A48 The Utility of Digital Imaging Technologies for the Virtual Curation and Metric Analysis of Skeletal Remains

Devin L. Adcox, Middle Tennessee State University, Dickson, TN 37055; Tiffany B. Saul, PhD, Forensic Institute for Research and Education, Murfreesboro, TN 37132*

Learning Overview: After attending this presentation, attendees will understand that cranial measurements taken from various 3D modeling platforms are comparable to each other and to measurements taken with traditional hand-held instruments. Attendees will also gain a better understanding of the techniques used to create 3D models of skeletal remains.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating the accuracy 3D curation and showing that these technologies are viable methods of data collection for forensic skeletal cases and collaborative research.

Virtual curation methods such as 3D laser scanning and 3D photogrammetry are exciting developments within the field of anthropology. However, outside of Sholt et. al.'s research in 2011 as well as Bridget Algee-Hewitt's and Amber Wheat's research performed in 2016, there is little work discussing the accuracy of measurements taken from these models.[1,2] This research adds to that body of literature. It compares the accuracy of 3D laser scanning, 3D photogrammetry, and a 3D digitizer to measurements taken in the traditional way by testing two hypotheses: (1) that measurements obtained from 3D models are comparable to traditionally derived metrics, and (2) that measurements taken on different 3D modeling platforms are comparable to each other.

To evaluate the accuracy of the 3D laser scanner, the 3D digitizer, and 3D photogrammetry, all 28 standard cranial measurements, excluding those of the mandible, were recorded nine times for three skulls (n=9 for each measurement) and compared to traditional measurements. The averages and ranges for the datasets from each skull were then used to determine if there was a statistically significant difference between the different modeling technologies, and between the modeling technologies and hand-held metrics. 3D models of each skull were made by rotating them in 20-degree increments, and if areas of the 3D model were incomplete, individual images or scans of the skull were made to capture the missing area. After the models were uploaded, points were placed on each cranial landmark, and inter-landmark distances were calculated electronically. Once the outliers were removed, the data were analyzed using Levine's Equality of Variance and a two-way Analysis of Variance (ANOVA) test.

In a comparison between the measurements taken on the 3D models and the traditionally derived measurements, there was no significant difference between the digitizer (p = .818 to 1.0) or the 3D laser scanner (p = .900–.999). This trend continued in a comparison between 3D photogrammetry and traditionally derived measurements (p = .827–.996). These results indicate that digital 3D models can be used as an accurate substitute to taking measurements in the traditional way, since the inter-landmark distances derived from each method were comparable to each other.

Comparisons between the different 3D modeling techniques also yielded no statistically significant results. The p-values ranged from .716–.992 in a comparison of the digitizer to the laser scanner, and .813–.998 when comparing 3D photogrammetry to the digitizer. Similar results occurred in a comparison between the 3D laser scanner and 3D photogrammetry (p =.868–.969), showing again that there was no statistically significant difference.

The results from this study demonstrate that 3D models created with various platforms are an acceptable form of digital curation, since the measurements taken on the 3D models were comparable to the measurements taken using traditional techniques. Furthermore, the different 3D modeling techniques were comparable to each other, meaning that these technologies can be used to virtually curate and share images without a significant impact on metric data collection. This research supports the use of these technologies for virtual data capture and information sharing between researchers, making future collaborations between distant universities easier, providing broader access to collections. It will also allow the opportunity for remote work when in-person work is impossible or hazardous.

Reference(s):

1. Sholts et. al. Comparison of Coordinate Measurement Precision on Different Landmark Types on Human Crania Using a 3D Laser Scanner and a 3D Digitizer Implications for Applications of Digital Morphometrics. *International Journal of Osteoarchaeology* 21, (February 2010): 535-543.
2. Bridget Algee-Hewitt and Amber Wheat. The Reality of Virtual Anthropology: Comparing Digitizer and Laser Scan Data Collection Methods for the Quantitative Assessment of the Cranium: Digitizer and Laser Scan Data Collection Methods. *American Journal of Physical Anthropology* 160, no. 1 (Spring 2016): 148-155.

3D Modeling, Metric Analysis, Virtual Curation