Temporal bone imaging with CBCT

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Introduction
The Cone Beam CT (CBCT) technique is normally used in head and neck area for dento-maxillofacial, sinonasal and cervical spine imaging. Until recently, temporal bone imaging has typically been done with multidetector CT (MDCT). An issue related to CBCT in this anatomical area is the thick bony mass that surrounds the small details of the middle and inner ear. When the narrow cone shaped beam is localized to the small field-of-view (FOV), this bony mass, which is outside of the target area, significantly attenuates the X-rays before and after they pass the region of interest and therefore pose challenges to the image formation. The MDCT technique covers axially the whole head and hence does not have this problem, but at the expense of a considerably higher radiation dose. The usefulness and diagnostic capability of the CBCT technique in the temporal bone area is demonstrated in the following three case reports.

Case Reports
The CBCT unit used in this study is SCANORA® 3D (SOREDEX, Tuusula, Finland) with the technical factors of 90 kV, 75 mAs. The patient was stabilized in seated position in order to minimize movement artifacts. With the used device, the FOV size can be selected according to the volume to be imaged. The small FOV of 75x100 cm was used as it can be accurately located to the temporal bone region. The voxel size was 133 µm. The effective dose was approximately 0,03 µSv, 0,06 mSv for both sides of temporal bone imaging. The effective dose of a 16 slices MDCT is approximately 1 mSv.
**CASE STUDY**

Case 1.

A) The coronal reformatted CBCT image shows the presence of a diffuse soft mass in the area of epitympanum of the middle ear medial to the incudo-malleolar bony joint, which does not show any signs of bony destruction suspicious of otitis media and soft tissue complications. B) The axial reformatted CBCT image shows the presence of tympanosclerosis leading to thickening of the tympanic membrane without perforation (tympanosclerosis). Also, the presence of a former atticomastoidectomy is well seen with the presence of a soft tissue graft. A part of the aerated Eustachian tube is seen. C) A sagittal reformatted CBCT image of the right temporal bone shows the presence of a non-specific inflammatory soft tissue mass in the epitympanum without any bony destruction. D) The sagittal reformatted CBCT image shows that the incudo-malleolar joint is intact. The longitudinal area of the facial canal is visualized.

Case 2.

A) and B) The sagittal and coronal reformatted CBCT images show the presence of a mild amount of fluid in the mastoid bone in the area of the antrum. The scutum appears normal and the presence of mild soft tissue thickening is seen in the external auditory meatus. C) and D) Axial images show the presence of fluid in the mastoid cavity. Also, the presence of soft tissue thickening in the anterior and posterior walls of the external auditory meatus is seen. The posterior part of the Eustachian tube is well aerated. The aditus ad antrum is clearly visible.
Case 3.

A) The coronal CBCT image of the right temporal bone shows the rounding of the scutum due to disintegrated cholesteatoma and a small bony defect in the area lateral to the tympanic membrane. B) MDCT reformatted image, which is identical in identification.

C) CBCT image D) Axial MDCT of the same right temporal bone showing that the bony details are seen much more homogenous than in the CBCT image (C).

Conclusion
Although it has been known that the bony details of the temporal bone area are well seen on CBCT, the major difference in comparison with MDCT is the homogenous bony disposition of the bone seen on a MDCT image. However, the use of CBCT can be recommended in cases of soft tissue changes, like in otitis media and larger cholesteatoma masses, which affect the destruction of the temporal bone regardless of the fact that the quality of the soft tissue mass on a CBCT image is non-specific. This recommendation is based on two clear advantages produced by CBCT technique; firstly, the amount of radiation is 16 or even 32 times less in CBCT, and, secondly, the margins of the soft tissue masses and the bony details are visualized much better on CBCT than on MDCT. The amount of radiation by MDCT can naturally also be reduced by using iterative reconstruction techniques, but while considering the correct imaging modality for the temporal bone area, it is worthwhile to keep in mind that CBCT is a cost-efficient, low dose alternative available.