H97 Sex Estimation Using Metric Analysis of the Human Clavicle

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After attending this presentation, attendees will have learned the degree of sexual dimorphism present in the human clavicle and several discriminant functions useful for the estimation of sex from both whole and fragmentary clavicles.

This presentation will impact the forensic science community by improving practitioners' ability to estimate the sex of skeletonized human remains when pelvic and cranial remains are not available or are too taphonomically damaged for analysis.

The development of methods for sex estimation using skeletonized postcranial remains other than the pelvis and cranial elements is imperative for physical anthropology to improve the reliability of biological profile estimates in cases of incomplete and/or fragmentary skeletal remains. As one of the last skeletal elements to complete fusion, the clavicle has the most extended period of post-pubertal development, making it an ideal element for use in sex estimation. Previous metric studies of the clavicle used the clavicle in combination with other skeletal elements to estimate sex with varying degrees of accuracy (Thieme specific accuracy not given and Frutos 92%).[1,2] Previous research using only the clavicle to estimate sex produced limited success (60-72% accuracy), although the sample population (Indian) is not demonstrably sexually dimorphic.[3] The use of computer-automated measurements improves the ability to estimate sex using the clavicle (92% accuracy), although the applicability to field work is limited due to the expense and time required for the use of computer-automated technology.[4] The Hamann-Todd Collection was chosen because it could yield a greater sample size than most modern collections, thus developing a stronger method prior to adjustment for secular change in modern populations.

The three standard measurements of the clavicle (maximum length, sagittal diameter at midshaft, and vertical diameter at midshaft) were recorded along with 15 measurements developed for this study. The developed measurements include circumferences, lengths, widths, and angle heights, derived to decipher and record the complex pattern of sexual dimorphism in the clavicle. Sexual dimorphism in the clavicle was assessed using these 18 measurements of the left clavicle of 265 (132 females; 133 males) adults (fully fused clavicles) from the Hamann-Todd Collection. Independent samples t-tests with Bonferroni correction show male and female means differ at a statistically significant level for all 18 variables ($p<0.05$). A discriminate function analyses using the stepwise method (0.05 to enter, 0.10 to exit) produced a four-variable model with cross-validated accuracy of 89.8%. The measurements used in the four-variable model include the maximum length, circumference at midshaft, the height of the acromial end, and the sternal end width. A holdout sample from the Hamann-Todd Collection (n=30) similar in demographic character to the calibration sample was tested using the four-variable model. The accuracy of the four variable model on the holdout sample was 90.0%. Additionally, a three-variable, a two-variable, and four single-variable models were developed for use with fragmentary and taphonomically damaged remains. They also have high predictive power (75.1-88.3% cross-validated calibration sample; 60.0-93.3% hold-out sample). This study suggests the sternal end has more predictive power than the acromial, which likely corresponds to the later fusion of the sternal end. Circumference and length are also highly predictive, as they are used in all multivariate models along with being useful on their own.

This method serves to supplement, not replace, sex estimation based on the traditionally highly accurate pelvic and cranial remains. Further research is required (and planned) to confirm these methods are applicable to modern populations.

References:

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3. Jit I, Singh S. The sexing of the adult clavicle*s*. Indian J Med Res 1966;54:551-71.
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Sex Estimation, Clavicle, Metric Analysis