

TECHNICAL NOTE

Gretchen R. Dabbs,¹ Ph.D.

Is Dwight Right? Can the Maximum Height of the Scapula Be Used for Accurate Sex Estimation?*

ABSTRACT: This paper presents data from a sample of 803 individuals (308 females and 495 males) from the Hamann-Todd collection testing Dwight's century-old assertion that maximum height of the human scapula can be used for sex estimation—males being larger than 170 mm, females falling below 140 mm. The results of this project show Dwight's method has high accuracy when scapular height falls either above or below the sex specific demarcation points (96.81%), but a vast majority of both males and females fall in between. The overall accuracy of the method is just 29.27%. By empirically demonstrating the limited usefulness of Dwight's technique, the author hopes the rote republication of this method in introductory texts on the subject will cease, and draw attention to the need for multiple methods of sex estimation as a response to the overlap in both size and shape between males and females.

KEYWORDS: forensic sciences, forensic anthropology, bioarchaeology, sexual dimorphism, human variation, metric analysis, scapula

Failure to independently test sex estimation methods has, many times, led to the application of methods of age and sex estimation that simply do not work as well on outside populations as originally reported. The author has stumbled across one of these problematic situations with Thomas Dwight's method of sex estimation using the maximum height of the human scapula, first published in 1894. In his Shattuck Lecture, Dwight based his assertions on the observation of 123 individuals (39 females and 84 males). Given the antiquity of the article, it is unsurprising no statistical analysis is included. Dwight reports his observations on the scapula dimension; specifically that he observed no females with scapula height >170 mm, and no males with scapula measuring <140 mm (1). It is unfortunate, but Dwight failed to report the exact method by which the scapular height was assessed.

This metric observation was largely ignored for the next 85 years, until Stewart published it in his volume on forensic anthropology, outlining that the scale of the measurement suggests "they can only be maximum lengths between the superior and inferior angles" (2:97). Stewart furthered his examination by testing Dwight's observations on a 90 individual sample (40 females and 50 males) from the Terry collection. He reported that "by arranging the measurements by sex into frequency distributions, it appears that the overlap supports Dwight's claim" (2:97). Stewart does not report overall accuracy, or other statistics that may assist the reader in identifying the usefulness of Dwight's observations on the sexual dimorphism of the human scapula and its usefulness for sex estimation.

Stewart's reporting of Dwight's observations have often been cited as a method of sex estimation using scapula metrics, particularly in introductory texts on osteology and forensic anthropology. The method follows Dwight's observations on the height of the scapula, arguing individuals with maximum scapula height over

170 mm should be estimated as males, while values under 140 mm indicate a female. Values falling between these two demarcation points cannot be used to estimate sex with any degree of accuracy, and thus individuals fall into the indeterminate sex category, which fails to be useful in both forensic and archaeological situations. While the remainder of this paper will not discuss it, it should be noted that Stewart advocates the use of glenoid fossa height as a sex indicator based on observations Dwight reported in his 1894 Shattuck Lecture. Fortunately, some authors have already addressed problems associated with the poor definition of the measurement as reported by Dwight (2), and the lack of extensive testing on this sex estimation method (3).

Perhaps the greatest problem here is not the inaccuracy of the original method, or the inadequate statistical reporting of later tests, but instead is the rote repetition of these untested findings in future scholarly works. Of this, many of our colleagues are guilty. Basic introductory book by Bass, and the 2008 edition of Byers both report the Dwight method without mention of either the lack of empirical testing, or the large degree of overlap between males and females (4,5). More often Dwight's method is not mentioned at all, a situation likely preferable to the dissemination of an untested and, at least in this case, ultimately inaccurate method (6). This paper reports the results of the author's test of the Dwight method on a large sample of early 20th-century individuals.

Materials and Methods

During the course of the author's thesis research in 2004 and 2005, data were collected on the maximum height of the scapula as part of a larger study. The sample consists of 308 females (169 Black and 139 White) and 495 males (194 Black and 301 White) from the Hamann-Todd collection at the Cleveland Museum of Natural History. Ages range from 19 to 93 years. Inclusion criteria for the original study required all seven secondary centers of ossification be fully fused to the scapular body, thus this is also true for this study. The age distribution for the sample shows slight

¹University of Arkansas, Fayetteville, AR 72701.

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overrepresentation of individuals 25–54 years old. Earlier research has demonstrated morphological and metric changes in the scapula with advancing age (G. Dabbs and P. Moore-Jansen, unpublished data). However, no discernible pattern was identified among the ages of the population either incorrectly assessed, or those unable to be assessed using this method.

Measurement of the maximum height of the scapula was taken from the superior to inferior angles, as described by Stewart (2). As such, the height represents the linear distance between the superior and inferior angles; no attention is paid to the ventral curvature of the scapula. The data recording procedure varied slightly between the two collection sessions. In 2004, data were hand recorded and only recorded to the nearest whole millimeter. In 2005, a Mitutoyo automatic digital input tool recorded data with two decimal place precision. Examination of the results revealed this variation had no effect on the overall accuracy of Dwight's method.

Results

Using the maximum height of the scapula measurement, the author tested the Dwight method of sex estimation using the scapula. Overall accuracy for the Dwight method was quite low, only 29.27% (Table 1). However, this results largely from the significant percentage (68.74%) of the sample being indeterminate as to sex (Table 2). When only individuals above or below the demarcation point are considered the accuracy increases considerably (Table 3). Eight males have scapulae measurements <140 mm, something Dwight (1) and Stewart (2) never observed. It should be noted that two of these eight individuals have scapular heights within rounding error of 140 mm (139.73 and 139.90 mm). Additionally, half of the males with maximum scapular heights <140 mm are older than 35 years. Previous research has shown that with advancing age, the white male scapula increases in ventral curvature with no associated increase in border length, thus reducing the overall height of the scapula (G. Dabbs and P. Moore-Jansen, unpublished data). The remaining two males are young adults, 21 and 26 years. No females had scapular heights over 170 mm. The resulting accuracy for individuals falling above or below the demarcation points is 96.81%.

TABLE 1—Overall accuracy of Dwight method using maximum height of the scapula.

	Correct, n (%)	Incorrect, n (%)	Total
Males	94 (18.99)	401 (81.01)	495
Females	141 (45.78)	167 (54.22)	308
Total	235 (29.27)	568 (70.73)	803

TABLE 2—Sample distribution by size.

	Under 140 mm, n (%)	140–170 mm, n (%)	Over 170 mm, n (%)	Total
Males	8 (1.61)	385 (77.78)	102 (20.61)	495
Females	141 (45.78)	167 (54.22)	0 (0.00)	308
Total	149 (18.56)	552 (68.74)	102 (12.70)	803

TABLE 3—Accuracy when indeterminate individuals are excluded.

	Incorrect, n (%)	Correct, n (%)	Total
Males	8 (7.27)	102 (92.73)	110
Females	0 (0.00)	141 (100.00)	141
Total	8 (3.19)	243 (96.81)	251

Discussion

The importance of this work is twofold. First, results reported here make it clear it is time to cease the rote repetition of Dwight's century-old method of sex estimation using the maximum height of the scapula. While quite accurate when the individual falls on either end of the scapular height spectrum, the overlap of human variation between males and females is far too great, and the percentage of individuals who cannot be assigned to one sex or another is too high for this method to be perpetuated.

Second, the maximum length of the scapula illustrates the large area of overlap seen between males and females of the human species. This phenomenon is not new, and is registered in all elements of the skeletons, particularly the skull and pelvis (7). Not coincidentally, these elements are most commonly used to estimate sex from skeletal elements. Let the example of the scapula serve as stern warning for any who wish to develop or apply methods of sex estimation based on metric analysis. The level of overlap between males and females may preclude success.

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Additional information and reprints requests:

Gretchen R. Dabbs, Ph.D.
330 Old Main
Fayetteville
AR 72701
E-mail: gdabbs@uark.edu