A72 3D Slicer as a Tool for Creating Virtual Bone Models From Computed Tomography (CT) Data: Toward Validating a Step-By-Step Method

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Learning Overview: The goal of this presentation is to provide insight into how the step-by-step method developed in this study can increase availability of 3D models that are consistent, reproducible, and accurate for application in forensic anthropology.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by presenting a method that can improve a user's ability to handle CT scan data and develop 3D modeling performance.

This research sought to create an easy-to-use, step-by-step method for modeling CT data and to validate its application to the production of 3D models through testing the robustness of 3D models produced by first-time and experienced users.

CT scans are becoming more widely available and are offering significant opportunities for both traditional and novel methods of identification in forensic anthropology. At the moment, there are a wide range of software packages designed to build 3D models using CT data; however, these have not been validated or tested for their reproducibility in forensic anthropology. Therefore, this study sought to develop a method using open source (free) software to establish a valid technique for producing reliable, accurate, and reproducible 3D models from CT scan data.

A step-by-step method was developed for creating 3D models using 3D Slicer, a free open-source CT reconstruction software. The five observers selected for this study included three individuals with no prior experience in handling or producing 3D models and two with limited experience. The observers tested this method by producing 3D crania models from 20 clinical sinus CT scans of ten female and ten male living patients. The scans were obtained from University College London Hospital (UCLH), having received appropriate ethical approvals. The robustness of each model produced by each observer was assessed through a qualitative assessment and a comparison of sex-determination scores. Each observer scored their models using standard sex-determination methods.[1,2] To further validate this method and the utility of the 3D models, an additional four observers with a background in forensic anthropology were selected to take part in examining and scoring the sex of the original models. To demonstrate the accessibility of this method in a global sense, videos of the models in rotation were provided electronically to the additional four observers. Statistical analysis investigated the degree of observer agreement using Fleiss's kappa and Kendall's coefficient of concordance.

The results demonstrated that all observers successfully produced 20 exportable Stereolithic (STL) 3D models by following the step-by-step method provided. A qualitative inspection of the models found no major differences to the morphology of the crania models produced by each observer, but some minor discrepancies were seen, for example, in modeling the orbital bones. Statistical analyses showed there was high observer agreement between crania features in the sex-determination scoring and the observer video test scoring.

The findings demonstrated that: (1) users with little to no experience of 3D modeling (or using CT data) could create 3D models using the step-by-step method presented, and (2) consistent and robust crania models were produced, which overall verified the reproducibility of the step-by-step method developed. This method has the potential to provide a standardized visualization procedure, using open source software, that can be implemented reliably in future research and forensic human identification casework.

Reference(s):

1. Buikstra Jane E. and Douglas H. Ubelaker. *Standards for Data Collection from Human Skeletal Remains*. (Fayetteville, AR: Arkansas Archaeological Survey, 1994).
2. Walker P.L. Sexing skulls using discriminant function analysis of visually assessed traits. *Am J Phys Anthropol.* 2008;136(1):39-50.

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