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The Benefits of Using CBCT for Ear, Nose and Throat imaging

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Executive Summary
Diagnostic imaging in the ear, nose, throat (ENT) area has traditionally been performed with medical computed tomography (CT), magnetic resonance imaging (MRI) and plain radiography units. In recent years, however, cone beam computed tomography has been increasingly applied to perform a number of certain diagnostic tasks within ENT imaging. This is due to the rapid development of CBCT technology, which currently enables accurate 3D imaging of, for example, diseases of the sinonasal area, maxillofacial trauma and temporal bone diseases in addition to the conventional use within dentomaxillofacial radiology. Cone beam CT has gained popularity among clinicians because of its ability to image the structures three dimensionally and at the same time visualize both bony and soft tissue structures with extremely thin section images with high resolution.

The main benefits of using CBCT technology for certain ENT cases may be listed as follows:
- Low radiation dose
- High resolution diagnostic data
- Workflow effectiveness
- Quick return on investment

Background
Sinonasal region is one of the most common diagnostic areas with ENT cases. The origin of the site of infection in sinusitis can be determined with accurate precision using a fairly low dose of ionic radiation with CBCT. Sinusitis can be described as having one of the three following causes:

- odontogenic origin - a soft tissue density mass within the sinuses originating from a carious tooth with defective restoration, or extraction site with or without radiographically evident periapical lesion and mucosal thickening limited to the area of the tooth or extraction site in question
- nonodontogenic origin - a soft tissue density mass within the sinuses originating from other reasons such as asthma, allergy and polyposis and absence of carious tooth and mucosal thickening not limited to any tooth
- undetermined origin - a soft tissue mass with carious tooth and mucosal thickening not limited to the affected tooth

All three causes of sinusitis can be well imaged with CBCT. The use of CBCT in imaging diseases of the temporal bone and inner ear is now also well established. Structures visualized particularly well include the ossicular chain, bony labyrinth of the inner ear, internal cochlear anatomy and the facial nerve. Interestingly, reduced metal artifacts with cochlear implant imaging as well as improved detection of small laser-induced lesions in the ossicular chain have been observed when compared to multi-detector CT (MDCT).

Benefits of CBCT for ENT Imaging
Low radiation dose
The main advantage of CBCT over medical CT is the comparatively low dose of ionic radiation: patient receives considerably less dose compared to conventional CT, depending on the selected field of view (FOV). With high resolution CBCT imaging of the temporal bone, the dose is approximately equivalent to one to two panoramic images. In high resolution, sinonasal imaging with a large field of view, the dose is approximately equivalent to three panoramic images.

High resolution diagnostic data
With an in–office CBCT system high resolution diagnostic data
is available within minutes after the exposure. A CBCT provides extremely thin (0.1-0.2mm) slices in axial, coronal and sagittal planes. Various field-of-view sizes and high/standard resolutions can be selected for different imaging tasks. High resolution is recommended for primary diagnostics, for example, for accurately revealing the bony details of the maxilla, mandible and temporal bone, whereas standard resolution is sufficient for follow-up and measurement tasks providing thus appropriately low dose according to the ALARA principle.

Workflow effectiveness
An in-office CBCT system greatly contributes to the workflow effectiveness of a clinic. Patients may be scanned the same day as the initial office visit and diagnostic information is available within minutes thanks to short scan and reconstruction times. Consequently, patient treatment is fast, effective and economic both for the clinic and for the patient, both in terms of money and time. Additionally, patient queues for MDCT scans are shortened as a result of transition to cone beam scans.

Quick return of investment
An in-office CBCT system is an affordable solution that provides quick return of investment. The initial investment in a unit is relatively low and cost-effective in comparison to medical units. Its footprint is small, installation is fast and no extra ordinary lead shielding is needed. A CBCT unit may be operated by only one nurse and it is easy to use. Operating costs are minimal and are further reduced by high reliability and preventive maintenance. Above all, a CBCT system is compatible for a variety of patient cases ranging from dentomaxillofacial applications all the way to regions of ear, nose and throat allowing therefore frequent and diverse patient flow for a fast recoup of the investment.

SCANORA® 3D Low Dose CBCT System
The transition from traditional imaging of the ear, nose and throat area to increasing use of cone beam computed tomography for certain diagnostic tasks is being successfully met by the SCANORA® 3D system by SOREDEX®.

SCANORA® 3D is a compact CBCT system for diagnostic imaging of the dentomaxillofacial and head and neck areas. The cylindrical field-of-view sizes range from 6x6cm up to 13x14.5cm. The voxel sizes, which represent the spatial resolution, range from 133µm to 350µm. SCANORA® 3D offers superior versatility by combining cone beam 3D imaging with a CMOS flat panel detector and dental panoramic imaging with a charge-coupled device (CCD) sensor. At the press of a button, the unit automatically switches between 3D and panoramic imaging modes with an AutoSwitch™ function, making it quick and efficient to use. The volume of interest can be freely located in the skull area, thanks to the motorized positioning movements of the unit. The proper volume can be accurately located with laser positioning lights.

The SCANORA® 3D system makes the workflow as fast and efficient as possible. Short scan and reconstruction times further increase the efficiency and usability of the unit. Reconstruction times are fast, starting from one minute.

The flat panel detector, compared to traditional image intensifiers, offers superior image quality due to its large dynamic range, better contrast and lack of image distortion. Additionally, it is insensitive to electromagnetic interference, compact in size and has a very long service life. The separate CCD sensor for panoramic functioning produces high quality, two-dimensional (2D) images. In addition, the panoramic view can be reconstructed from the 3D data. Then the focal through can be freely adjusted after exposure.

SCANORA® 3D is a total 3D imaging solution and comes with complete 3D software package for advanced diagnostics. Through Digital Imaging and Communications in Medicine (DICOM) support, the SCANORA® 3D system integrates with the picture archiving and communication system (PACS) and is compatible with most third party software, drill and surgical guide applications.

Clinical User Experience
A SCANORA® 3D system has been installed in a moderate-sized private radiology clinic in Tampere, Finland. During the installation period of approximately 3 years, we have used the system in the diagnosis of various diseases of the ear, nose and throat. We have studied patients with, for example, acute and chronic sinusitis, temporal bone diseases and inner ear anomalies.

Principally our SCANORA® 3D has been used to image paranasal sinuses, that is, sinusitis and polyposis, where our ENT surgeons have been more than satisfied with the availability of images in 3D planes at extremely low radiation dose to the patient. In the area of head and neck and temporal bone, its main use at our clinic is focused on the preoperative evaluation of the anomalies in maxilla, mandible and that in the inner ear, but it has worked equally well in cases with infections and trauma of the temporal bone. The image data has also been used for virtual planning and navigation.
Case 1. A 65-year-old woman with a history of sudden nocturnal ear pain and bleeding of the external auditory meatus was referred for a CBCT of the left temporal bone. A sausage shaped soft tissue tumor with a thin calcified film at its periphery was found, possibly a complicated granuloma.

Case 2. This image shows a 25-year-old deaf patient, who recently underwent a cochlear implantation operation on the right ear. Postoperatively hearing was not adequate. So a CBCT of the inner ear was performed because of a suspicion of implant failure. CBCT showed that all the pearls of the intracochlear region were intact.
Case studies

Case 3. A 40-year-old nurse suffering from chronic repeated maxillary sinusitis had been treated with antibiotics unsuccesfully for nearly 10 years. On a CBCT an apical cystic lesion of the first left upper molar was observed, which gave rise to maxillary sinusitis of odontogenic origin.

Case 4. This image shows a 60-year-old male patient who underwent a tooth extraction operation for repeated infections in the maxilla. A big sinus perforation was observed iatrogenically in the area of removal. This led to considerable odontogenic sinusitis in the left maxillary sinus. In addition, there was a presence of polypotic inflammation of the right maxillary sinus.
SOREDEX focuses on developing innovative imaging solutions that enhance diagnostic performance for healthcare professionals. SOREDEX medical imaging systems are developed in close cooperation with leading ENT and dentomaxillofacial specialists at universities and hospitals around the world. This gives us deep insight into the advanced clinical requirements of our systems. With assistance of global radiology partners, we diligently follow the latest treatment guidelines and industry best practices. From the founding of our company in 1977, the leading principle of our development work is the well-being of the patient. SOREDEX imaging systems are well known for cutting-edge technological solutions, high quality standards, ease of use and excellent clinical results. Our global distributor network is thoroughly trained and ready to give the best support and service for our systems. SOREDEX imaging systems are the point-of-care solution for faster, cost-efficient and patient-friendly diagnostic performance.

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Reference