

DENTO-MAXILLARY RADIOLOGY AND IMAGING

Course 2

DENTO-MAXILLARY IMAGING TECHNIQUES

MEDICAL IMAGING

It's a generic term which covers a set of methods and techniques that non-invasively produce images of the internal aspect of the body for the purpose of medical diagnosis.

The discovery of the X - rays, has induced a true revolution in medical diagnosis due to the development of radiology, the seventh medical specialty.

Medical imaging methods include:

- **CLASSICAL RADIOLOGY** - use X - rays as image acquisition vector;
- **COMPUTED TOMOGRAPHY (CT)** - also using X - rays as image acquisition vector;
- **ULTRASOUND** - use vibrations in ultrasounds range for image acquisition;
- **MAGNETIC RESONANCE IMAGING (MRI)** - use external strong and very homogeneous magnetic field, radio - waves and patient's internal hydrogen nuclei;
- **NUCLEAR MEDICINE** - use low dose radiation isotopes - gamma, beta and alpha - rays;
- **THERMOGRAPHY** - infrared radiations spontaneously emitted by tissues.

X- rays and gamma, beta, alpha are ionizing radiations which have the capacity to ionize atoms and dissociate molecules, causing biological damage.

Ultrasounds and Magnetic Resonance Imaging are non-ionizing methods, causing no biological damage, being generally preferred as methods of first choice due to their inherent safety.

CLASSICAL RADIOLOGY

Use a cone beam of x-rays for image acquisition and it is the first imaging technique available in modern medicine.

An x-ray beam passing through the patient is decreased (attenuated) being absorbed according to the density and atomic number of the various tissues and then the x-ray beam projection on: a radiographic film - will become radiography and on a fluorescent screen - will make possible a fluoroscopy dynamic examination.

For oro-facial and dento - maxillary X - ray exam we use the routine perpendicular regional image projection from face and profile, oblique and special topo-anatomic projection together with dedicated methods: retroalveolar and occlusal dental radiography, different projected facial telerradiography and orthopantomography.

COMPUTER TOMOGRAPHY

It is a diagnostic imaging procedure that uses a collimated X-ray beam and detectors in order to create cross-sectional images - slices - of the body, detectors measuring the densities of the tissues passed by the X-ray by calculation the attenuation coefficients of the X-rays during the passage through the body segment.

The image is then mathematically reconstructed from attenuation coefficient numbers being a digital image consisting of square matrix of picture elements - pixels - each of which representing a volume element - voxel - of the patient tissue – due to this it is also named computer-assisted tomography.

Dento - maxillary and oro - facial regions benefits of dedicated C.T. investigation programs which offer a huge volume of information with specialized reconstruction possibility.

Cone Beam Computer Tomography - CBCT is an advanced imaging modality which uses a cone X - ray beam in order to provide an excellent 3D visualization of the dental hard tissues and osseous structures in three dimensions. It has become widely used over the last decade due to its multiple applications in dento - maxillo - facial structures imaging diagnosis.

MEDICAL ULTRASONOGRAPHY

It's a diagnostic imaging technology which use high-frequency sound waves - well beyond the range of human hearing - to produce images of the inside of the body being able to picture internal organs, tumours and cysts.

Ultrasound images (sonograms) are made by sending a pulse of ultrasound into tissue using an ultrasound transducer - the sound reflects and echoes off parts of the tissue - this echo is recorded and displayed as an image to a monitor.

Especially the oro-facial and neck soft tissues are very well depicted by ultrasound exam and with color Doppler technique it may be investigated regional vascular axes and also can be differentiated reactive - benign cervical lymphadenopathies from the malignant one.

MAGNETIC RESONANCE IMAGING

Medical imaging technique used to investigate the anatomy and physiology of the body in both health and disease without exposure to ionizing radiation.

Magnetic resonance imaging (MRI) is the current used term instead of Nuclear magnetic resonance imaging (NMRI) - in order to differentiate from nuclear medicine methods.

MRI scanners use strong magnetic fields, radio waves and hydrogen nuclei from the investigated body to form images being by far the most sensitive diagnostic methods of oro - facial and neck pathology, the only regional limiting factor are the presence of prosthetic dental devices or metallic filling materials which may generate important metallic artifacts.

NUCLEAR MEDICINE

It's a medical specialty involving the application of radioactive substances in the diagnosis and treatment of the diseases.

A radionuclide is combined with other elements to form chemical compounds, or else combined with existing pharmaceutical compounds, to form radiopharmaceuticals which administered to the patient, can localize to specific organs or cellular receptors.

Nuclear medicine allows detecting a disease process in the body, based on the cellular function and physiology rather than relying on physical changes in the tissue anatomy and thus can identify medical problems at an earlier stage than other diagnostic tests.

Radiopharmaceuticals are taken internally, for example, intravenously or orally and localize to specific organs or cellular receptors; then, external detectors - gamma cameras - capture and form images from the radiation emitted by the radiopharmaceuticals.

This process of imaging is an emission diagnostic method unlike diagnostic X-ray, where it is a transmission of an external radiation which passed through the body to form an image.

It's a ionizing diagnostic method like diagnostic X-ray producing tissular damages, being also used in oncologic therapy.

Nuclear medicine methods include planar Scintigraphy and two types of emission computer topographies: SPECT and PET.

Scintigraphy use gamma cameras to capture emitted radiation from internal radioisotopes to create two-dimensional images.

SPECT (single photon emission computed tomography) imaging, as used in nuclear cardiac stress testing, is performed using gamma cameras - usually one, two or three detectors or heads are slowly rotated around the patient's torso.

PET (Positron emission tomography) scanning, can also use multi-headed gamma cameras where there isn't a dedicated PET scanner.

INTERVENTIONAL RADIOLOGY

Invented in 1953 by Seldinger it includes a wide variety of procedures in which a percutaneous catheter is used under imaging control for:

- tumoral biopsy or embolization,**
- arteries occlusion in hemorrhage or dilatation of arterial stenosis,**
- thrombolysis by thrombolytic drugs delivery directly to the clot,**
- treatment of angiomas and arterio - venous fistulae...**