Ear, Nose and Throat Imaging with 3D Technology

The transition from traditional imaging of ear, nose and throat areas to increasing use of cone beam computed tomography for certain diagnostic tasks is successfully being done with this three-dimensional system.

For years, diagnostic imaging in the ear, nose and throat areas had been performed with medical-computed tomography (CT), magnetic resonance imaging (MRI) and plain radiography units. In recent years however, there had been movement afoot to use more cone-beam computed tomography (CBCT) for specific diagnostic tasks. SOREDEX has successfully introduced the Scanora® three-dimensional 3D CBCT system for ENT applications, in addition to its successfully use in the dental industry.

ENT Imaging
With CBCT it is now more than possible to image various ENT diseases with consistent accurate 3D techniques. As this technology has been used quite conventional in dental maxillofacial radiology, likewise there has been increasing use of the same technology in the diagnosing of diseases in the sinonasal region, maxillofacial trauma and even temporal bone diseases. One of the reasons for its newfound use among ENT clinicians is due to its ability to image the structures three-dimensionally, and at the same time visualize with bony and soft tissue structures with extremely thin section, high-resolution images.

The main advantages of the CBCT system over medical CT, are: the ability to provide comparatively lower doses of ionic radiation (three to six times the amount); its ability to image extremely thin slices (sub-millimeter – 0.1 to 0.2 mm) in axial, coronal, sagittal- and sub-planes; the automatic generation of surface and volume reconstructions; and the high resolution of bony details of the maxilla mandible and temporal bones it provides.

In the sinonasal region, 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:

- Adontogenic 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.
- Nonadontogenic origin – a soft tissue density mass within the sinuses originating due to other causes, such as: asthma, allergy and polyposis and absence of carious tooth and mucosal thickening and not limited to any tooth.
- Undetermined origin – a soft tissue mass with carious tooth and mucosal thickening not limited to the affected tooth.

Scanora® 3D Low-Dose CBCT System
Scanora® 3D is a compact CBCT system for the diagnostic imaging of the dental maxillofacial and head and neck areas. Various field-of-view sizes and high-standard resolutions can be selected for different
imaging tasks. The cylindrical field-of-view sizes range from 6x6cm up to 13x14.5 cm. The voxel sizes, which represent the spatial resolution, range from 133um to 350 um. Standard resolution offers fast imaging with low dose, suitable for follow-up and measurement tasks. High resolution is recommended for primary diagnostics. In addition to excellent diagnostic performance, special concern has been addressed to the ALARA (As Low as Reasonably Achievable) principle with low patient dose. Doses levels of the Scanora® 3D are considerably less than those associated with medical CT imaging, depending on the selected FOV (Field of View).

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. The 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 the traditional image intensifiers, offer 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 a 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 Use
The Scanora® system was installed in a moderately-sized private radiology clinic in Tampere, Finland. During the three months, the resident doctors reported their studies of patients with acute and chronic Sinusitis, temporal bone diseases and inner ear anomalies. The purpose of this experiment was to analyze the safe use of this new technique with various ENT diseases. The Scanora® system was principally used to image paranasal sinuses (Sinusitis and Polyposis) and the staff reported it was satisfied with the availability of images in 3D planes at extremely low radiation does to patients. Additionally, the Scanora® was used for head and neck and temporal bone use with a focus on preoperative evaluations of the anomalies in maxilla, mandible and inner ear. The system also worked equally well in cases of infection and trauma of the temporal bone. The image data was also used for virtual planning and navigation.