A57 The Reliability of Morphoscopic Data From 3D Surface Scans

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Learning Overview: After attending this presentation, attendees will be more knowledgeable of the reliability and accuracy of obtaining morphoscopic data from 3D surface scans, in contrast with traditional methods of data collection utilizing physical human skeletal remains. This presentation will briefly discuss the advantages of 3D surface scans over other technologies, including radiography and Commuted Tomography (CT) techniques.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by discussing the utility of 3D surface scans in place of physical bones when seeking morphoscopic data and will discuss the potential of 3D surface scans to increase accessibility of human skeletal collections worldwide through the creation of digital skeletal collections, as well as increase sample sizes for future research endeavors. Accordingly, this presentation will contribute to the discussion of the types of data that can be accurately gleaned from such digital skeletal collections.

Digitally formatted human skeletal elements represent an area of recent and increasing interest within forensic anthropology, particularly for the purpose of obtaining metric data.[1,2] Digital human skeletal elements, in the form of CT scans, photogrammetric images, and 3D surface scans, have been used in numerous studies employing geometric morphometric techniques to obtain metric data.[1,2] Research seeking morphoscopic data from similar digitally formatted human skeletal elements, particularly from 3D surface scans, however, is not prevalent within the literature, suggesting that this area has not been thoroughly explored.[3]

3D surface scans of human skeletal elements may be useful in providing morphoscopic data for various parameters of the biological profile, particularly for estimations of sex, age, and ancestry.[4] Previous studies utilizing 3D surface scans and focused on the collection of metric data through geometric morphometrics have reported results of high precision and accuracy.[5-7] Additionally, limited research focused on the collection of non-metric data from 3D representations of bones has also reported findings of high reliability and accuracy.[4,8] Such studies of non-metric data collection, however, have primarily employed a form of CT scan as their data source.[4,9] This study utilizes 3D surface scans as they are more readily produced by forensic anthropologists and others without easy access to clinical medical equipment.[2,3]

This study investigates intra-rater agreement of trait expression utilizing seven non-metric traits of the mandible, including pinching of ascending ramus, shape of inferior border, protrusion of mental eminence, undulation of inferior body, gonial eversion, height of coronoid process, and shape of mandibular notch. These traits were scored twice on a sample of 50 mandibles from the Bass Donated Skeletal Collection, once utilizing digital renderings of the mandibles in the form of 3D surface scans, and a second time using the bones themselves. This sample was comprised of individuals of European and Hispanic descent and included both males and females. 3D scans were synthesized using a NextEngine® 3D laser scanner. Cohen's kappa was used to assess agreement between both sets of scores and all individuals were pooled for statistical analyses, as inter-group differences were not a focus. Standard error and 95% confidence intervals were also calculated for each trait.

The results of these analyses suggest that shape of inferior border, undulation of inferior body, gonial eversion, height of coronoid process, and shape of mandibular notch demonstrate moderate to substantial agreement between 3D surface scans and physical mandibles. These five traits presented kappa values of 0.467 to 0.638 and *p*-values of $\leq$0.001, indicating agreement for these traits was statistically significantly different from zero. Pinching of ascending ramus and protrusion of mental eminence demonstrated smaller levels of agreement. Among all traits included, gonial eversion and shape of mental eminence demonstrated the greatest agreement, with kappa values of 0.524 and 0.638, respectively.

This study serves to demonstrate the potential utility of 3D surface scans in place of physical bones when remains are inaccessible or no longer within an anthropologist's possession. Results demonstrated encouraging results, moderate to substantial agreement between formats, which may become more pronounced in studies of larger sample sizes. Further investigation through future research, as well as investigation of additional skeletal elements, however, is necessary before these techniques should be employed.

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Morphoscopic, Surface Scan, Inter-Rater Agreement

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