker, Summer J., Davy-Jow, Stephanie L., Ford, Jordan M., Hilbenick, Don R. Virtual Determination of Sex: Metric and Nonmetric Traits of the Adult Pelvis from 3D Computed Tomography Models. *Journal of Forensic Sciences* 56, no. 5 (2011): 1067-1114.
2. Wiid, Anja Yzabella. *Four modalities in the evaluation of the pelvic canal in South Africans*. PhD diss., University of Pretoria, (2016).
3. Klales A., Ousley S., and Vollner J. A revised method of sexing the human innominate using Phenice's nonmetric traits and statistical methods. *American Journal of Physical Anthropology* 149 (2012): 104-114.

Sex Estimation, Morphometrics, Forensic Anthropology