H19 The Accuracy of 3D-Printed Models Using Measurements Obtained From Volume-Rendered Computed Tomography (CT) Images

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After attending this presentation, attendees will appreciate the accuracy and usefulness of 3D-printed models created using measurements obtained from volume-rendered CT images.

This presentation will impact the forensic science community by elucidating the precision of volume-rendered models from CT images and raising awareness regarding their potential validity, reproducibility, reliability, and utility in providing visual aids for legal proceedings.

Forensic pathologists are frequently called upon to be expert witnesses in a wide variety of cases. Courtroom testimony often requires pathologists to explain scientific concepts and complicated injuries that can be confusing and difficult to describe to a jury. With the increasing availability of 3D printers, there has been a rising interest in using 3D models to enhance such testimony. A 3D reproduction of a skull with multiple blunt force injuries, for example, can help jurors better understand how, where, and with what force the decedent was struck. In addition to providing a nearly first-hand experience for an audience, 3D models create an opportunity to illuminate physically small but important autopsy findings that can be difficult to appreciate with a 2D photograph or autopsy report.

For a 3D model to be truly impactful in courtroom testimony, it should be a nearly exact representation of the deceased. An effort should thus be made to determine how accurately 3D-printed models reproduce objects that can actually be measured, such as bone. If there is a very small or negligible difference between the measurements from the 3D model and bone itself, a valid argument can be made to use 3D models whenever appropriate.

In practice, though, generating 3D models by means of physical measurements may be difficult. To render a 3D model of a cranium with blunt force trauma, for example, remains must be completely skeletonized to obtain accurate dimensions. A previous study at the Office of the Chief Medical Examiner for the State of Maryland investigated the accuracy of CT-derived dimensions from specific skeletal elements and determined there was a very minimal difference between physical measurements and those obtained from CT imaging. As such, a reasonable step is to create 3D models using data points from CT images of skeletonized remains. To validate the accuracy of these 3D reproductions, their measurements can then be compared to those of the original skeleton.

Seven skeletonized crania from the previous study were analyzed using multiple cranial measurements, such as orbital breadth, orbital height, nasal breadth, and nasal height. They were then scanned with a General Electric® (GE®) Light Speed RT-16 multi-detector scanner at the Office of the Chief Medical Examiner for the State of Maryland with a slice thickness of 1.23mm. The acquired images were then volume rendered using the GE® Advanced CT Workstation (AW-2 version aws-2.0-5.5).

The data from these CT scans will be converted to Stereolithography (STL) format using free software. The STL format will then be converted by free slicing software to generate a G-code file for 3D printing. 3D models will be created via a filament-based 3D printer with a 0.4mm nozzle printing. Models will be printed using Polylactic Acid (PLA) 1.75mm filaments and 0.1mm thick layers.

3D-printed models of a portion of the skulls from the prior study will be made and measurements from these models will be compared to those taken previously. Percent differences between these measurements will determine if there is an acceptable difference between the two values and validate the use of 3D models in legal proceedings as a demonstrative aid. An accurate representation of what was seen at autopsy could be an invaluable resource for all forensic pathologists.

3D Printing, Postmortem CT, Legal Proceedings

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