A67 Manipulation and Analysis of Virtual Bones: A Novel Method of Sex Estimation From the Mandible

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After attending this presentation, attendees will better understand the use of 3D laser scanning to create virtual models of human skeletal remains and how these models can be automatically manipulated and analyzed in novel ways to build up a biological profile. The principles involved in these processes are exemplified through a feasibility study on automated sex estimation using topographical analysis of the mandible.

This presentation will impact the forensic science community by highlighting the capabilities and advantages of automated, computer-based anthropological analysis and by introducing a new avenue for sex estimation of skeletonized human remains.

Analysis of virtual osteological material is an emerging field in physical anthropology, conferring advantages over traditional methods in areas such as reproducibility, data handling, and retention, as well as range of possible measurements and unique analyses available. This study, which is part of the Virtual Skeletal Analysis (ViSA) Project, attempted to apply these principles to the mandible with regard to sex estimation.

Thirty-four complete, non-pathological human mandibles from the St. Bride's Church crypt collection in London were digitized using hand-held laser topography. Using a tailor-made R[1] package based on the geometric properties of the bones, each resulting point cloud was manipulated into a standardized orientation. The exterior surfaces of the posterior ramus borders and mandibular angles were separated from the main body and re-oriented for further analysis.

A triangular mesh network was formed over the point clouds representing the posterior rami and mandibular angles and these were analyzed for mean slope, mean aspect, and size (2D area, 3D surface area, and valley volume) using Geographic Information Systems (GIS) software; an uncommon approach in anthropological analysis that has never previously applied to the mandible. This software treats the bone surface as a miniaturized landscape, providing a unique and quantifiable method of analyzing bone morphology.

It was found that both the posterior rami and mandibular angles were sexually dimorphic in terms of size, either bilaterally or unilaterally (particularly on the right side), and in the mean slope of the left posterior ramus. Preliminary demarcation points for the estimation of sex were created and tested for each sexually dimorphic analysis. The 2D area of the right posterior ramus and valley volume of the right mandibular angle were each independently able to correctly sex over 80% of the sample.

This particular methodology must be tested on further samples to confirm and refine its findings; however, the study successfully revealed a largely unexplored territory of anthropological analysis, with great capacity to expand. The study especially exposed the dearth of specialized software for the virtual analysis of skeletal material, despite the considerable advantages and potential for the field.

Reference(s):

1. R Core Team. R: A Language and Environment for Statistical Computing. (Internet). 2015; Available from: http://www.r-project.org/

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