Correlation of 2D Reconstructed High Resolution CT Data of the Temporal Bone and Adjacent Structures to 3D Imaging

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Purpose
Understanding the anatomy of the temporal bone and adjacent structures is difficult by looking at cross-sectional images especially when reconstructed to a small field of view alone. 3D imaging can help to understand the spacial relationship of the bony parts of the skull base, nerve structures and the middle and inner ear but can be very time consuming (1–3). Furthermore 2D imaging often reflects the anatomy more accurately as some detail is lost by postprocessing (3, 4). Correlation of 2D images to 3D models as a reference therefore might help in understanding of structures in areas of complex anatomy that cannot be sufficiently evaluated in 3D models or where creating 3D models would be excessively labor-intensive.

Materials & Methods
CT-scans of the temporal bone were obtained with 1.25 mm collimation (140 kV, 40 mA), exposure duration of 7.8 seconds and pitch of 3 with a multi-slice CT (GE CT Light Speed QX/I, GE Medical Systems, Milwaukee, WI) at the Dept. of Neuroradiology, Medical School Hannover, Germany. A temporal bone without any known pathology and 6 temporal bones with different pathologies including malformation, trauma, implants, tumor, and inflammatory disease were investigated. A bone reconstruction algorithm was applied (0.3 mm reconstruction interval, 9.6 cm field of view) (5). Postprocessing was performed using the software "slicer" and "slicer2k" (www.Slicer.org, Surgical Planning Laboratory, Brigham and Women's Hospital, Harvard Medical School, Boston, MA). Following thresholding manual segmentation was performed separating the relevant structures. In the normal temporal bone all the visible parts of the individual skull bones were labeled, as well as the ossicles, the inner ear structures, and the nerves VII and VIII. In the pathologic cases the relevant anatomical structures were displayed. Two-dimensional slices were correlated to the 3D display of the entire region by means of orienting the models along with the cross-sectional images into 6 standardized views. Furthermore the segmented areas were displayed in axial, coronal, and sagittal slices. Anatomical structures were labeled by correlation of cross-sectional and 3D images.

Results
The temporal bone and the adjacent parts of the sphenoid, zygomatic, occipital bone as well as the mandible were displayed. Correlation of cross-sectional images to 3D models helped to correlate the 2D slice into a 3D impression of the anatomy. The complex spacial relationship of the components of the skull base and the anatomical structures of the temporal bone were easier to understand using cross-sectional slices if information about the location was added using a 3D
image. The fully segmented normal temporal bone could be used as a reference model for the pathologies.

**Conclusion**

Correlation of cross-sectional images to 3D models is a more effective way of reaching a spacial understanding of the individual anatomy. This way diagnosis can be made easier as spacial relation of the structures is understood better. The method can be used further for preoperative planning and medical education.

**References**