A24   Estimating Age From 2D and 3D Imaging of Skeletal Remains: An Assessment of Reliability Using the Medial Clavicle

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Learning Overview: After attending this presentation, attendees will be familiar with the reliable use of photographs and 3D scans for assessing medial clavicle fusion, including the effects of experience level and scoring method.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating: (1) that observers generally produce more reliable scores using photographs compared to 3D scans; (2) that osteological experience improved reliability of assessment for both viewing modalities; in addition to (3) supporting previous research that the application of a three-phase method of scoring the medial clavicle, rather than five-phase method, is less subjective and thus more reliable.

Research regarding the utility of digital imagery in conducting preliminary remote forensic analyses, or analyses of remains occurring outside of the laboratory, is necessary for the progression of forensic anthropology as new technologies arise. Further, examination of the use of high-resolution imagery for subsequent study of remains is integral for understanding the validity and biases of using photography and 3D scanning for forensic research. For these reasons, it is necessary to determine if photograph and 3D scan modalities can be reliably used for the macroscopic assessment of skeletal remains for age estimation when the physical remains are not available. This study evaluated whether or not an assessment of the developmental stage of the medial clavicle can be replicated consistently among macroscopic analysis of the physical skeletal element and a photograph or 3D scan of the same element.

This research was conducted at the Defense POW/MIA Accounting Agency (DPAA) Laboratory at Offutt Air Force Base, NE, utilizing remains of service members killed on the USS *Oklahoma* during the Japanese attack at Pearl Harbor, HI. The relative reliability of scores taken from each digital modality was assessed. The age estimation method used was the McKern and Stewart five-phase scoring method.[1] Scores were also collapsed into the Langley-Shirley and Jantz three-phase scoring method to assess the effect of different scoring methods on reliability.[2] It is important to emphasize that this study did not assess the accuracy of the aforementioned age estimation methods, but instead addressed the replicability of scoring an element using digital imagery in place of the physical element. The experience level of participants was also taken into account by determining if the ability to reliably assess developmental phase from each modality was affected by the extent of observer experience. Participant groups comprised those with extensive osteological experience (*n*=3) and no osteological experience (*n*=3). Intra-observer error for each modality and method was assessed using intra-class correlation. The absolute difference of scores for each modality compared to the physical remains was calculated for the pooled observer groups and for each observer group using each scoring method; differences greater than one phase were also assessed. Weighted kappa was used to estimate observer agreement for each phase compared to the physical remains.

Intra-observer reliability was excellent when using photographs and good when using 3D scans for both scoring methods. Observations from photographs were more reliable than 3D scans; however, experienced participants produced more reliable scores using photographs and inexperienced participants produced more reliable scores using 3D scans. Differences in reliability between observer groups show that osteological experience is necessary for both modalities. In addition, the three-phase scoring method was found to produce more reliable scores than the five-phase scoring method, indicating that the three-phase method is less subjective and thus more reliable.

These findings support the use of both photograph and 3D scan modalities for assessing epiphyseal fusion of human remains for observers with osteological experience. The remote assessment of remains can thus be reliably applied to preliminary medicolegal casework, which may help quicken the identification process. Further, this research also supports the use of digital photograph and 3D archives of remains for future study and biological profile development, thus expanding the availability of human remains for research and making research collections more accessible. Finally, this research also supports the use of digital inter-lab proficiency testing, which could lead to training standardization among laboratories.

Reference(s):

1. McKern, T.W., and Stewart, T. D. (1957). Skeletal age changes in young American males. Analysed from the standpoint of age identification. Quartermaster Research & Development Center, Environmental Protection Research Division.
2. Langley-Shirley, N., and Jantz, R.L. (2010). A Bayesian approach to age estimation in modern Americans from the clavicle. Journal of Forensic Sciences, 55(3), 571–583.

Medial Clavicle, Utility, Digital Modality

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