



A19 A Comparison of Two Data Collection Methods for the (hu)MANid Program on a Diverse Sample of Mandibles

Paige A. Lynch, MS*, University of New Mexico, Albuquerque, NM 87131; Luis L. Cabo, MS, Mercyhurst University, Erie, PA 16546

Learning Overview: After attending this presentation, attendees will better understand the differences in performance of 3D scans versus direct measurements in the (hu)MANid program to estimate sex using the mandible.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by highlighting the different sex classification results that are produced for two methods of data collection, further helping to improve validation and the usage of (hu)MANid.

The (hu)MANid program is a free, web-based software developed by Berg and Kenyhercz that uses mandibular metric and morphoscopic variables to assess sex and ancestry through Linear Discriminant Analysis (LDA) or Mixture Discriminate Analysis (MDA).¹ The program's reference database contains 1,745 individuals from 15 different populations (including modern, historic, and prehistoric groups). Berg and Kenyhercz report that MDA renders the highest accuracies among the analytical methods offered by the software, with pooled sex estimation accuracies as high as 83.5%.¹ A relative limitation of (hu)MANid program is the use of some mandibulometer measurements, due to: (1) the error rates in some of them, and (2) the cost of the instrument.^{2,3} 3D surface scans (3D scans) may provide an alternative method for data collection. The aim of this study was comparing the (hu)MANid accuracies of 3D scans and direct measurements of a diverse sample.

Six metric and morphoscopic mandibular measurements were collected from 3D scans of mandibles from recent United States Black, United States White and Portuguese, as well as medieval Nubian and prehistoric Native American of both sexes ($N_{total}=555$). The same nine metric and morphoscopic measurements (including three mandibulometer measurements) were collected by direct measurement of mandibles from modern males and females from the Maxwell Museum Donated Body Collection ($N_{total}=59$). These data were run through (hu)MANid for pooled sex classification. MDA was applied due to its higher reported correct classification and its consideration of both metric and nonmetric measurements.¹

For both samples, no significant differences were detected between non-stepwise and stepwise options; therefore, non-stepwise option was employed in the remaining analysis. Overall, the direct measurements rendered average correct classifications similar to those originally reported for the program (85% vs. 83.5%, respectively), while those of the digital measurements were lower (65%). Males displayed similar correct classifications for the digital (93%), direct (92%), and direct-with-mandibulometer (93%) measurements; however, they differed in positive predictive power (60%, 90%, and 87%, respectively). Females varied significantly in their correct classifications for the digital (36%), direct (55%), and direct-with-mandibulometer (36%) measurements; furthermore, they differed in positive predictive power (82%, 60%, and 67%, respectively).

For pooled sex estimations, the (hu)MANid program is better than chance, but males are more likely to classify correctly with the direct measurements than females. Despite the smaller sample size, the direct measurements had higher correct classification, but the mandibulometer measurements did not increase the overall correct classification. However, further evaluation using more variables is suggested.

Reference(s):

1. Berg, Gregory E., and Michael W. Kenyhercz. Introducing Human Mandible Identification [(hu)MANid]: A Free, Web-Based GUI to Classify Human Mandibles. *Journal of Forensic Sciences* 62, no. 6 (2017): 1592-598.
2. Garvin, Heather M., and Kieran Severa. An Alternative Method to Using a Mandibulometer. *Journal of Forensic Sciences*, 2019.
3. Byrnes, Jennifer F., Michael W. Kenyhercz, and Gregory E. Berg. Examining Interobserver Reliability of Metric and Morphoscopic Characteristics of the Mandible. *Journal of Forensic Sciences* 62, no. 4 (2016): 981-85.

(hu)MANid Program, Sex Estimation, Mandible