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Cochlea Implantation – Eine Herausforderung für die CT Bildgebung: Experimenteller Vergleich von 4 und 16 Zeilen-CT und flat-panel Detektor basiertem Volume-CT

Cochlea implant – a challenge for CT: Experimental comparison of 4 and 16 row multisclice-CT and flat-panel based Volume-CT

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Purpose

Current imaging methods are challenged by cochlea implant imaging. The limited resolution and the metal artifacts compromise either the visualization of the implant or the surrounding cochlea. An exact definition of the position of single electrodes within the cochlea is impossible. Due to its high resolution and excellent metal artifact behavior flat-panel based Volume-CT could overcome these limitations.

Material and Methods

Two ex-vivo temporal bones were implanted, one with a Nucleus Contour © and one with a Nucleus Contour Softtip© . Stenvers projections were acquired to assess the electrode positions. Both temporal bones were scanned in a 4 slice (GE Lightspeed Qx/i) and a 16 slice CT (Siemens Sensation 16) using optimized temporal bone protocols. Due to logistical reasons the scan plain was somewhat arbitrarily selected. Further, a Volume-CT scan was performed, resulting in an isotropic dataset with 250 µm3 big voxels (Nyquist's limit).
The datasets were compared regarding the information about the implant, the inner ear and their relationship.

Results

Stenvers projections revealed that the second temporal bone was only inserted ¾ windings (Fig 1, 2, 3), while the first one was fully inserted. This could also be assessed in both MSCT datasets. Single electrodes could only be distinguished in the Sensation 16 (Fig 2) and Volume-CT (Fig 3). The outline of the bony labyrinth was severely compromised in all CT scans but the Volume-CT scan, in which only mild hardening artifacts occurred. Actually, the spiral osseous lamina was visible in some slices.
The Volume-CT (Fig 3) scan combined a feasible differentiation of single electrodes with an almost uncompromised display of the cochlea and its structures.

Discussion

We concluded from this experimental study that a rough assessment of the implant position is possible with all three CT scanners, but the only scanner that has the potential to give exact measurements of electrode positions within the cochlea is the Volume-CT. Exact measurements of electrode positions within cochlea and comparisons with histology is work in progress. Results might be presented at the meeting.
The comparison of the both MSCTs is limited due to several reasons, whereof the fact that the image quality is strongly dependent on the acquisition plain might be the biggest. The acquisition plain was not the same in both CTs. Due to its isotropic resolution, the Volume-CT is independent from the acquisition plain.
Further experiments need to show how the scanning of whole skull bases change the image quality of the Volume-CT. If our conclusions hold true for in vivo imaging, Volume-CT may be an ideal modality for implantation planning and implantation evaluation, both pre-, intra- and postoperatively.