A57 The Application and Accuracy of 3D Surface-Scanned Postcranial Bones

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The goal of this presentation is to provide attendees with an understanding of the complexity of 3D surface scanning of human remains, the principles of osteological scanning methods, the necessary considerations for successful scanning, and the current applications and limitations of a mid-range surface scanner.

This presentation will impact the forensic science community by highlighting current research assumptions and areas of necessary testing and by addressing the difficulties of osteology replication via surface scanning using the NextEngine®, a popular and economical tabletop scanner.

3D scanning provides forensic anthropologists with permanent records of human remains that can be shared globally and analyzed in innovative ways on 3D platforms with 3D tools. To utilize this growing technology in a scientifically meaningful way, set standards need to be implemented.

The objective of this research is to determine whether standardized surface scanning methods can accurately record skeletal characteristics for use in display, teaching, or research applications. Five categories of skeletal traits were selected: (1) gross morphology; (2) rugosity; (3) non-metric variation; (4) pathology; and, (5) trauma. These aspects were selected because of their effect on analyzing age, sex, and health. Parameters set to evaluate the scanning success for this study required 100% similarity in all categories to be used in research, 75% similarity to be used in teaching laboratories, and a 50% similarity to be used in display. The postcranial bones selected for this sample were from the ancient Maya trading site Moho Cay, Belize (AD 600-800), which was situated at the mouth of the Belize River. Although well-preserved, the human remains excavated from Moho Cay are fragile due to cyclic wet and dry seasons.

3D surface scanning the remains created a durable record of the Moho Cay Maya. Bones from nine adult males were selected for this study, including: (1) the sternal end of an unnumbered left rib; (2) a left ulna; (3) a lumbar vertebra; (4) a left clavicle; (5) a right scapula; (6-7) a left and right radius; and, (8-9) a left and right humerus. The selection included large, medium, and small sizes and complex and simple geometric shapes. All of the selected bones could be evaluated for rugosity, pathology, and trauma.

Scanning was carried out in the Louisiana State University (LSU) Digital Imaging and Visualization in Archaeology (DIVA) Lab. A trial scan was performed first, which began at the lowest division (lowest number of individual laser scans) and then increased in number of divisions until the complete geometry of the trial bone was captured. The method was then applied to all nine postcranial bones.

The bones and the 3D digital scans were separately evaluated according to the five categories of gross morphology, rugosity, non-metric variation, pathology, and trauma. Categorically, rugosity was the only trait with a 100% similarity. Gross morphology, non-metric variation, and trauma showed mid-range success but did not rate above 90% similarity. Pathology was the lowest categorical similarity, rating at only 11%. Using the parameters of similarity set up for this study, all of the 3D scanned bones could be used in display, approximately 50% of the bones could be used in teaching, and none of the digitized bones were precise enough to be used in research. Suggestions for improving precision in 3D surface scanning of skeletal material are discussed, including increasing the number of individual laser scans (rotations), increasing the point density for scanning, and adding macro-scans of bone features.

3D Scanning, Osteology, Digital