3D model of the temporal bone intended for teaching human anatomy via MicroCT scan

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Aims

The morphology of the human temporal bone is complicated, and students face special problems as a result. We offer a method for educational assistance using 3D models created by microCT technology for temporal bone educational purposes. The use of low resolution (0.7 mm voxel size) data collected from CT or MR scans to print three-dimensional models for learning materials is commonly known in the medical literature. Smaller structures can be better defined by micro-CT imaging, and data sets may be post-processed to produce realistic anatomical models for inspection and management. We generate and describe the process of creating 3D temporal bone models from high-resolution microCt images.

Method

The five dry temporal bones were selected in Ankara University Faculty of Dentistry Anatomi Laboratory, for the micro-CT scanning and analysis. The bones selected are one piece and unworn and unbroken. A high-resolution, desktop micro-CT system (Bruker Skyscan 1275, Kontich, Belgium) was used to scan the specimens. The scanning conditions were 125 kVp; 80-mA, 0.5-mm Al filter; 33-μm pixel size; and rotation at 0.2 step. To minimize ring artifacts, air calibration of the detector was carried out prior to each scan. Other settings included beam-hardening correction, as described, and the input of optimal contrast limits, according to the manufacturer's instructions.

After reconstruction, the images obtained were transferred to CTvox software to create a digital and colored three-dimensional model. In this software, the anterior and posterior sides of the bone were photographed. In addition, bone faces were recorded as movie.

In addition, image data were transferred to CTan software. Using the software's automated segmentation feature, the Scans were selectively segmented using intensity thresholds to isolate bone. Based on this information, standard STL files for 3D printing could produce for usage with a high-end 3D printer.

Dry bone, colored 3D CTvox images, and stl files landmark structures were compared by an experienced anatomist.

Results

Anatomical structures noticeable on the CTvox images and stl model of the temporal bone: temporal squama, zygomatic process, articular tubercle, mandibular fossa, tympanic part, external acoustic meatus, mastoid process, parietal notch, petrous apex, carotid canal, jugular fossa, styloid process, sphenoid margin, groove for the sigmoid sinus, arcuate eminence, internal acoustic meatus. All these structures, which can be preserved and visible on dry bone, were clearly visible in CTvox images and could also be selected in printed 3d models.

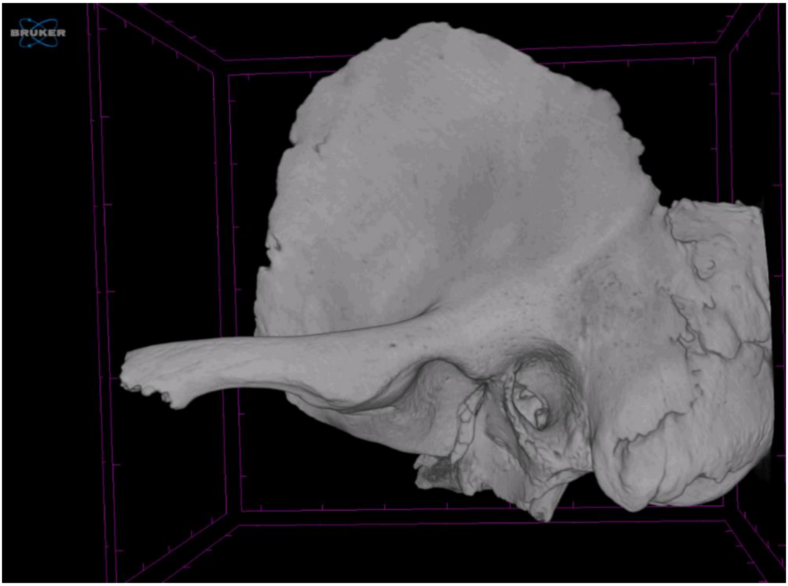

Figure 1: Anterior aspect of the temporal bone by CTvox software

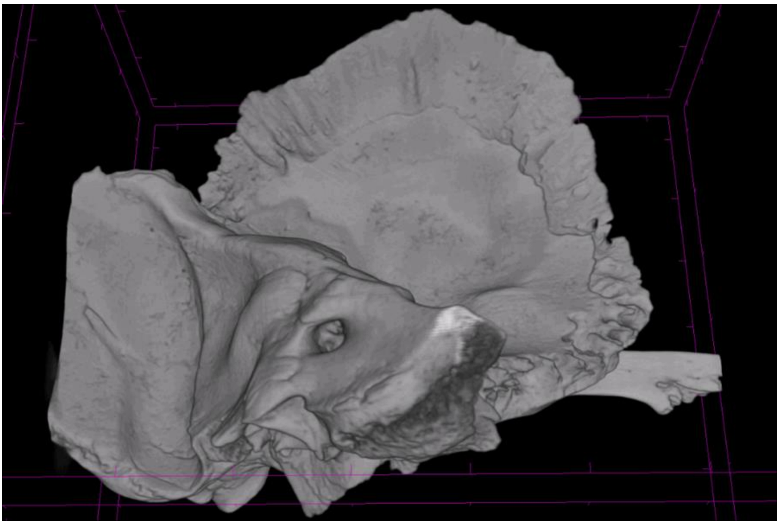

Figure 2: Posterior aspect of the temporal bone by CTvox software

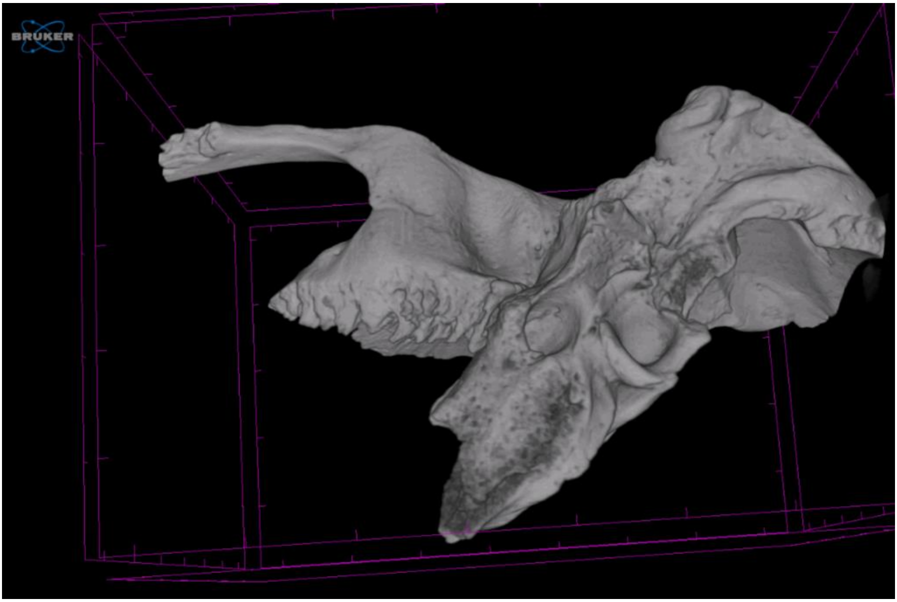

Figure 3: Inferior aspect of the temporal bone by CTvox software

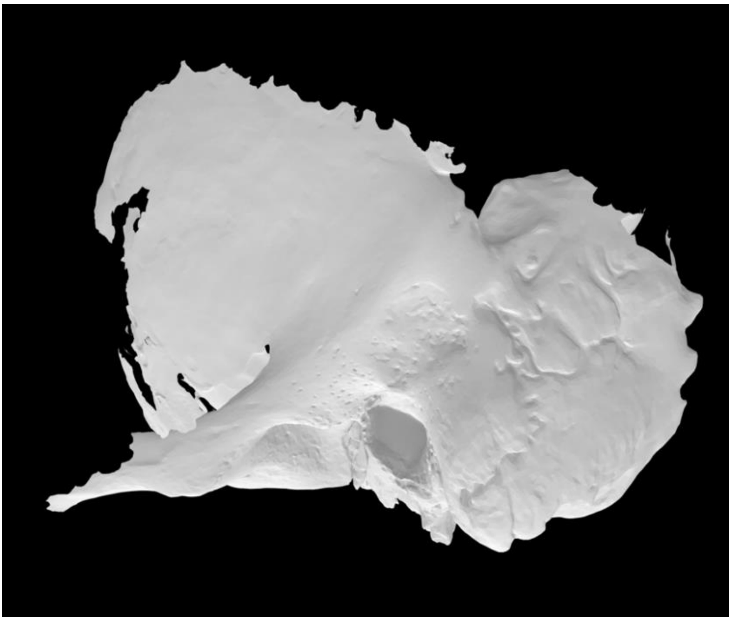

Figure 4: Anterior aspect of the temporal bone STL model

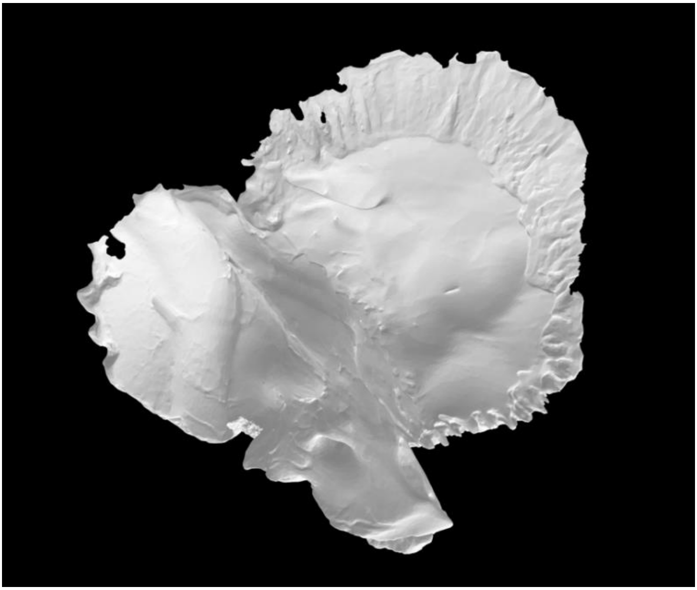

Figure 5: Posterior aspect of the temporal bone STL model

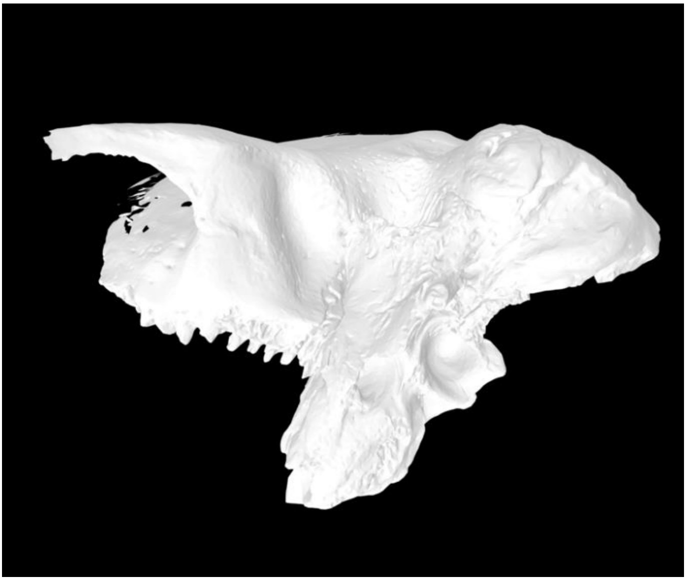

Figure 6: Inferior aspect of the temporal bone STL model

Conclusion

This study is showed how to use microCT to generate a prompt digital model of the temporal bone. Many structures were able to be replicated using the models. The models can be built fast and inexpensively enough to have educational training applications.

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