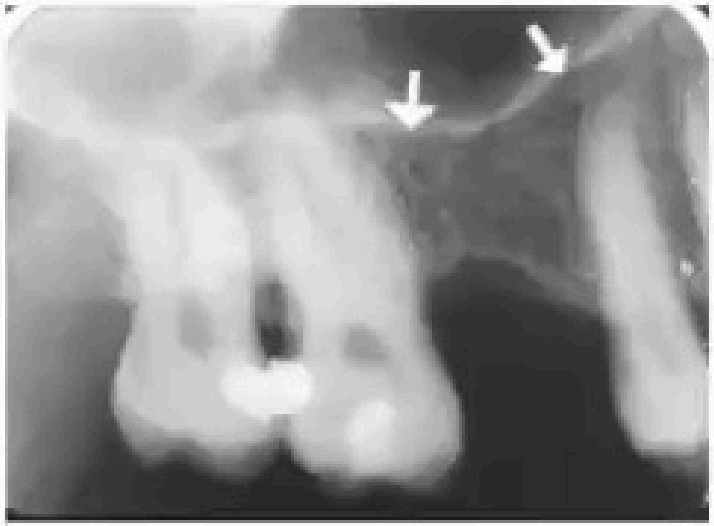
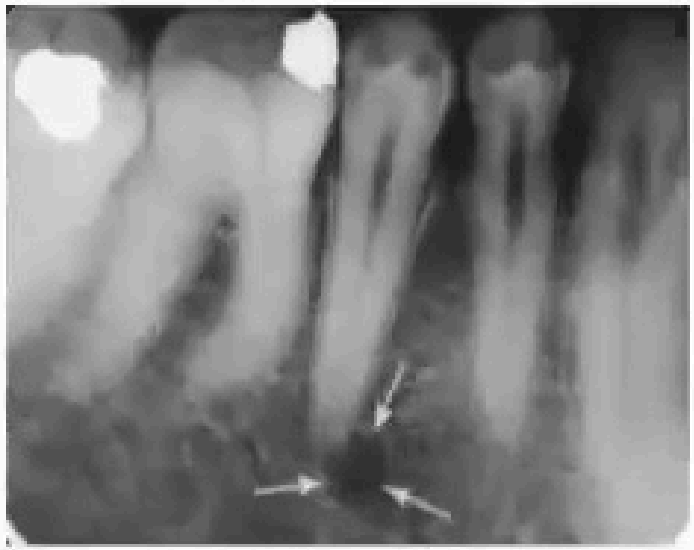
DENTAL & CRANIOFACIAL RADIOLOGY & IMAGING

TYPES OF RADIOGRAPHS

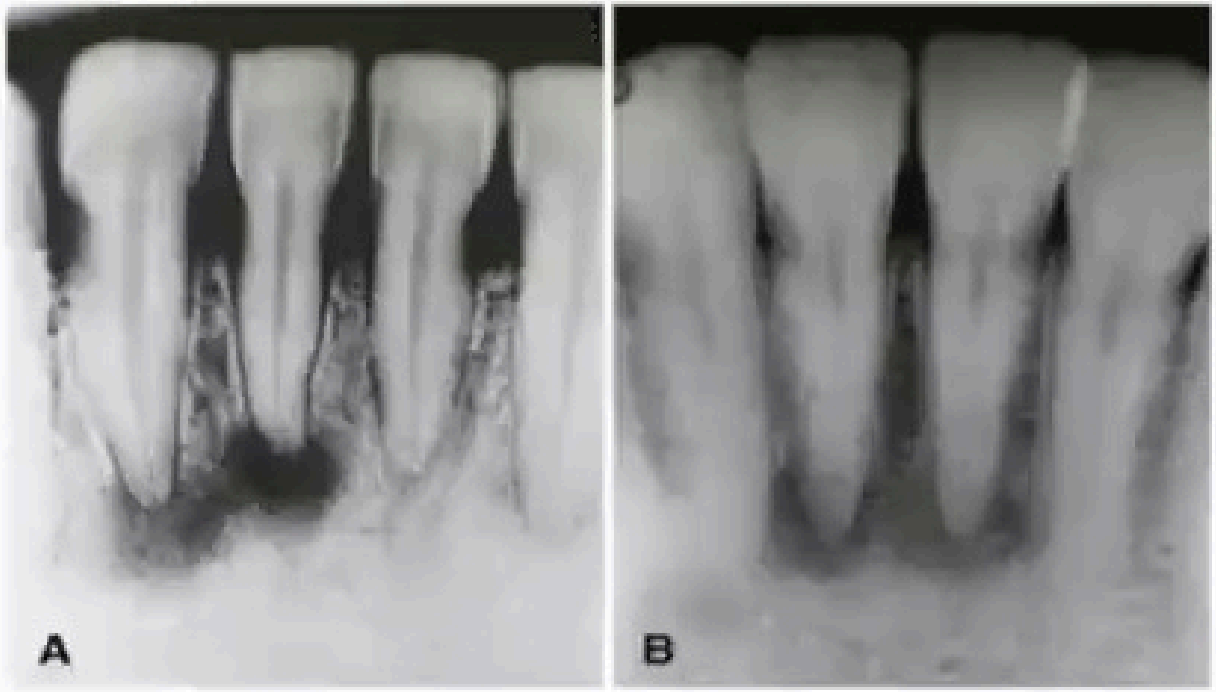
- INTRAORAL RADIOGRAPHY
- -Periapical Views
- -Bitewing radiographs
- -Occlusal radiographs

PERIAPICAL VIEWS

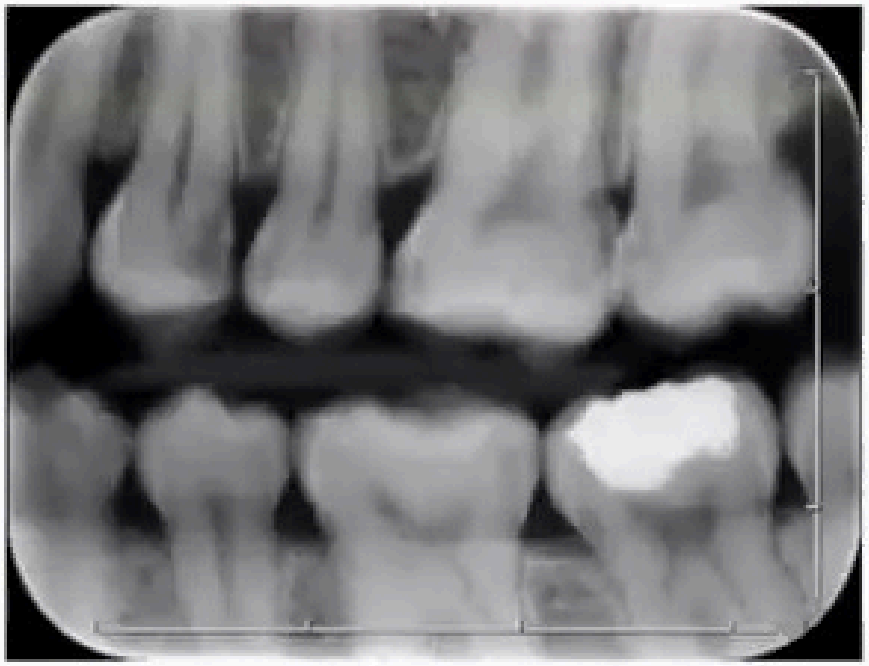




Periapical Cemental Dysplasia



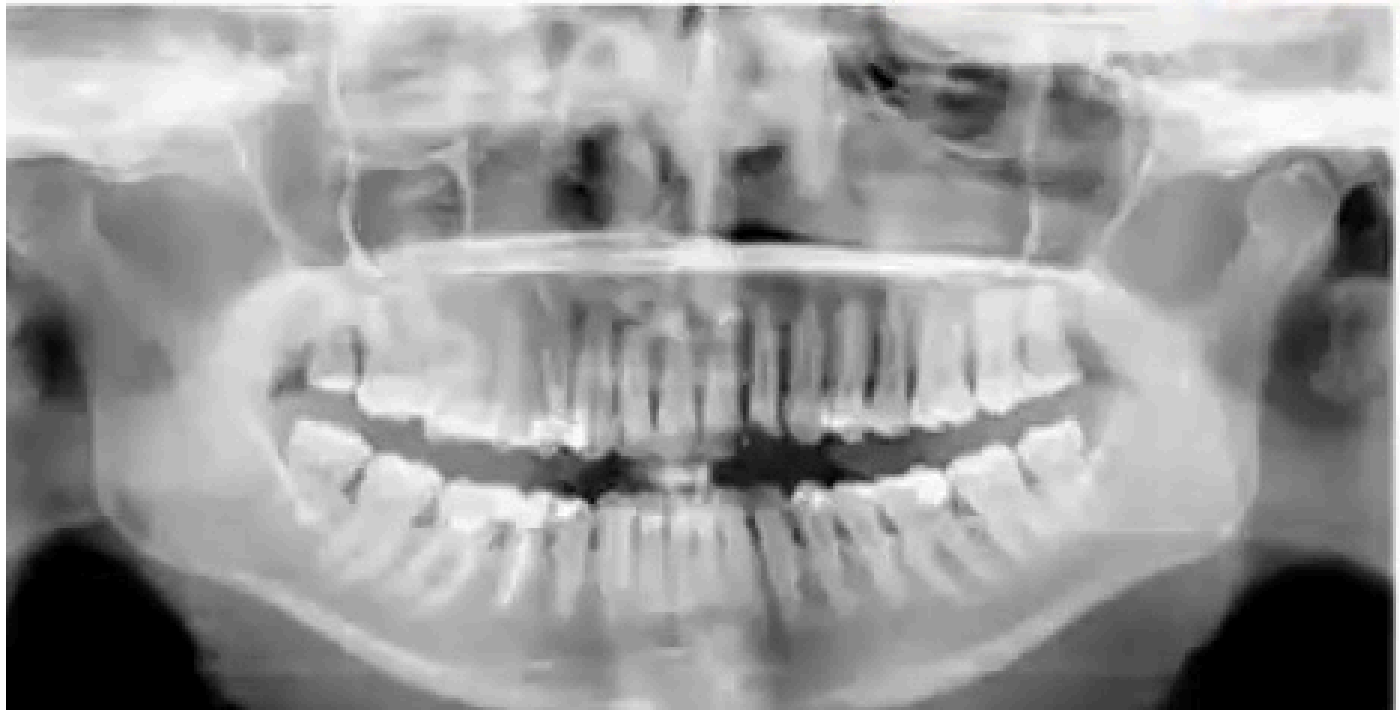
BITEWINGS

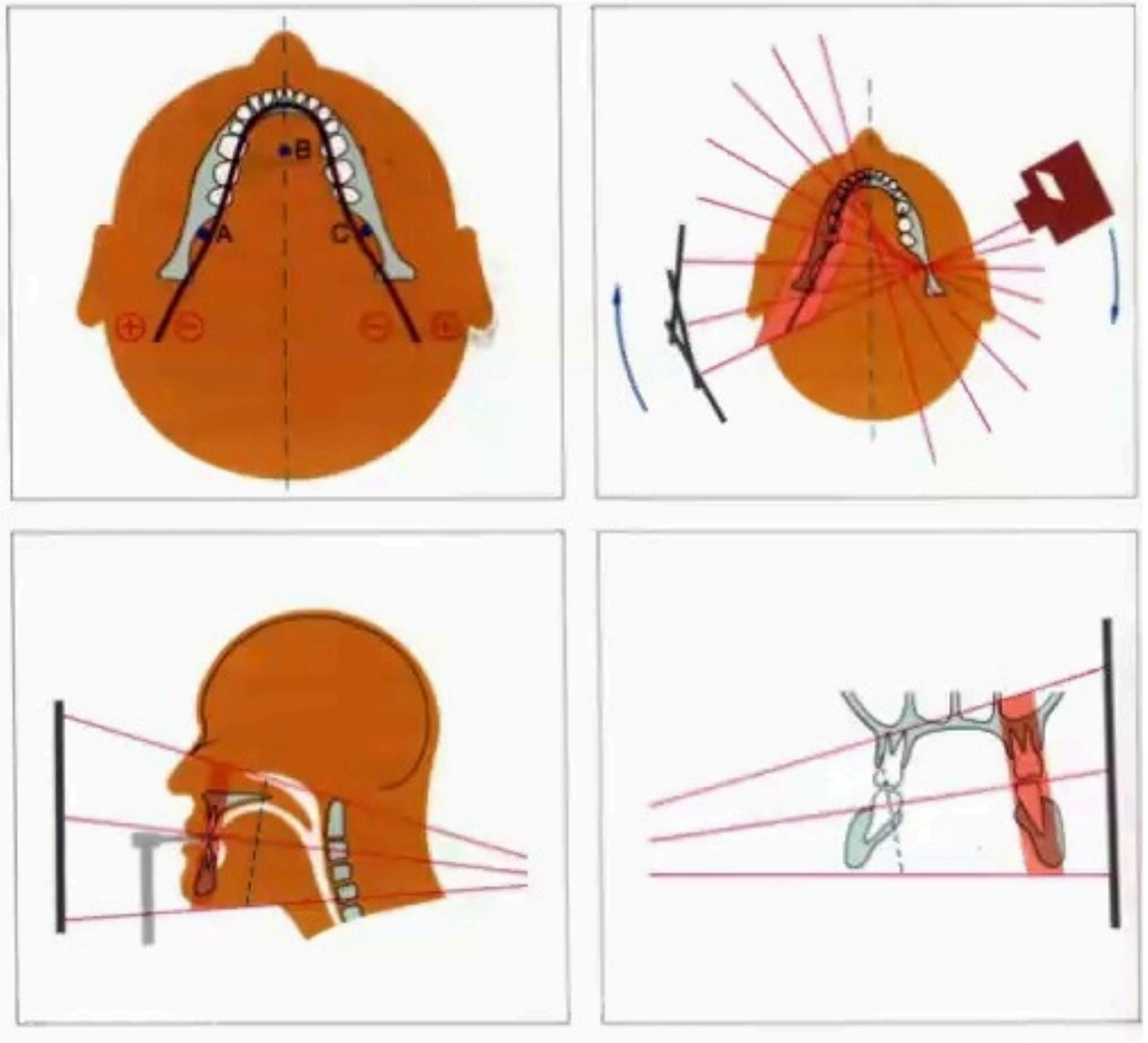


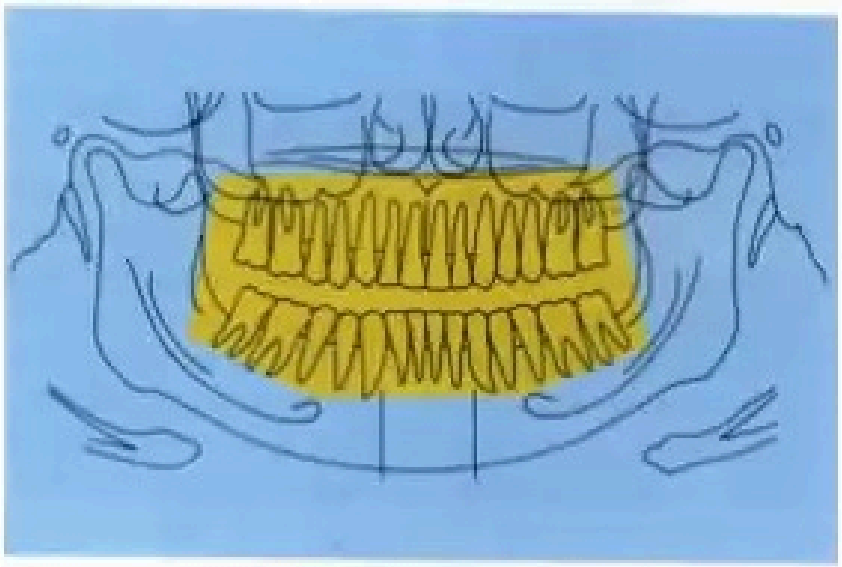
OCCLUSAL VIEWS

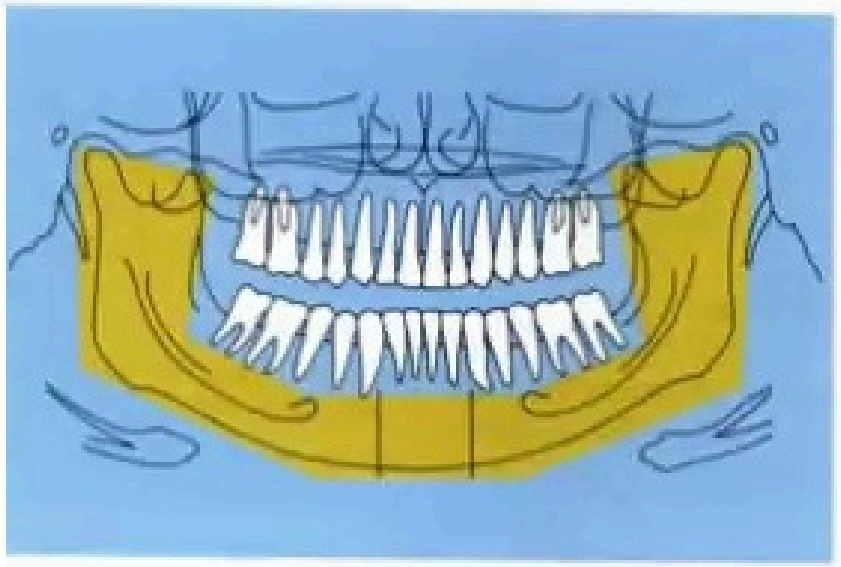
DENTAL PANORAMIC TOMOGRAPHY

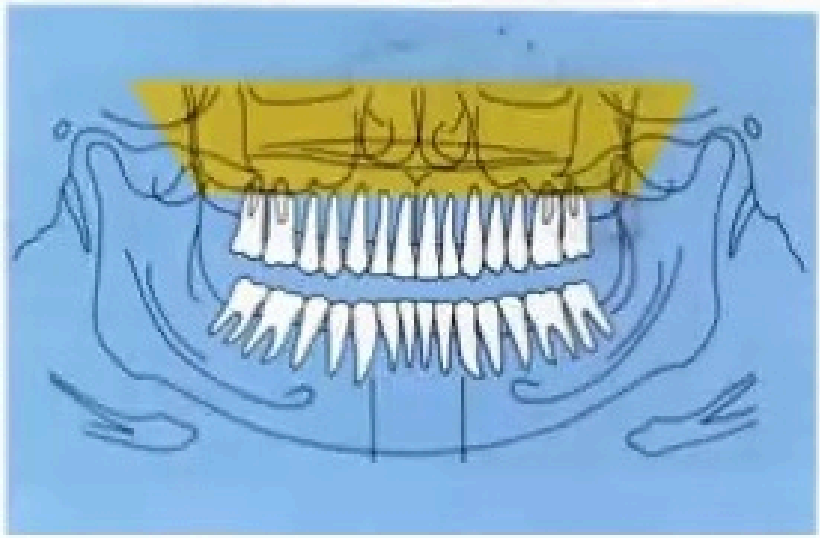
- Most common.
- It is a technique for producing a single tomographic image of facial structures that includes both maxillary and mandibular arches and their supporting structures.
- This is curvilinear variant of conventional tomography and is also used on the principle of the reciprocal movement of an x-ray source and an image receptor around a central point or plane called the image layer in which the object of interest is located.

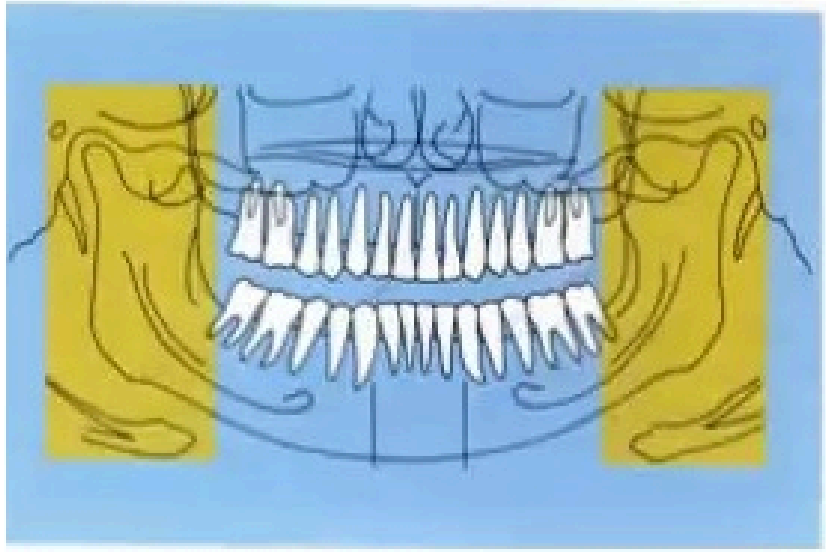



B
A
C

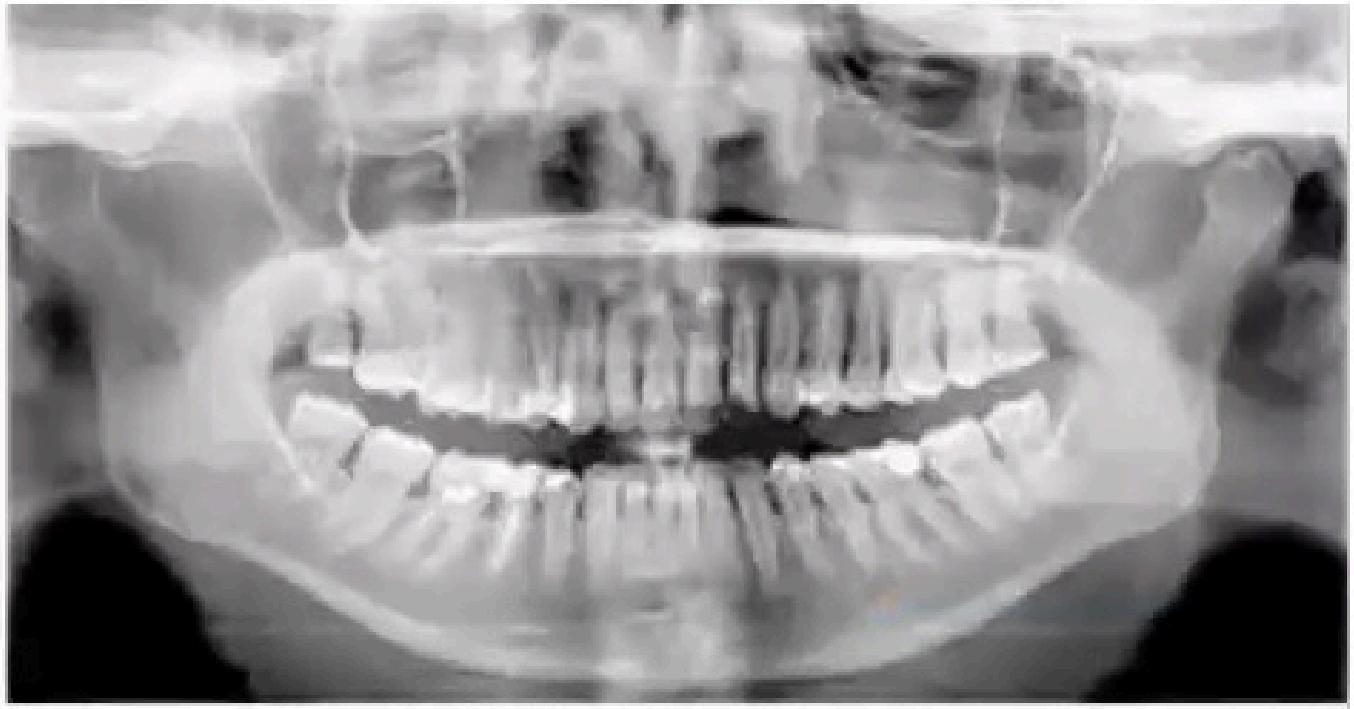








Panorama

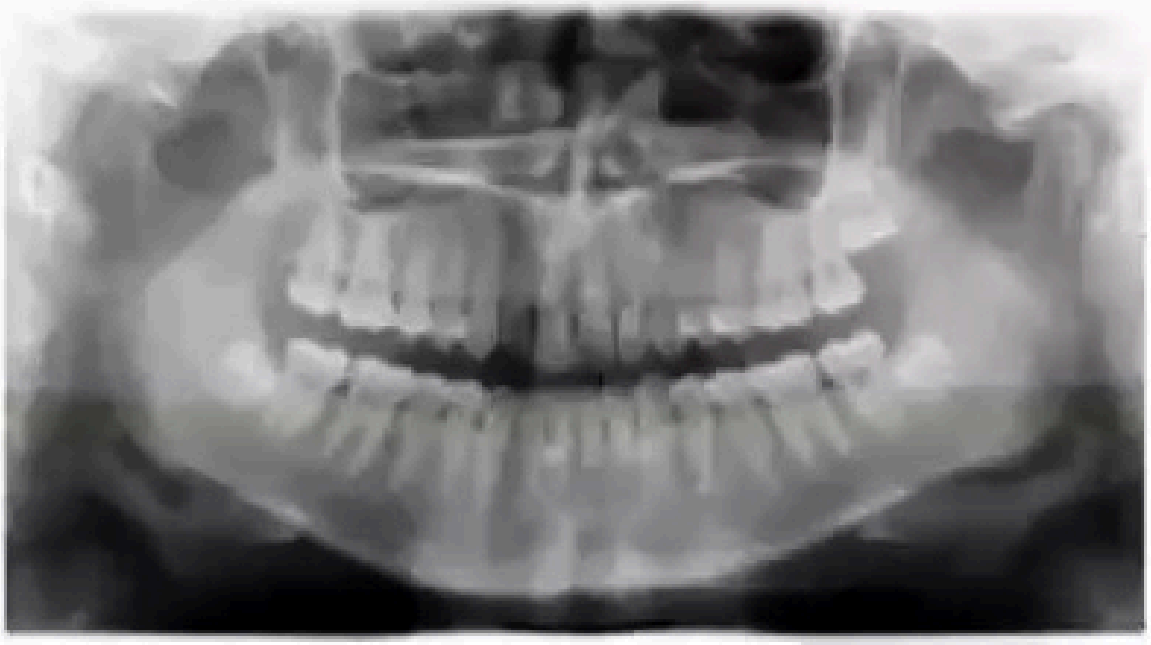


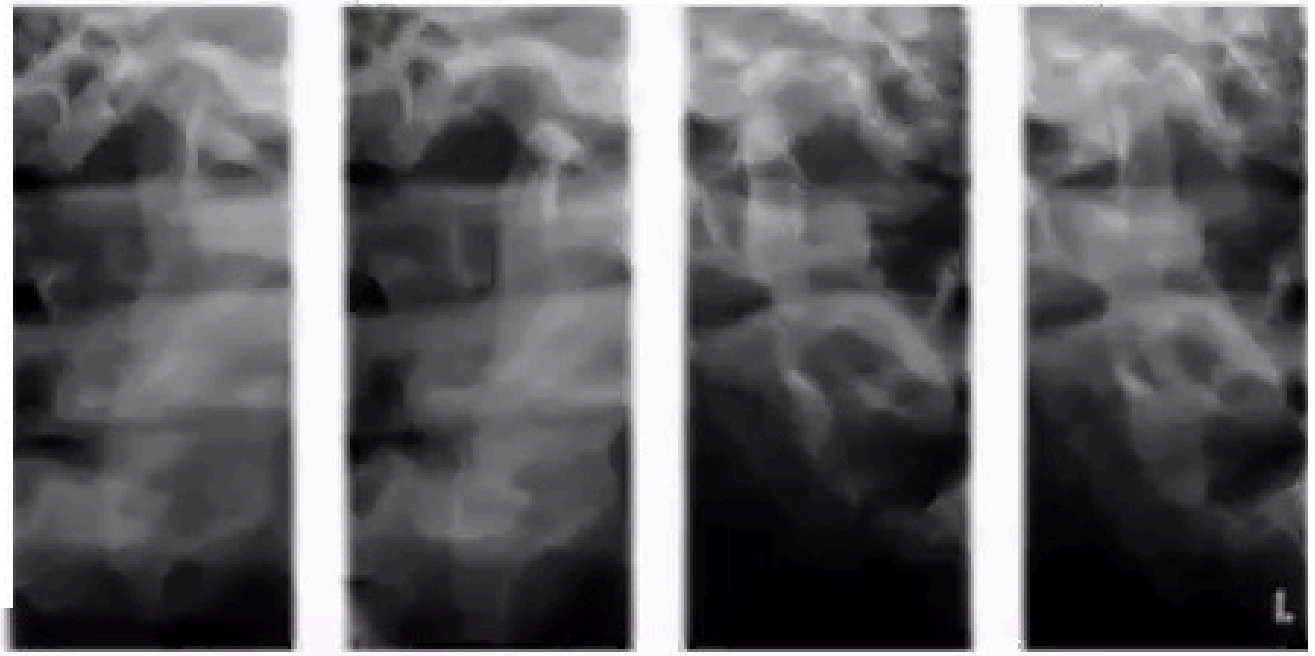
Indications-

Evaluation of-

- Trauma
- Location of third molars
- Extensive dental or osseous disease
- Known or suspected large lesions
- Tooth development
- Retained teeth or root tips
- TMJ pain
- Dental anomalies etc.

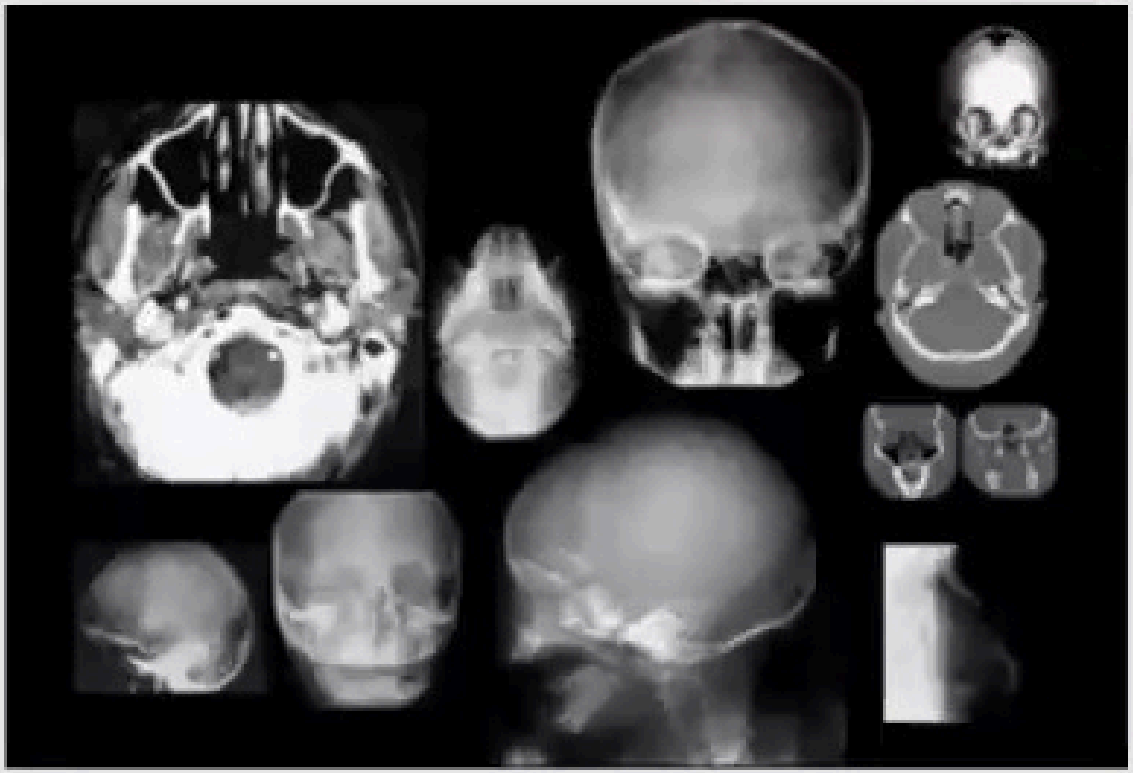
Panorama- TMJ





OTHER IMAGING MODALITIES

- CBCT
- CT
- MRI
- USG



Extraoral radiography

MAIN MAXILLOFACIAL PROJECTION

- Standard occipitomental 0°
- 30° Occipitomental
- Posteroanterior of the skull
- Posteroanterior of the jaw
- Reverse Towne's
- Rotated Posteroanterior
- True lateral skull and cephalometrical lateral
- Submentovertex

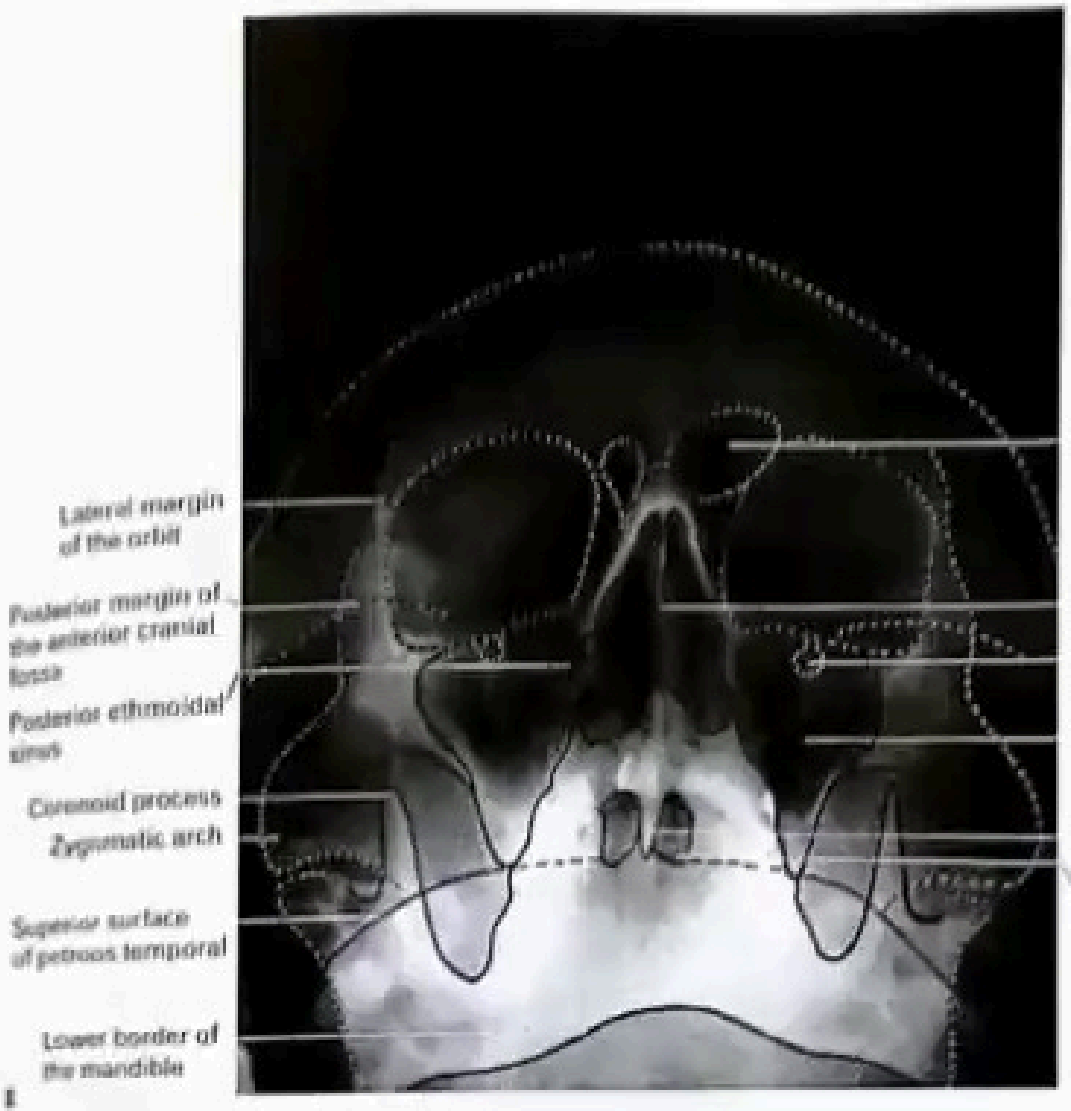
Extraoral Radiography

- Extraoral radiographs (outside the mouth) are taken when large areas of the skull or jaw must be examined or when patients are unable to open their mouths for film placement.
- Extraoral radiographs do not show the details as well as intraoral films.
- Extraoral radiographs are very useful for evaluating large areas of the skull and jaws but are not adequate for detection of subtle changes such as the early stages of dental caries or periodontal disease.
- There are many type of extraoral radiographs. Some types are used to view the entire skull, whereas other types focus on the **maxilla and mandible.**

Standard occipitomental 0º

Indications:

- **Middle third facial fracture**
- **Coronoid process fracture**
- **Maxillary,Ethmoidal and Frontal sinuses**



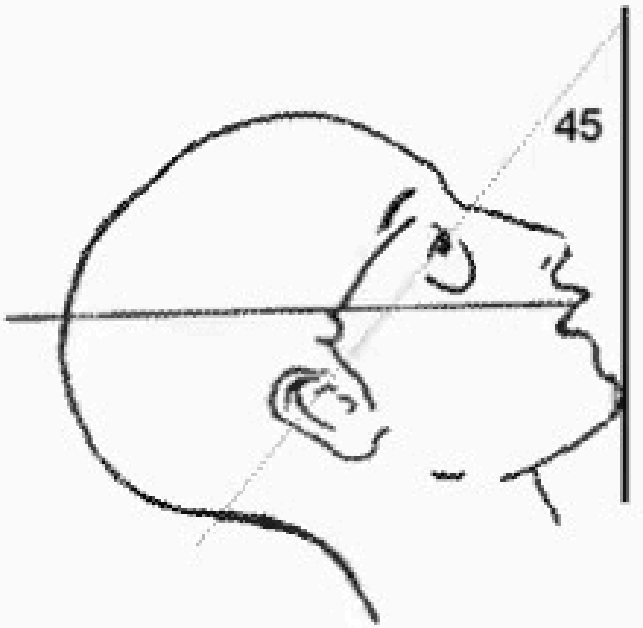
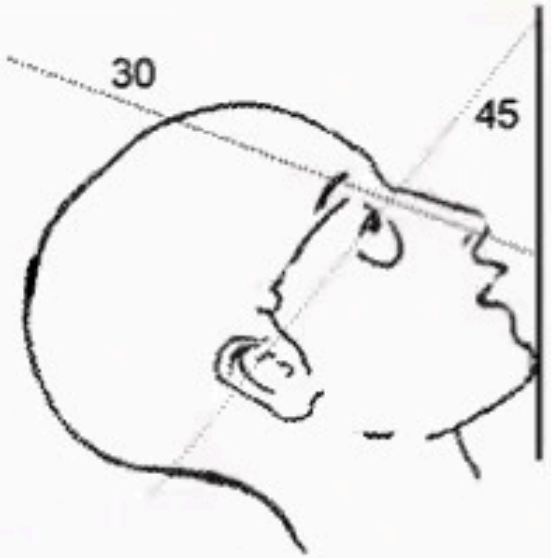


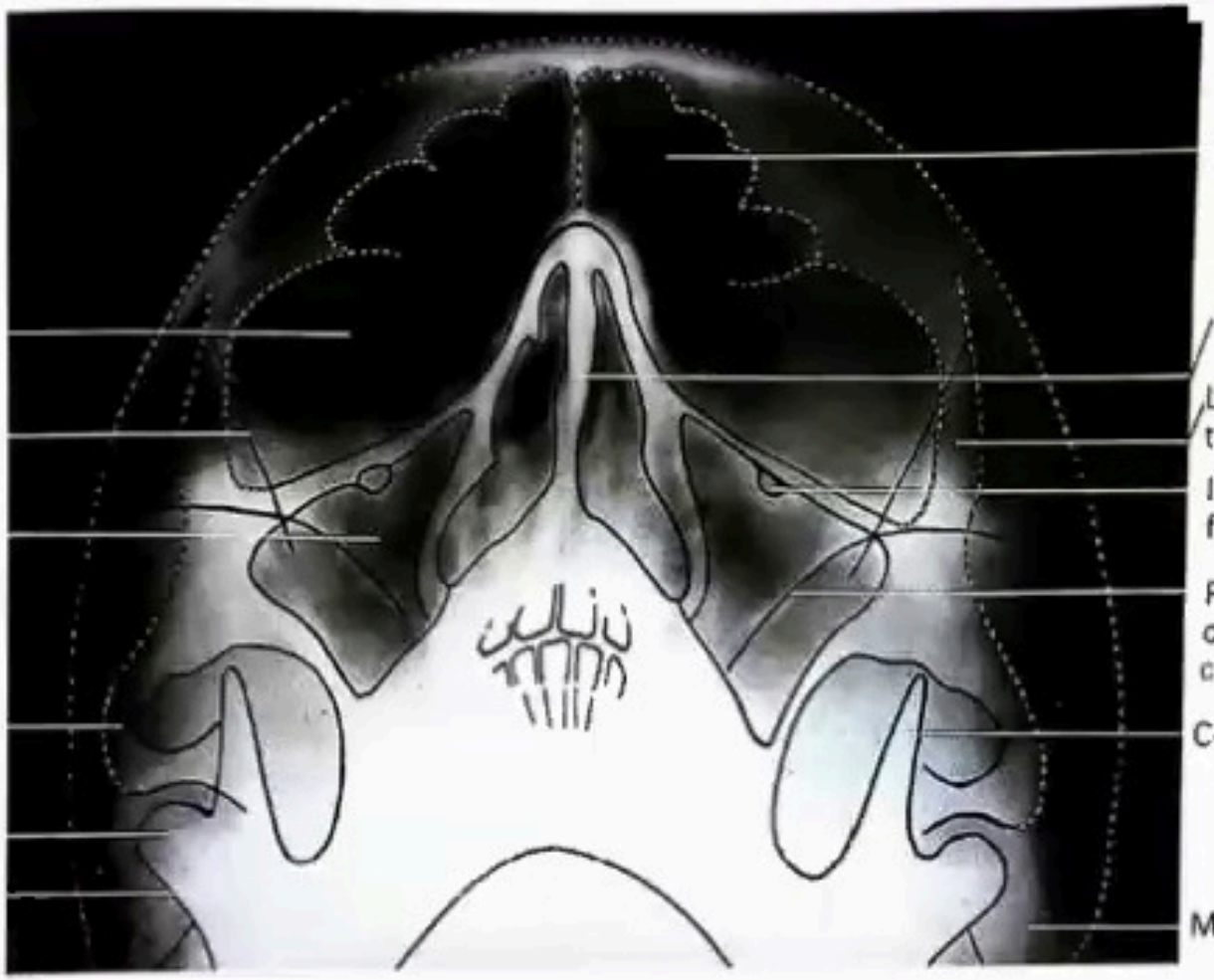
Fig. 14.68 The same radiograph with the major anatomical features drawn in.

30º Occipitomental

Indications:

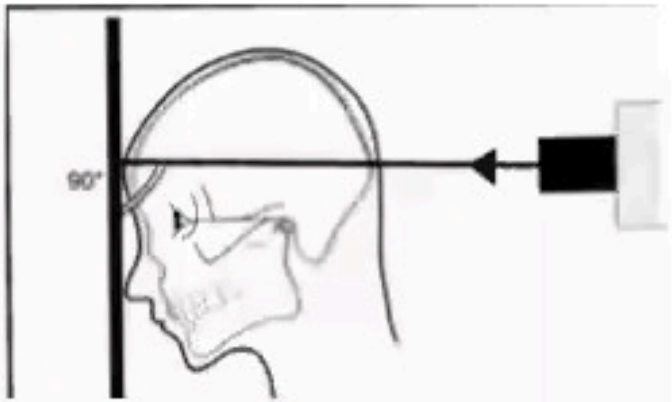
- **Middle third facial facture**
- **Coronoid process fracture**
- **Maxillary and frontal sinuses**

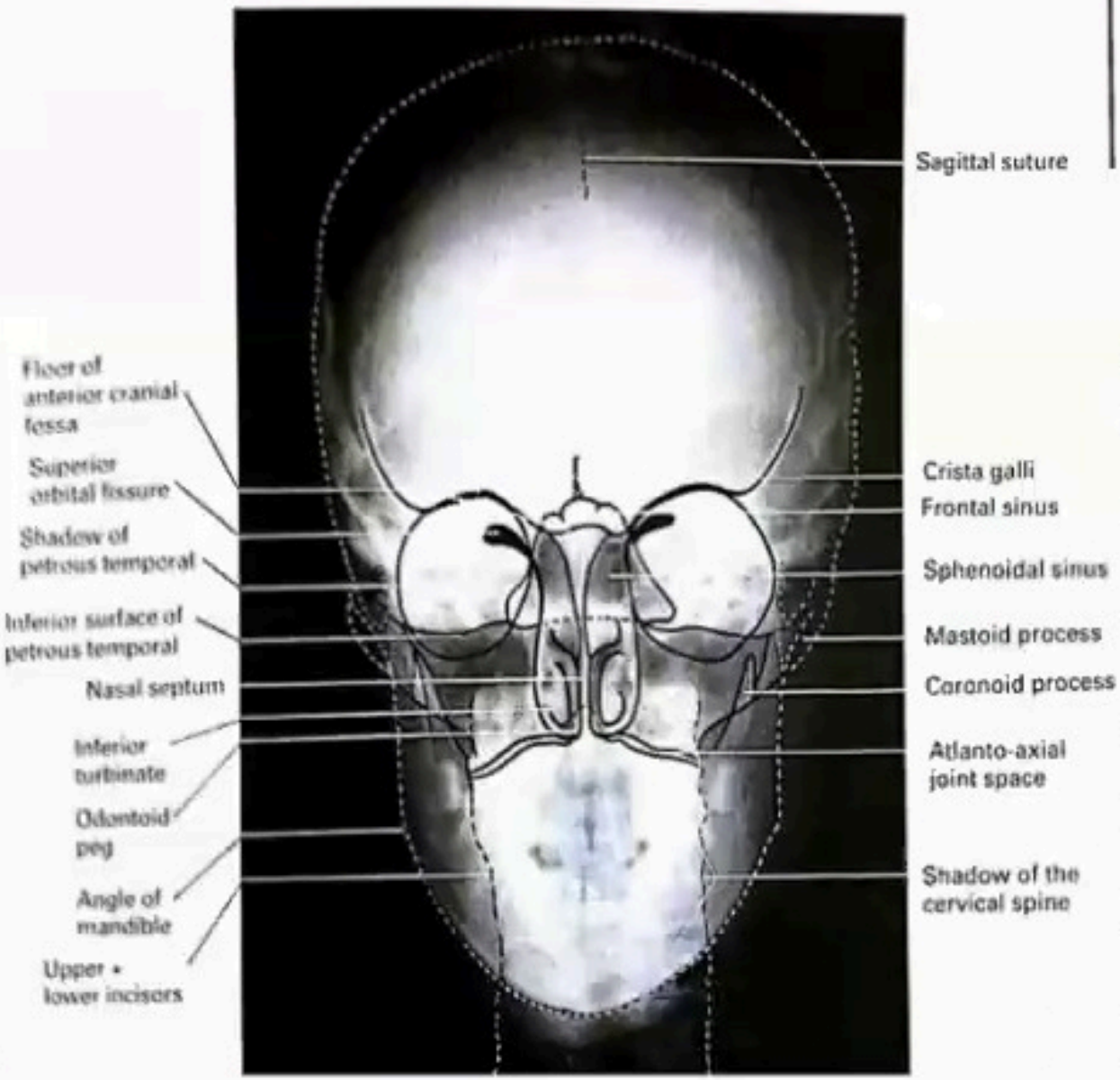




B

Posteroanterior of the skull

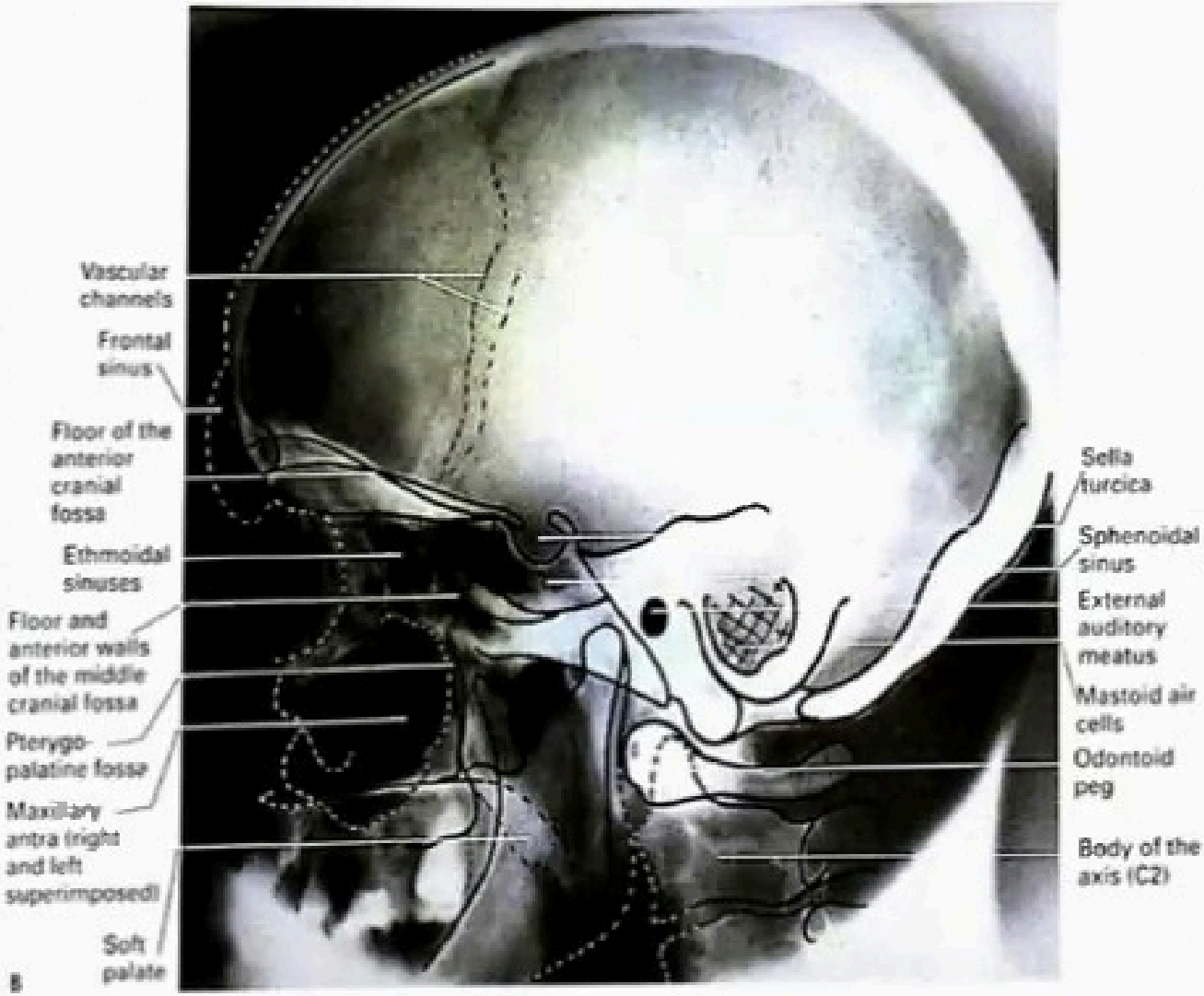




Indications:

- Fractures of skull vault
- Frontal sinuses
- Condition os cranium (Morbus Paget Myeloma multiplex Hyperparathyroidism)
- Intracranial calcification

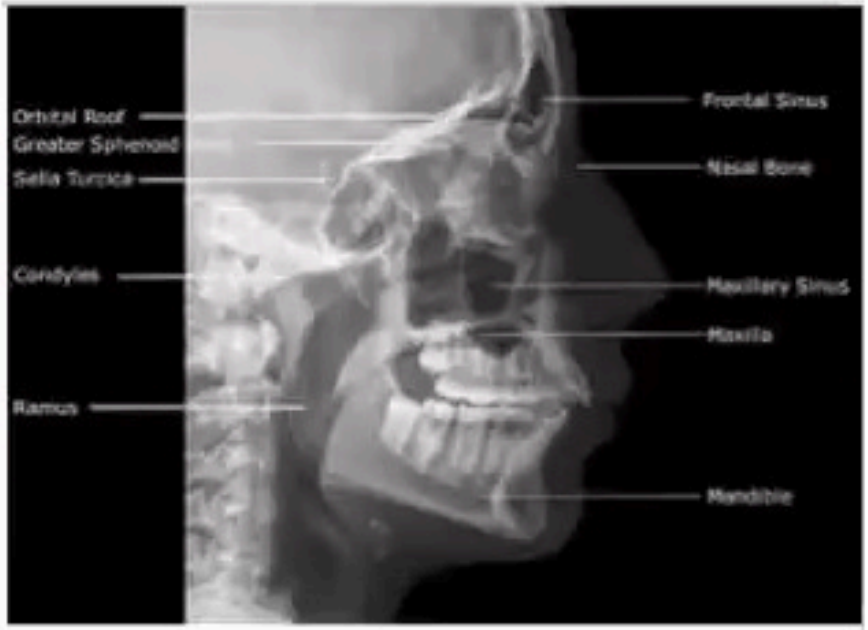
True lateral skull and cephalometrical lateral



Indications:

- Fractures of skull
- Ethmoidal and shpenoidal sinuses
- Condition of sella turcica

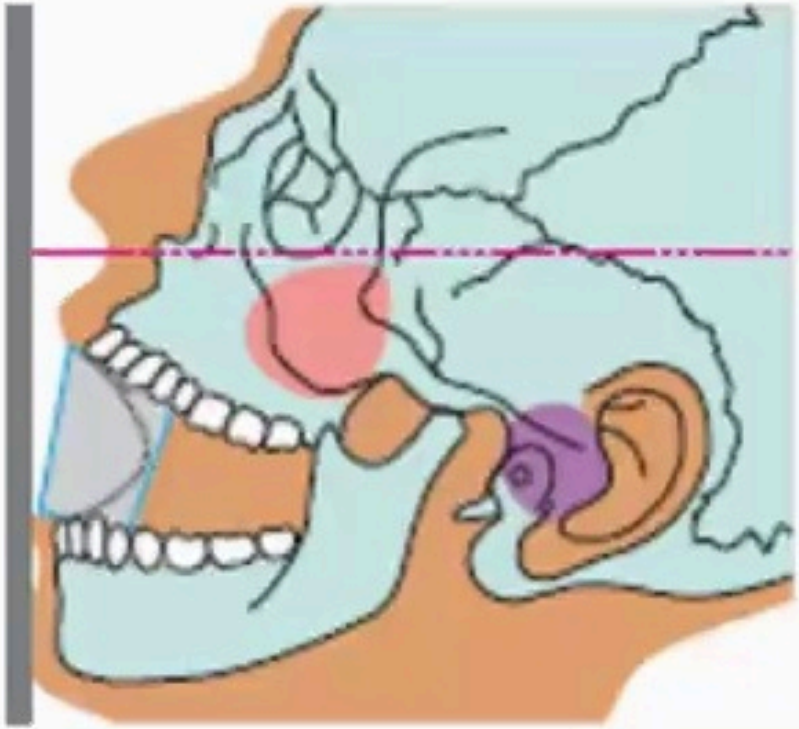
Chepalometry



- Measure relationship of cranial base to facial components
- Create radiographic record of facial structural growht and development
- Plan and monitor stages of treatment
- Detect and diagnose abnormalities

PA Water's view (PNS)

- The image receptor is placed in front of the patient and perpendicular to the midsagittal plane.
- The patient's head is tilted upward so that the canthomeatal line forms a 37 degrees angle with the image receptor.
- If the patient's mouth is open, the sphenoid sinus will be seen superimposed over the palate.
- The central beam is perpendicular to the image receptor and centered in the area of maxillary sinuses.

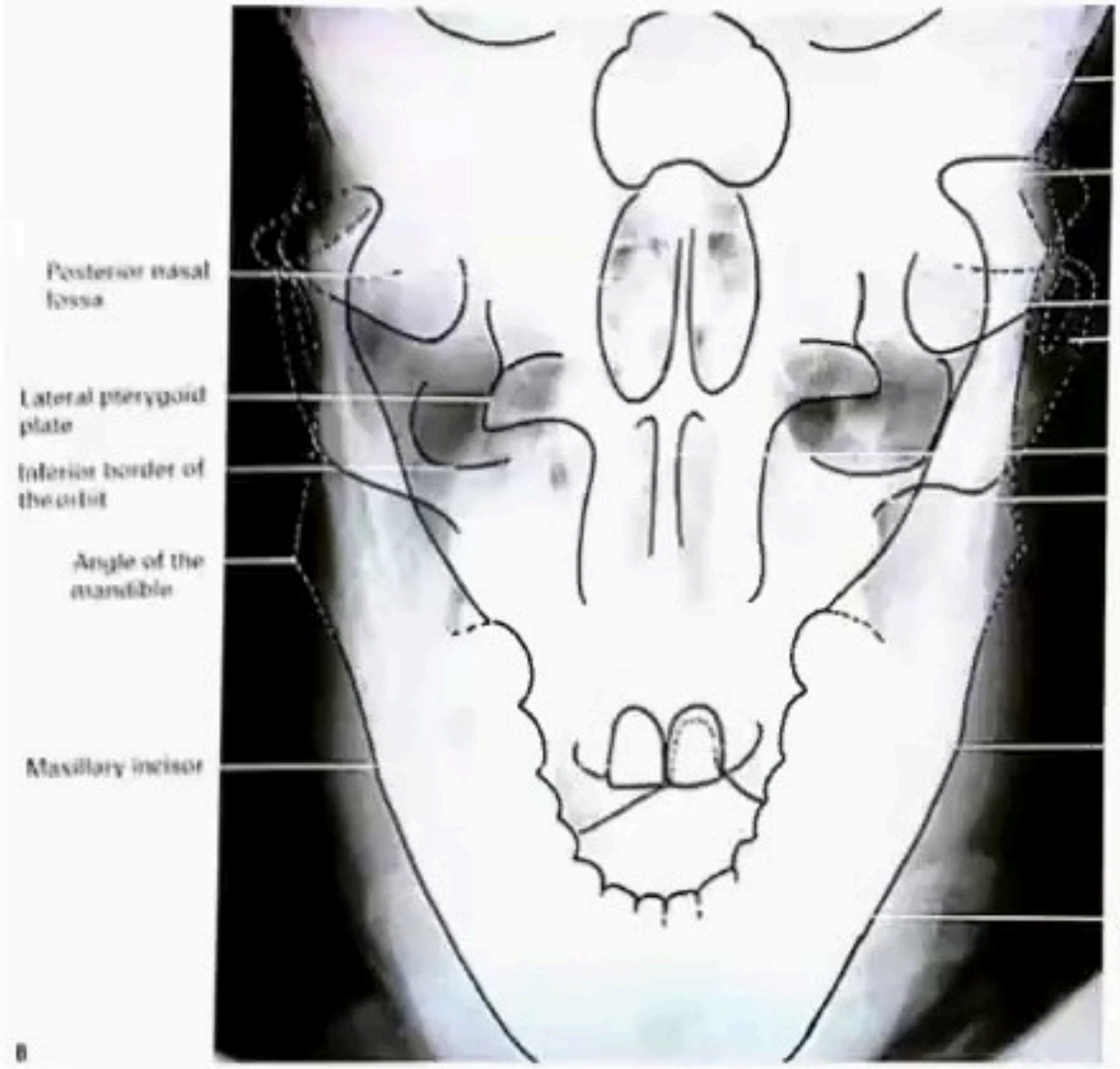


PA Water's view (PNS)

Indikation:

- Sinus maxillaris
- Sinus frontalis

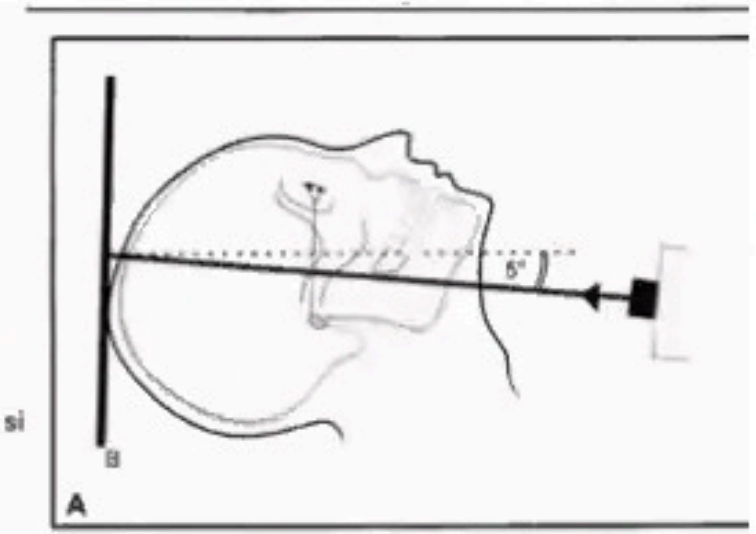
Reverse Towne's

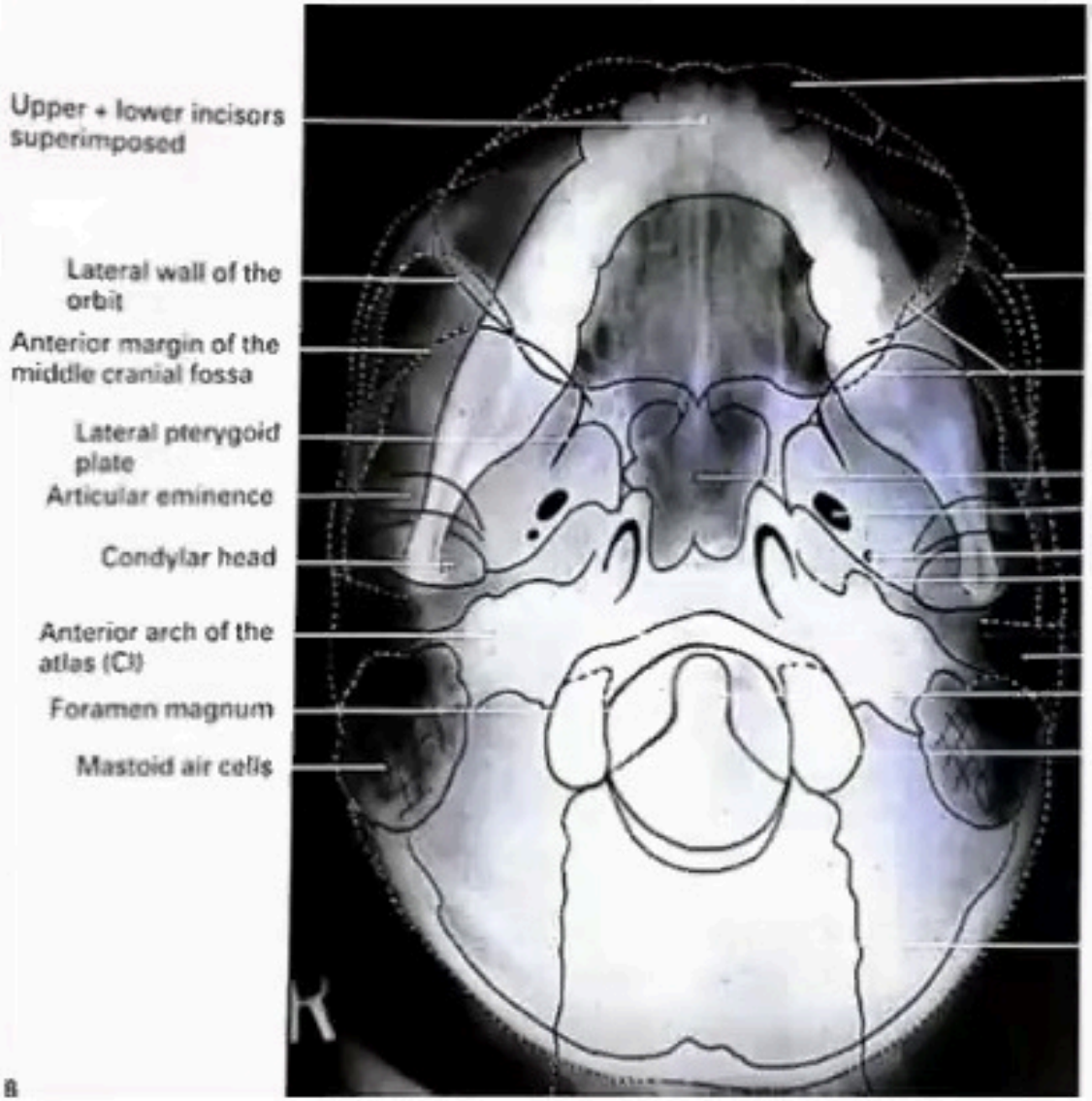


Indictaions:

- Fracture of condylar neck
- Articular surface of condylar head (TMJ d.)
- Condylar hypoplasia

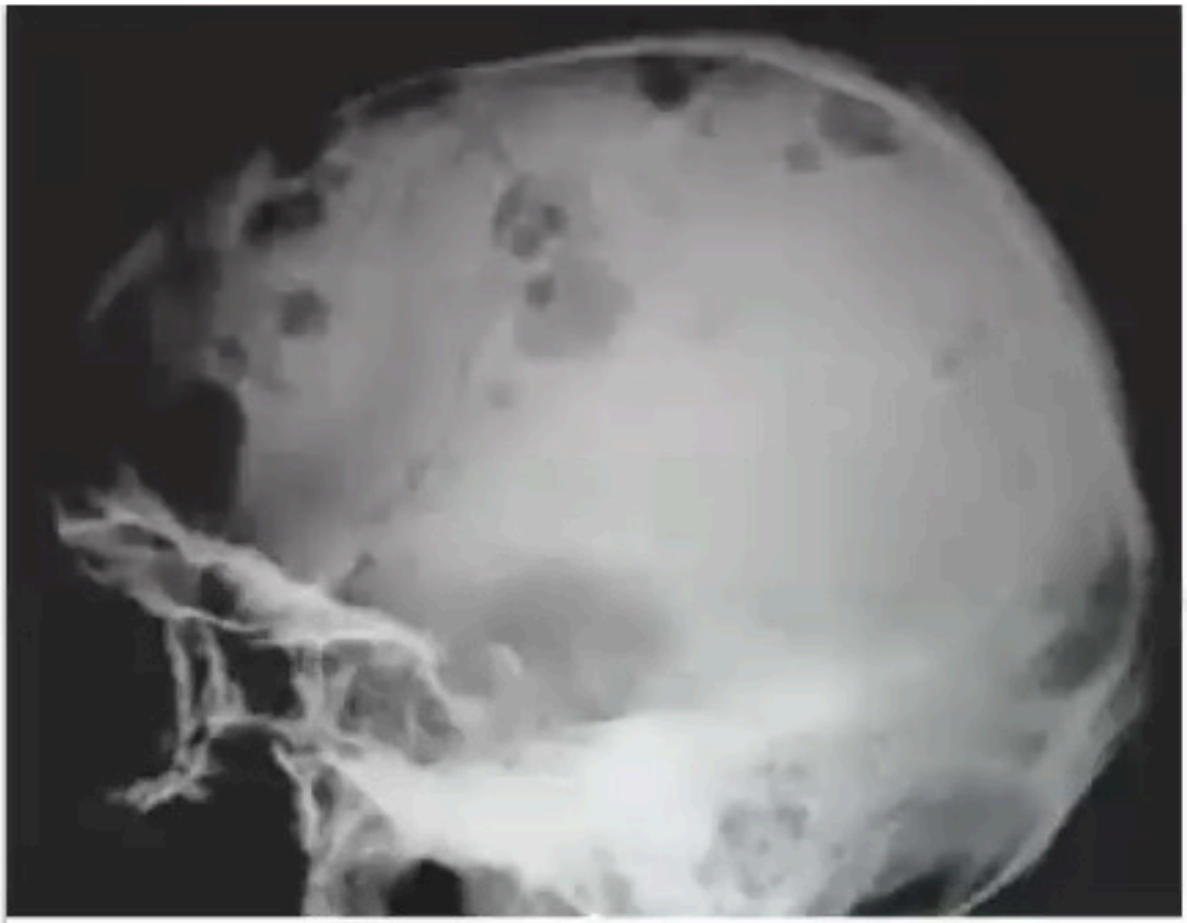
Submentovertex





Indications:

- Leasion of palate
- Sphenoidal sinus
- Fracture os zygomatic arches



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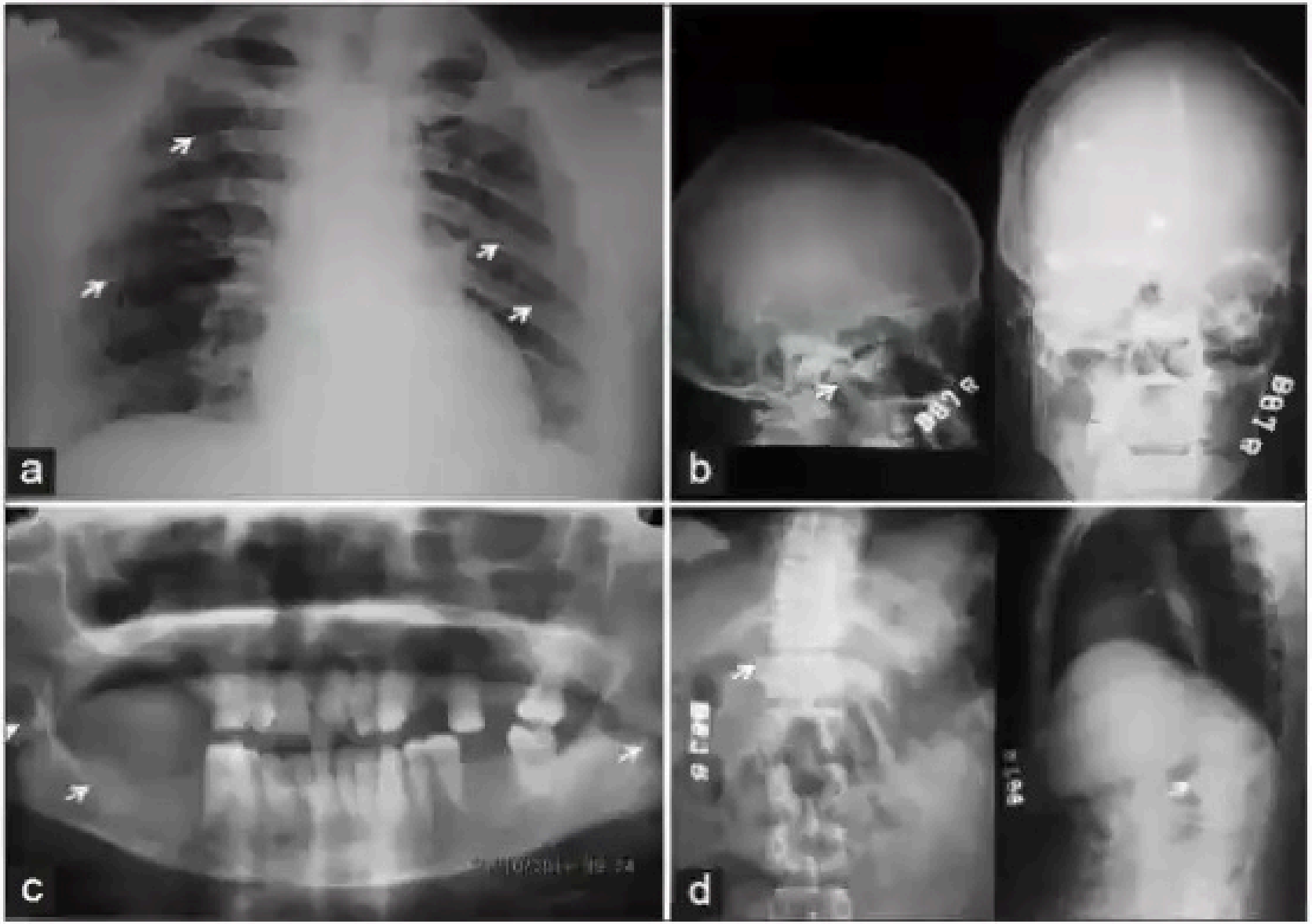


3.

4.

5.

COMPUTED TOMOGRAPHY

Indications-

The diagnosis and extent of

- Variety of infections
- Osteomyelitis
- Cysts
- Benign and malignant tumors
- Trauma in the maxillofacial region
- Lesions involving the bone
- 3D CT has been applied to trauma and craniofacial reconstructive surgery and used for treatment of congenital and acquired deformities.

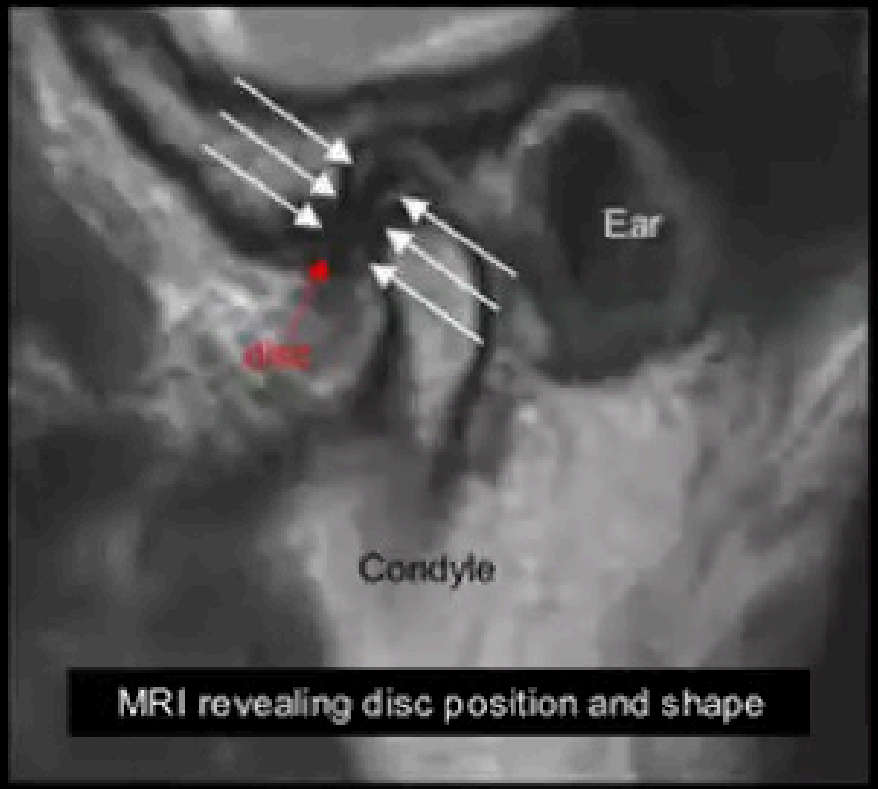
6.

MRI

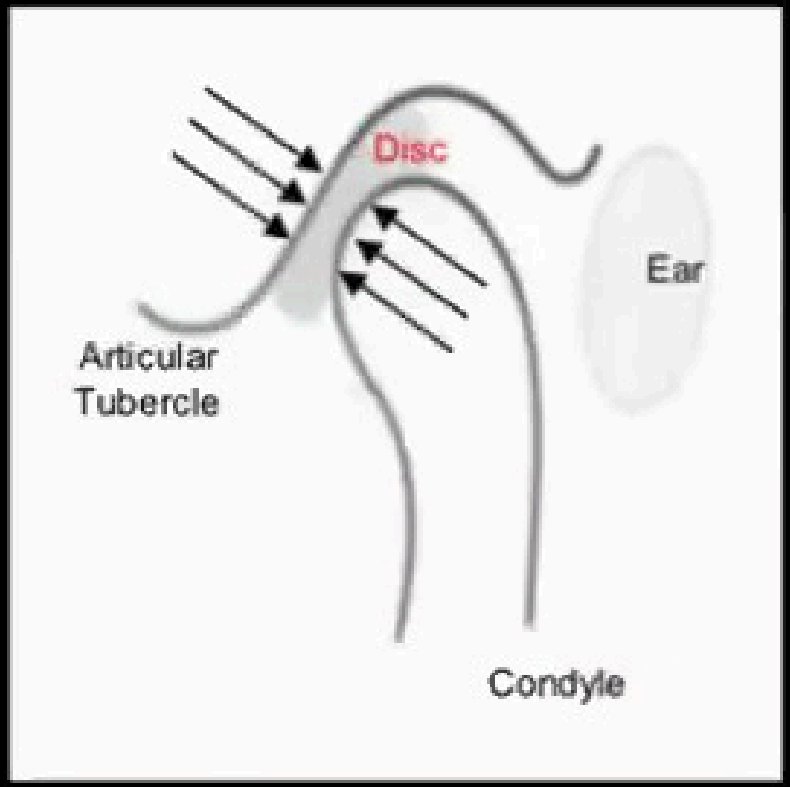
Indications-

- To evaluate the position and integrity of the disk in the TMJ.
- Neoplasia involving the soft tissues, such as tongue, cheek, salivary glands, and neck.
- Determining malignant involvement of lymphnodes.
- Determining perineural invasion by malignant neoplasms.
- With contrast, enhances the image resolution of neoplasia.

The Maintenance of a Functional Disc Position Requires the Application of Force



MRI revealing disc position and shape



During mouth opening and closing, force needs to be directed to keep the disc engaged between the condyle and the posterior slope of the articular tubercle. That force should be directed in an anterior-superior direction based on anatomy.

7.

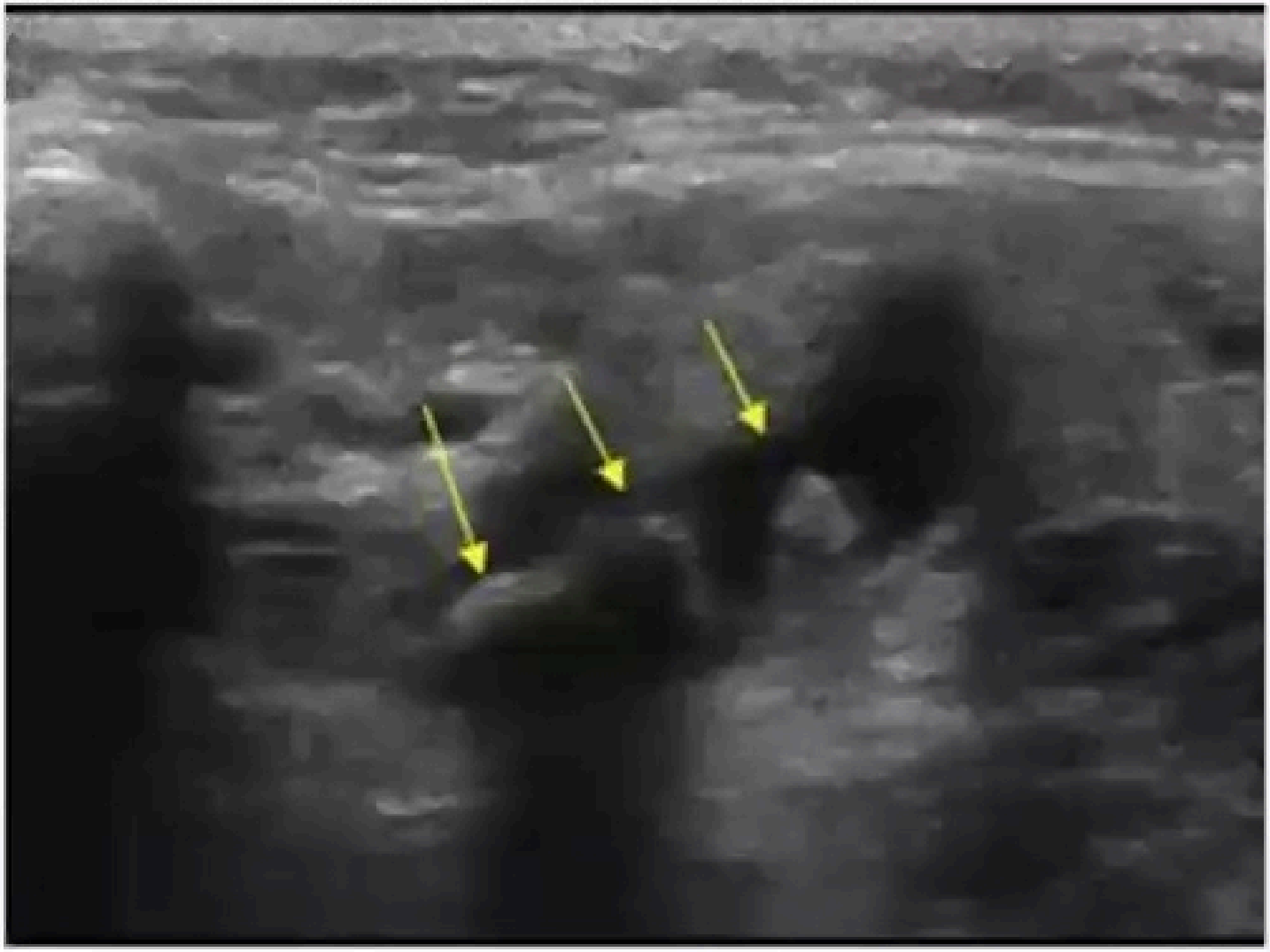
ULTRASONOGRAPHY

Indications-

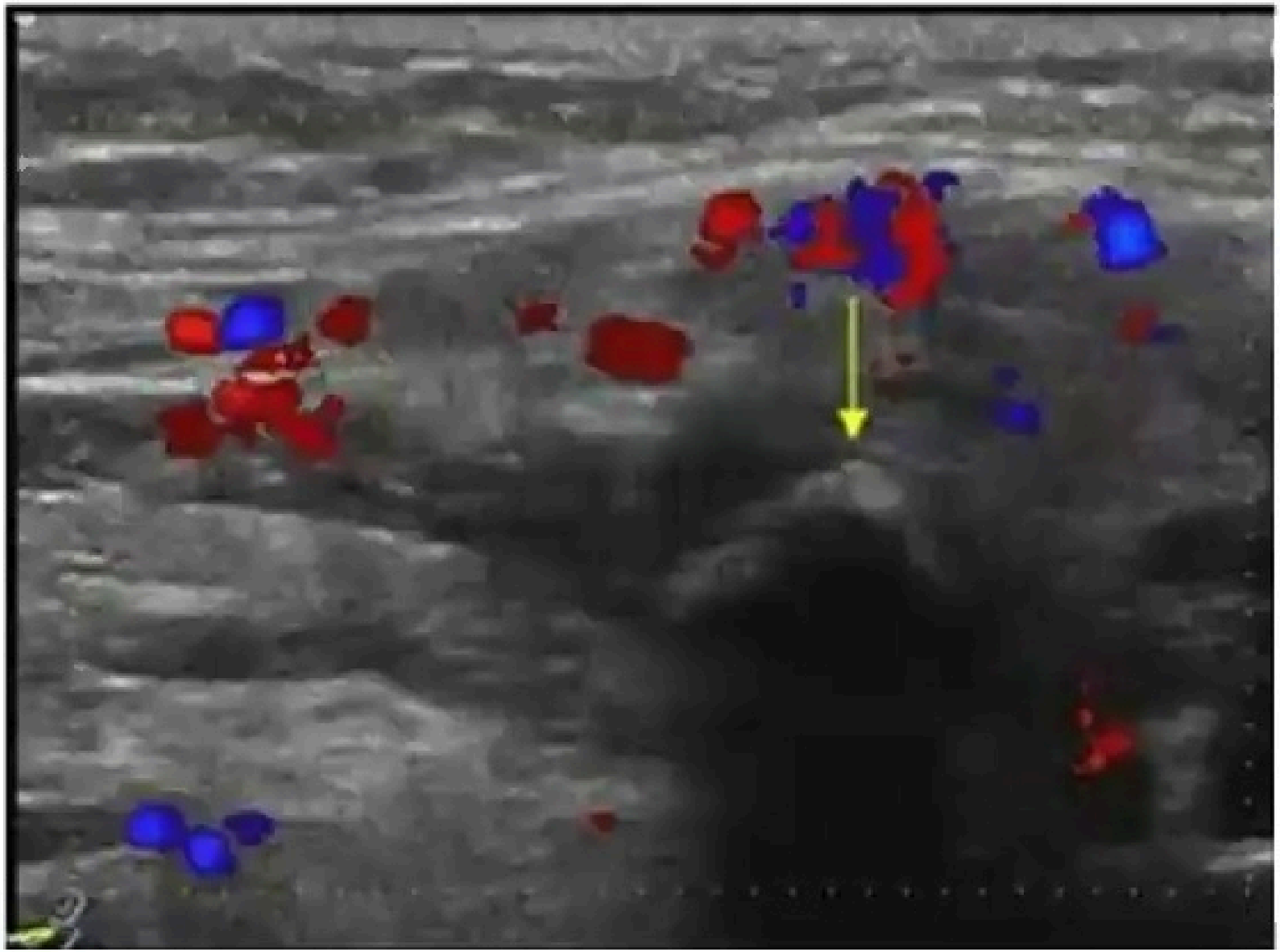
For the evaluation of

- Neoplasms in the thyroid, paathyroid or salivary glands or lymphnodes.
- Stones in salivary glands or ducts
- Vessels of neck
- To guide fine-needle aspiration in the neck

Sialolithiasis and sialadenitis with a swollen hypervascularized submandibular gland and multiple stones in a dilatated Wharton's duct



Stone in the hilum of the gland



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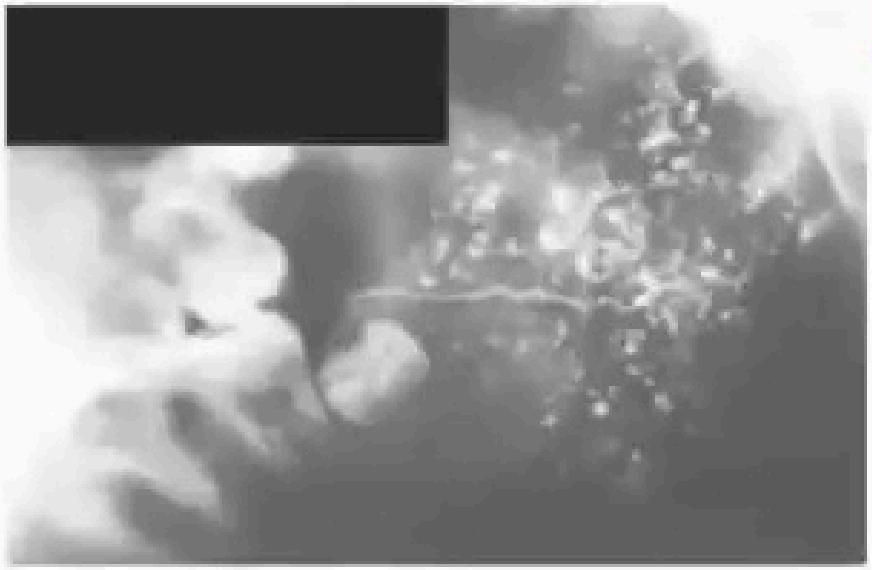
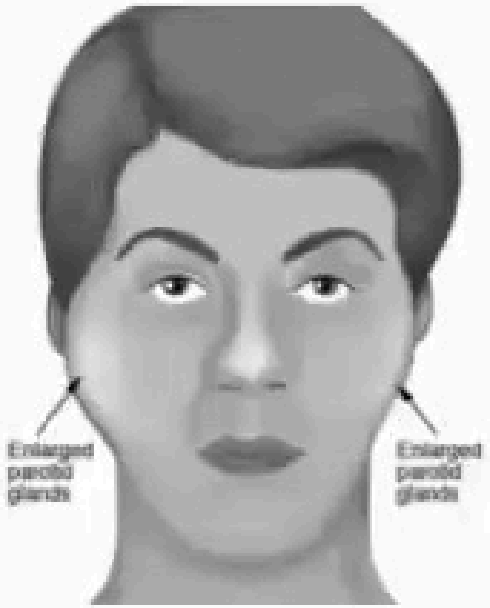
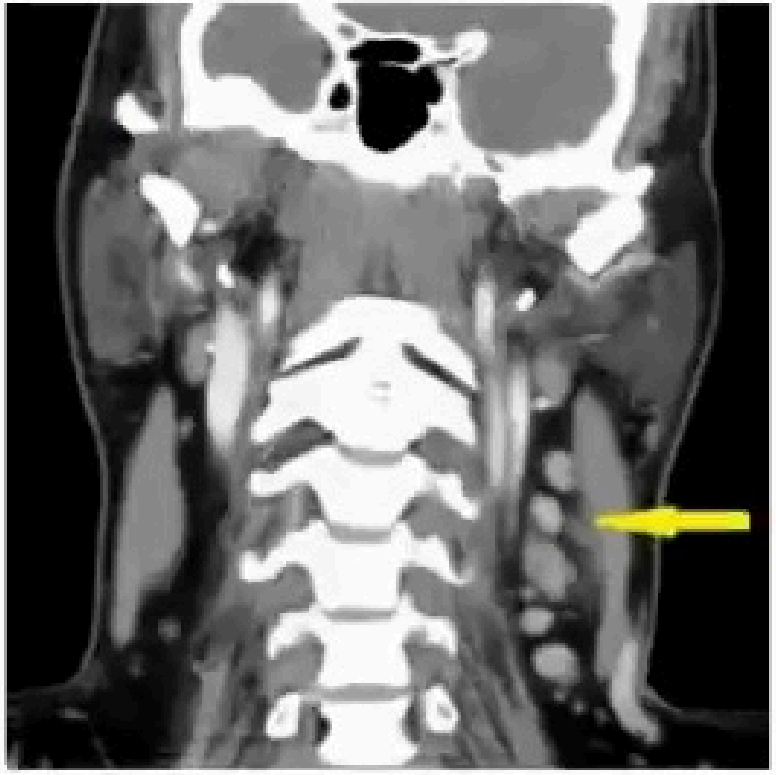
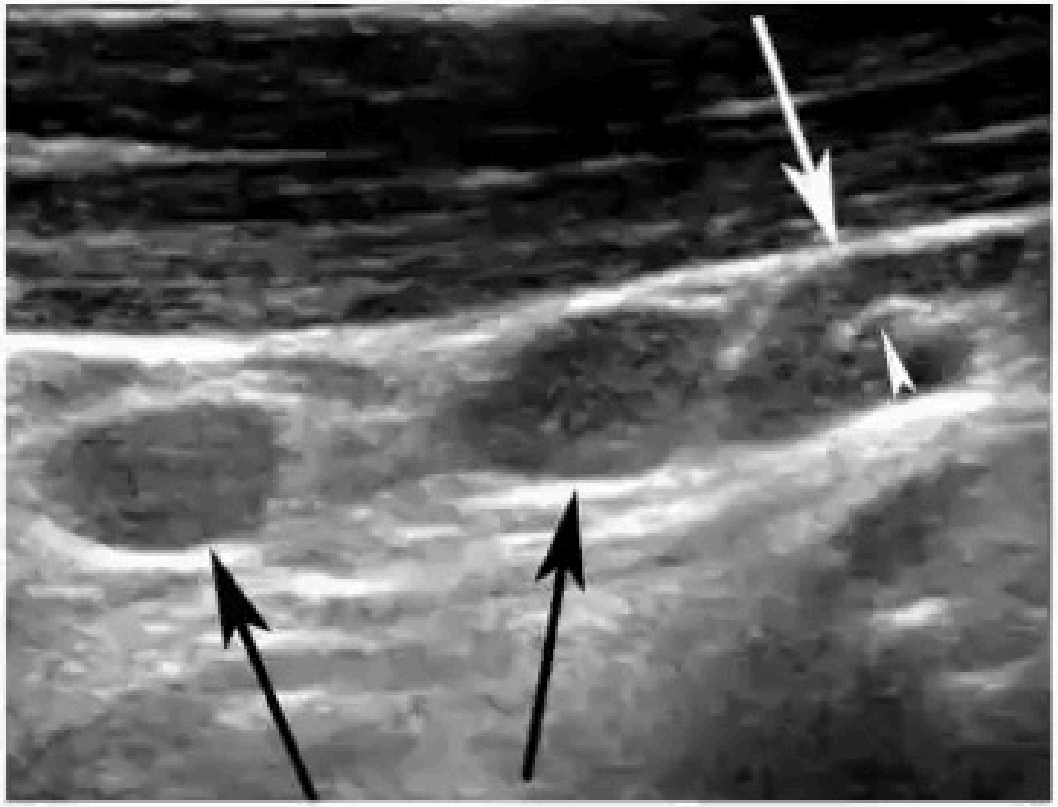



LT Parotid Long


Enlarged parotid glands
Enlarged parotid glands

10.





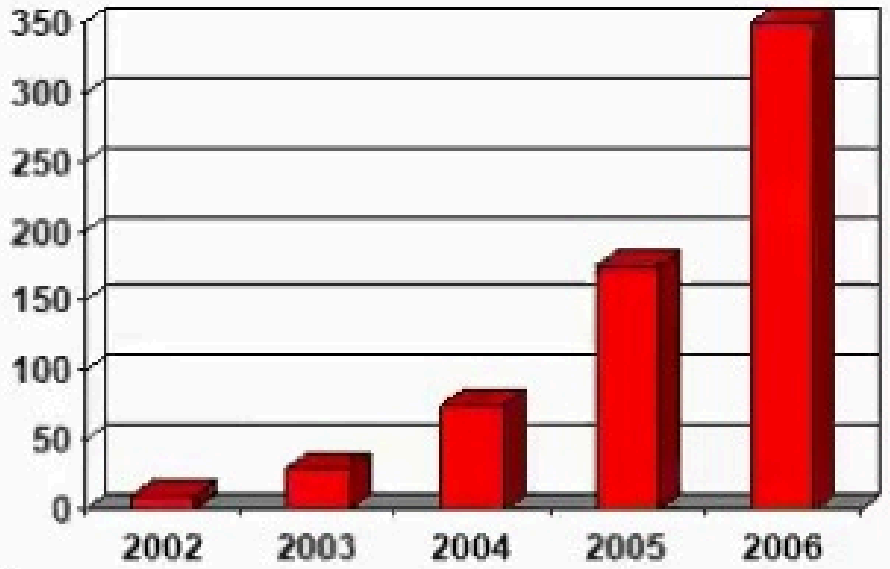
Dental Cone Beam Computed Tomography

(CBCT)

Cone-Beam CT

Introduced to the US in 2000

- 2002 (~10)
- 2003 (~30)
- 2004 (~75)
- 2005 (~175)
- 2006 (~350)



Rapid adoption in dentistry

- Dental Schools
- Dentists, Specialists, Imaging Centers

- Cone-beam computed tomography (CBCT) is a recent technology initially developed for angiography in 1982 and subsequently applied to maxillofacial imaging.

Companies Providing Cone Beam CT Systems

1. AFP **Newtom**
2. Hitachi : **Mercuray**
3. Image Science International / Danaher: **ICAT**
4. Imtec / Kodak : **Iluma**
5. Morita: **Accuitomo**
6. Planmeca: **ProMax 3D**
7. Sirona: **Galileos**
8. Vatech : **DCT& VCT**
9. Yoshida /Terarecon: **FineCube**

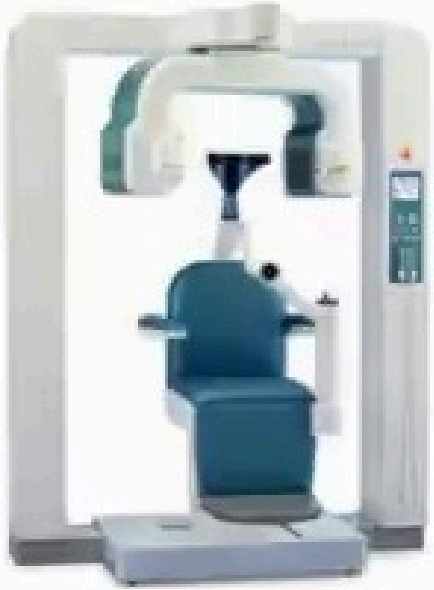
Cone Beam Maxillofacial Imaging Systems

Imaging Sciences Int'l - I-Cat

Imtec Imaging - Iluma

Vatech - DCT

Hitachi - CB MercuRay



J. Morita - 3D Accuitomo

Yoshida/Terarecon - FineCube

Cone Beam Maxillofacial Imaging Systems

Vatech - VCT

Newtom - 3G Scanner

Planmeca – Promax 3D

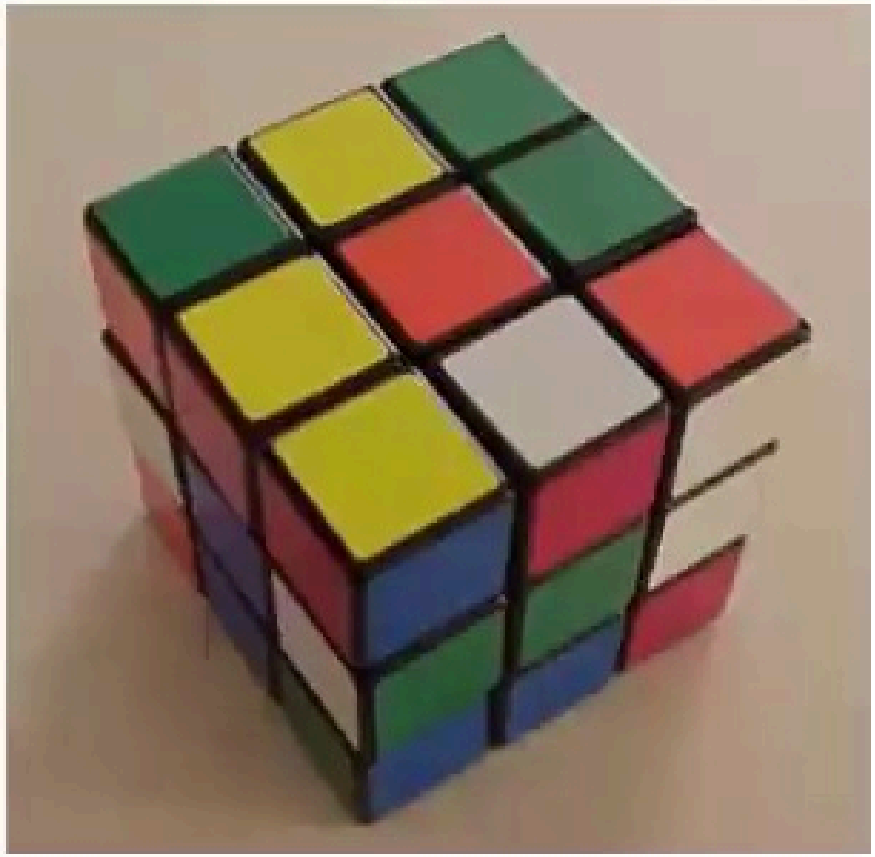
Sirona - Galileos

A voxel is the smallest distinguishable box-shaped part of a 3-D image. The term voxel is short for volume pixel.

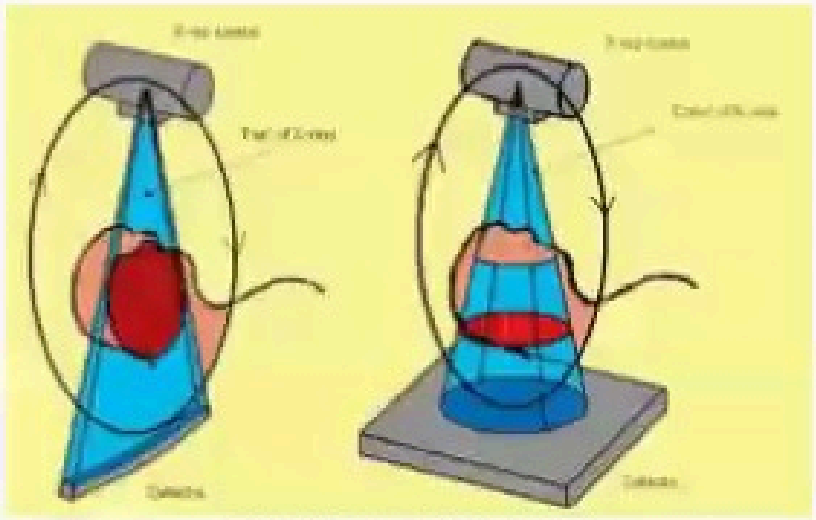
Voxels serve as the building blocks of 3-D imaging such as dots per inch (dpi) in the computer industry

The distance between any two pixels is called inter-pixel distance and this represents real-world distance

As an image is taken, it is presented in “slices” to represent vertical & horizontal depth

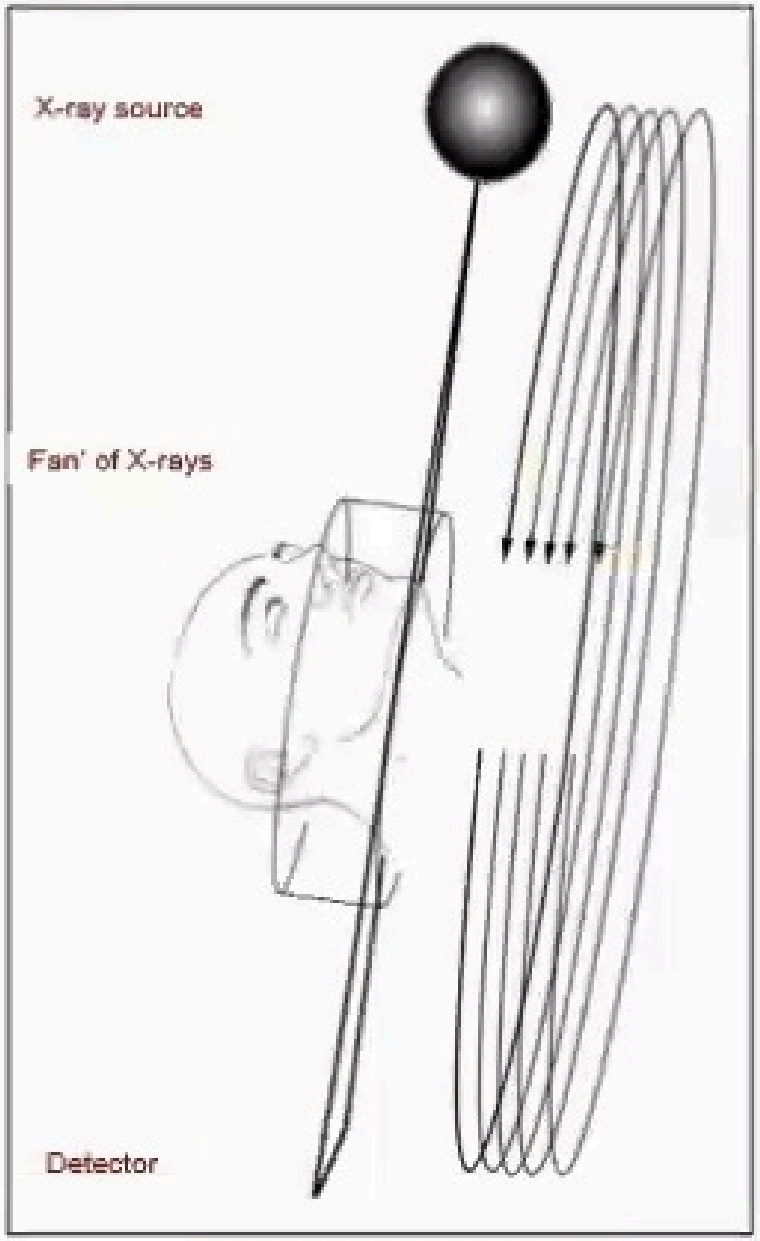


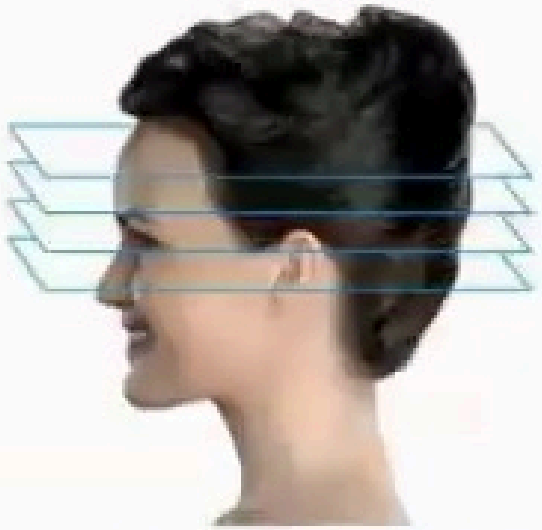
C B C T versus Medical C T



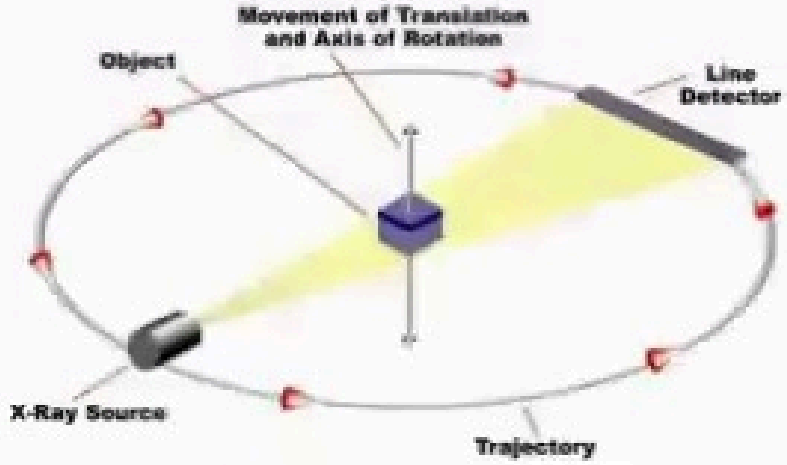
- Med CT
  - Conventional linear fan beam
  - Single row or a series (4, 8, 12, 32, 64) of solid state detectors
  - Provides a set of consecutive slices of the patient
- CBCT
  - Cone beam
  - Square 2 dimensional array of detectors
  - Provides a volume of data

CONVENTIONAL CT

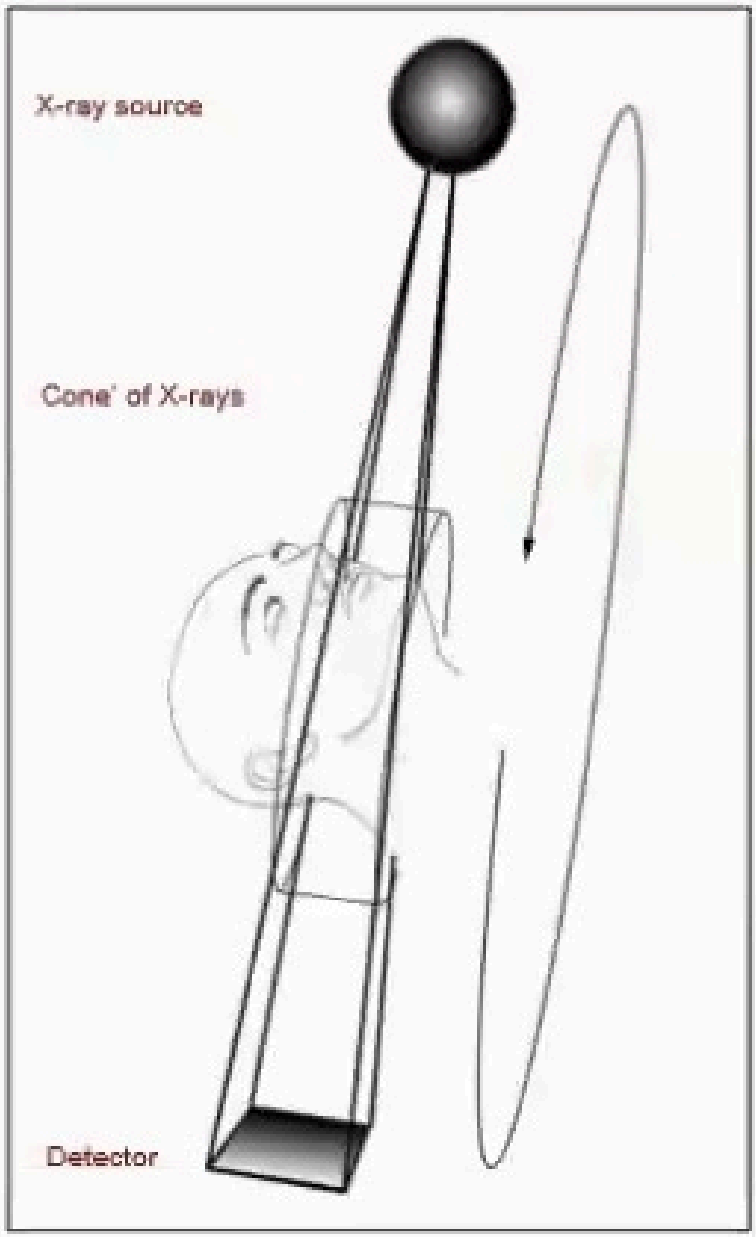


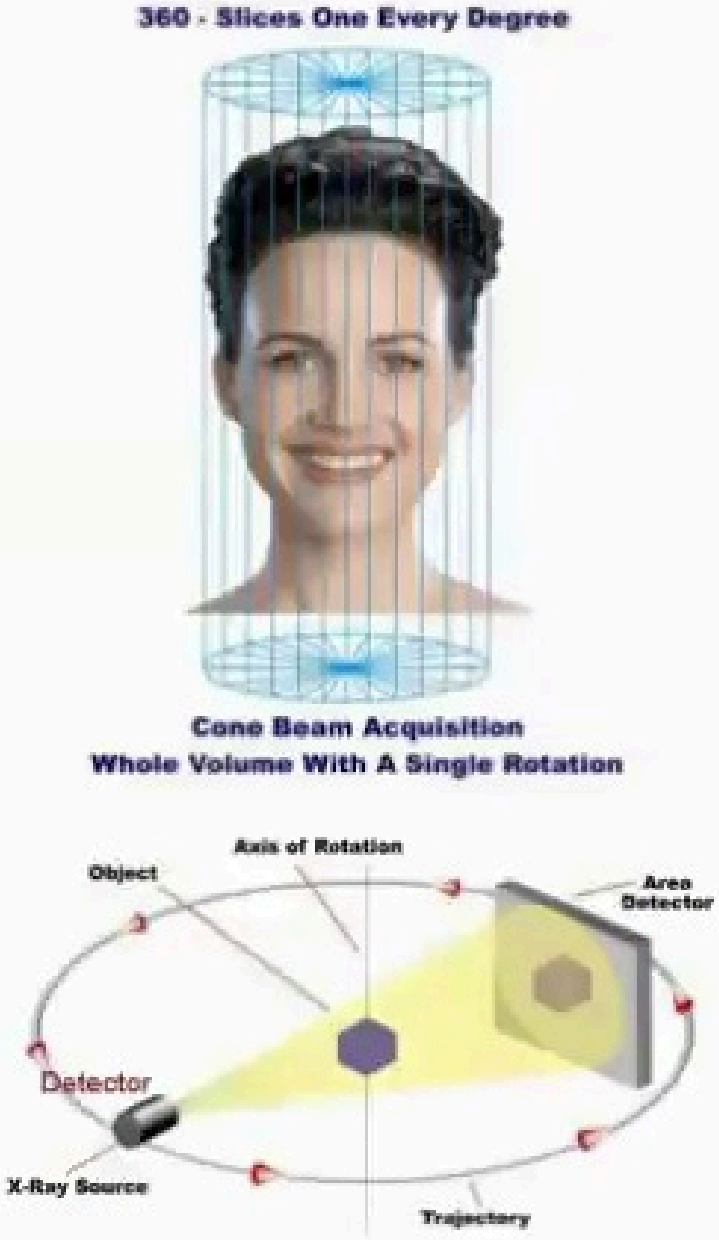


Cat Scan Acquisition
One Slice Every Rotation



CBCT/CBVT

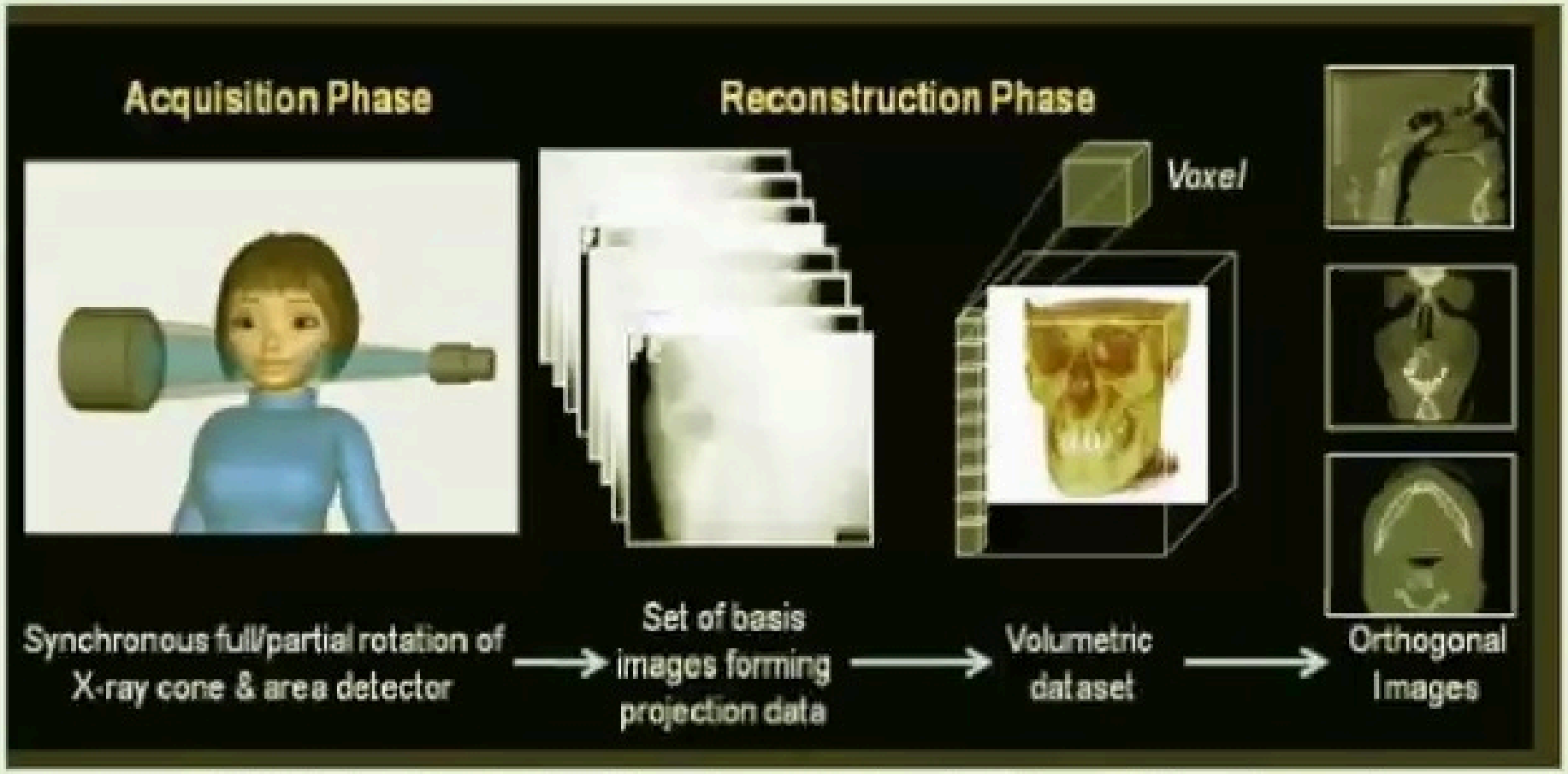

X-ray source
Cone' of X-rays
Detector


360 - Slices One Every Degree
Cone Beam Acquisition
Whole Volume With A Single Rotation
Axis of Rotation
Object
Area Detector
Detector
X-Ray Source
Trajectory

X-Ray C Arm rotates 360 degrees around imaging area and x-rays are accurately detected

How the image acquisition occurs?

FIGURE 1: THE MECHANICS OF CBCT ACQUISITION

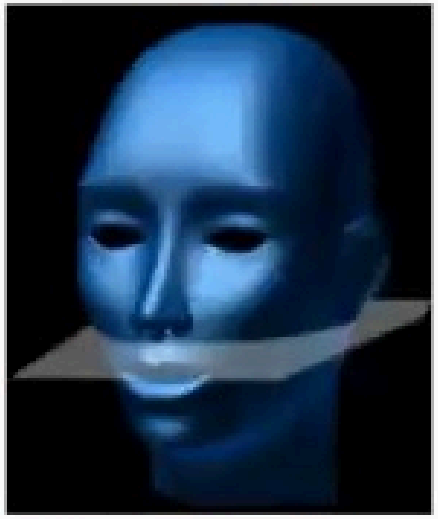


Multiple basis projections form the projection data from which orthogonal planar images are secondarily reconstructed in cone beam geometry.

CBCT

- **End Result**
  - 3-D visualization of the oral and maxillofacial complex from any plane
  - A stack of 360 images or exposures compiled into a volumetric dataset through a computer process known as primary reconstruction
  - This data volume is then converted into a patient-study by accompanying software
  - Can be visualized as
    - 2D trans-axial, multi-planar reformatted
    - 3D techniques such as surface reconstruction and volume rendering
    - A combination of 2D and 3D techniques

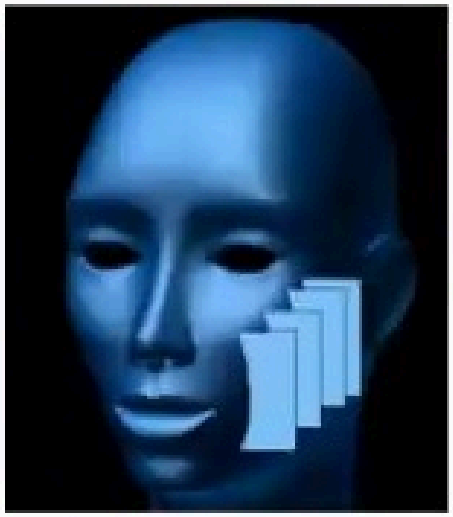
CBCT Reference Planes



Axial

Sagittal

Coronal

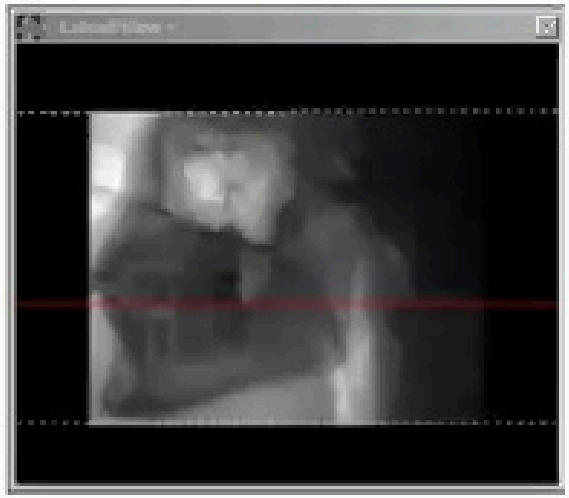


Transaxial

Axial Plane

(Transverse)

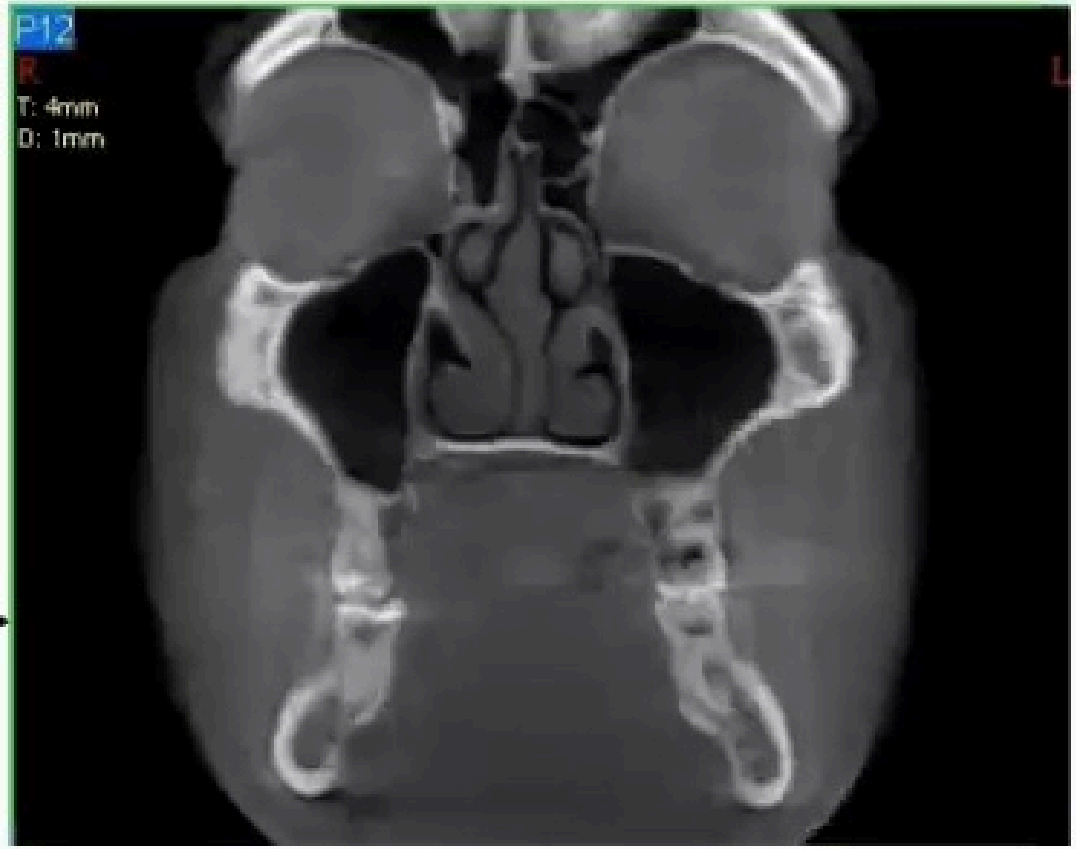
This is an Axial image..



...that represents this area of anatomy

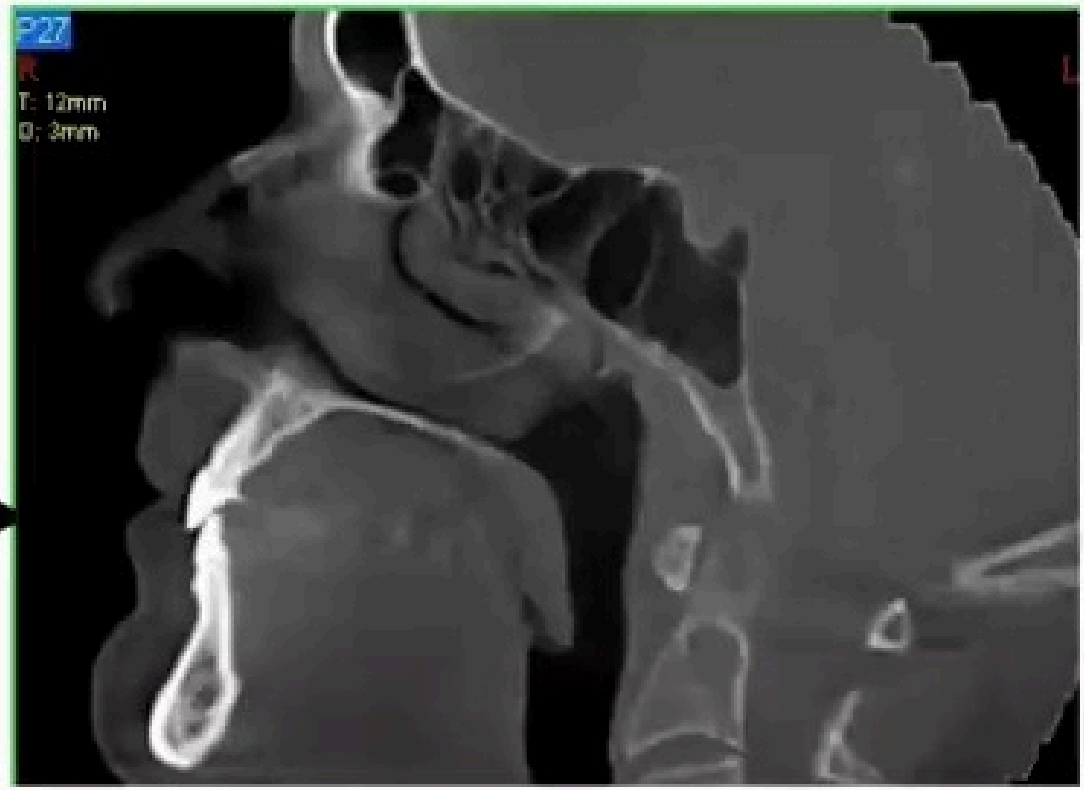
Coronal Plane

Coronal Plane slices through the anatomy from side to side.

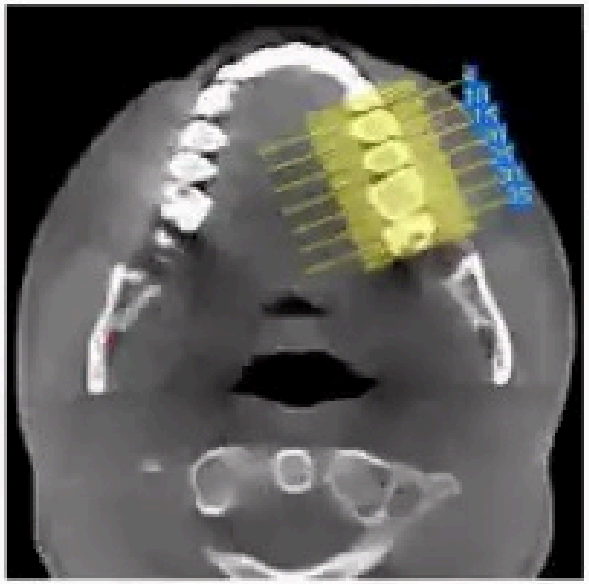


Sagittal Plane

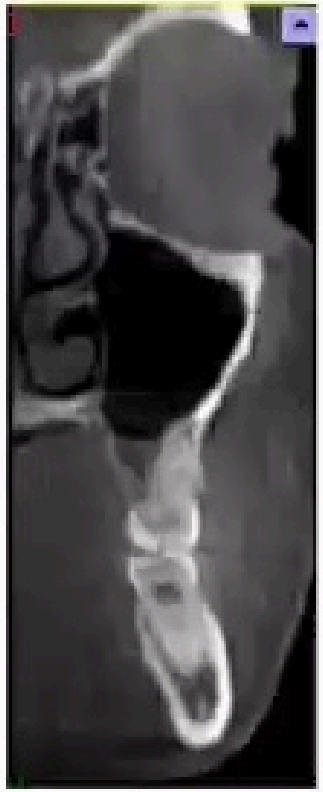
Sagittal Plane is a slice through the anatomy from front to back

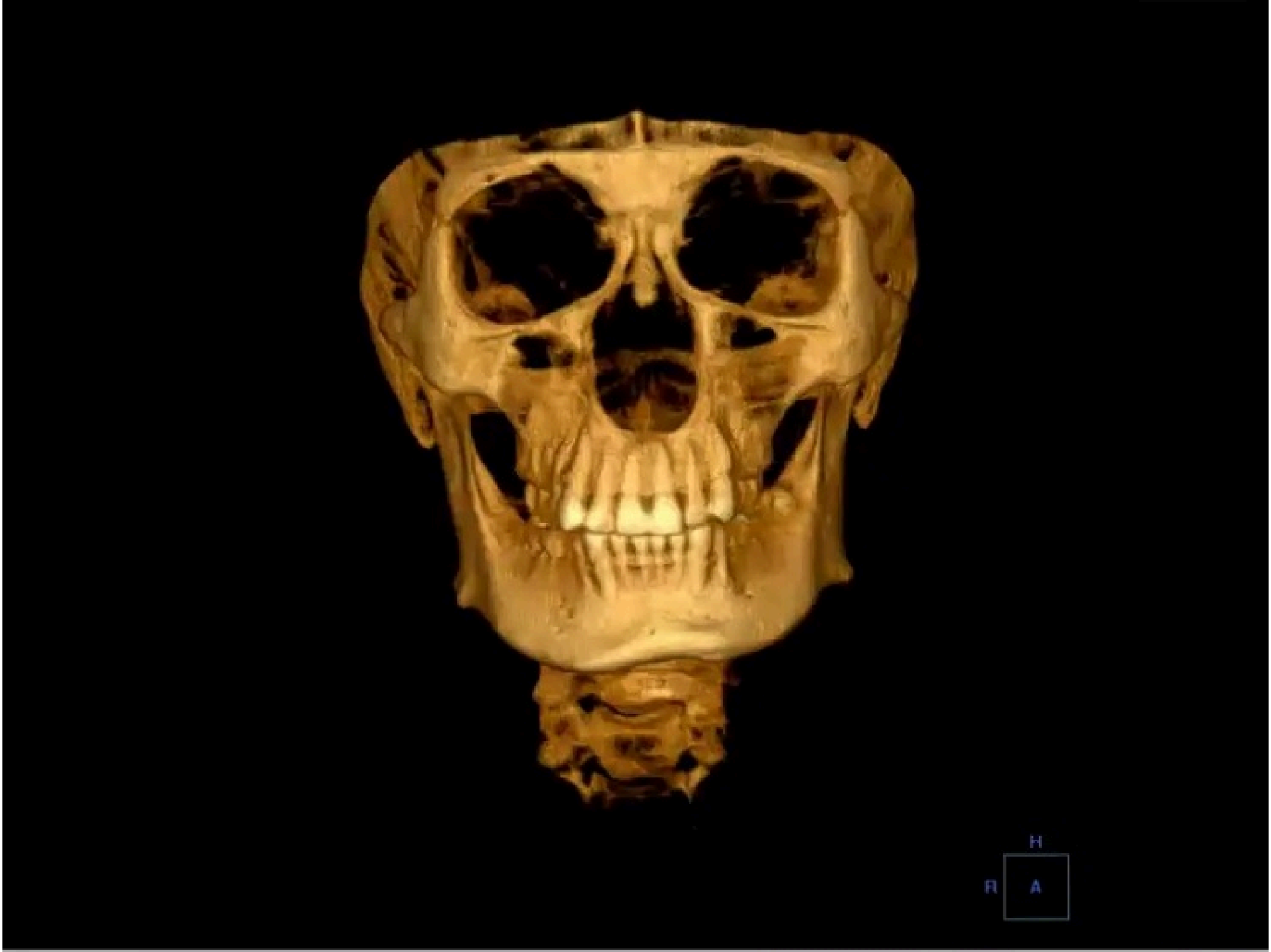


Series of Cross-Sectionals/Transaxials



Cross sectional images of an area can be developed with .5 to 5mm spacing between images.

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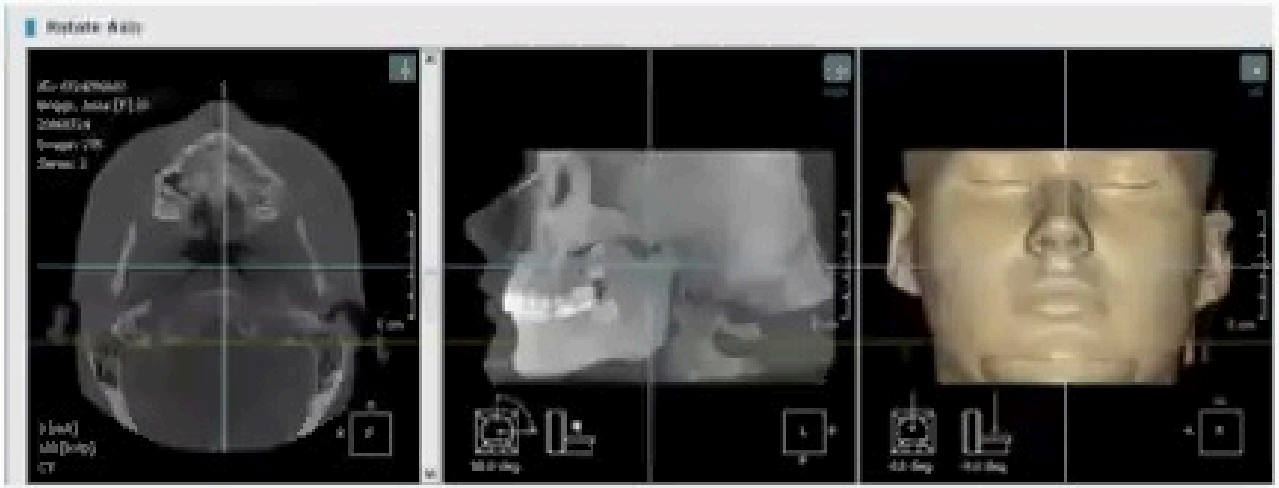
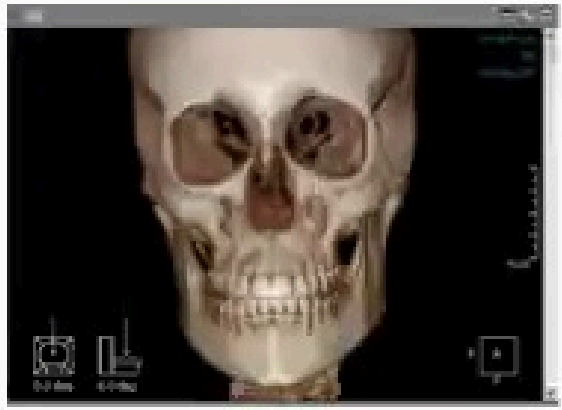
Clinical Applications of CBCT

- Dental Implant Planning & Guidance
- Temporomandibular Evaluation
- Pre-surgical Assessment
- Impacted Teeth
- Reconstructive
- Airway Assessment
- Orthodontic Assessment
- Periodontics
- Endodontics
- Pathology





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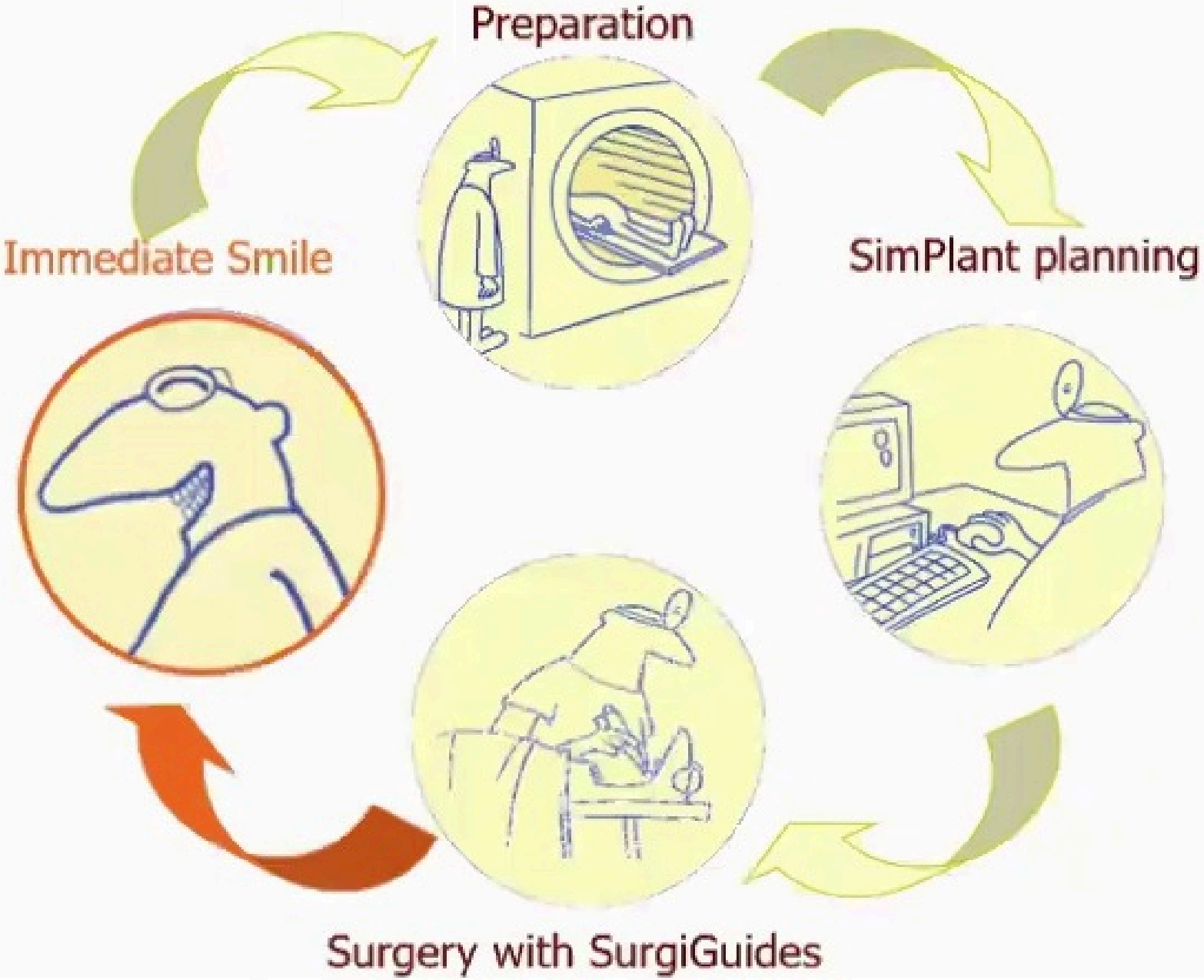
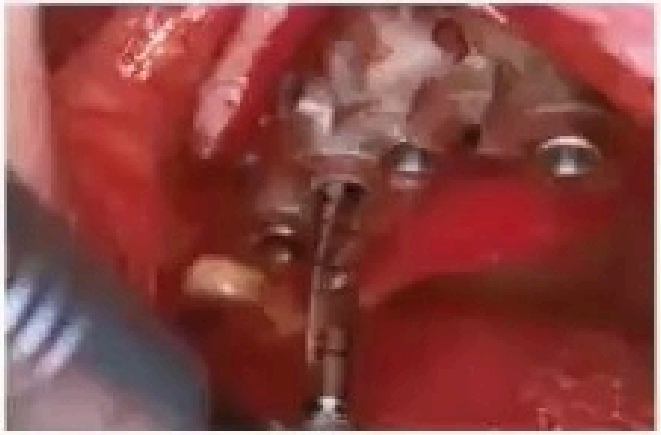
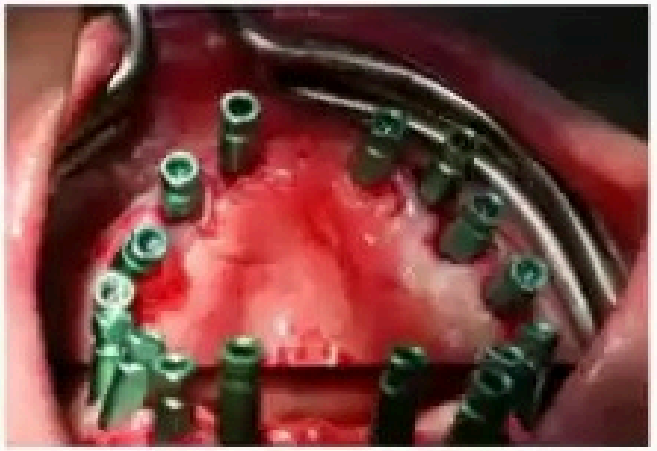
Clinical Applications of CBCT -Dental Implants



Clinical Applications of CBCT -Dental Implants





Clinical Applications of CBCT -Dental Implants

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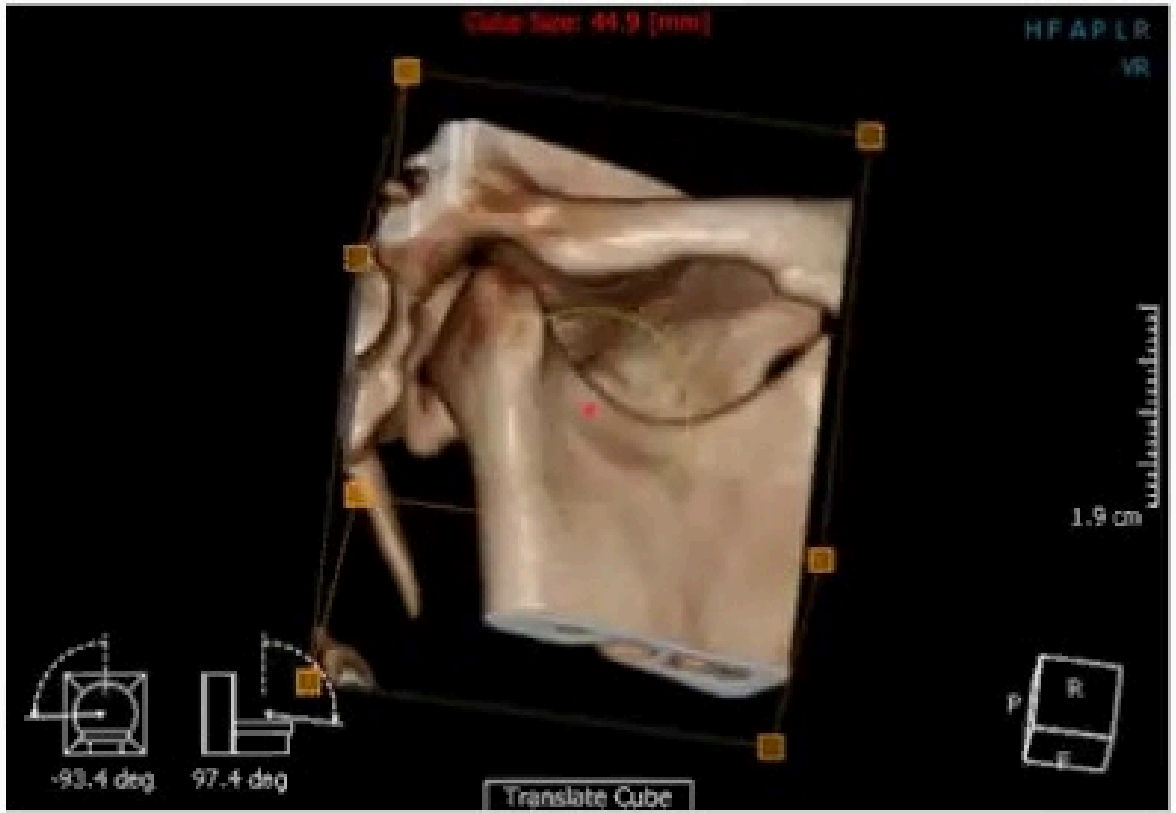
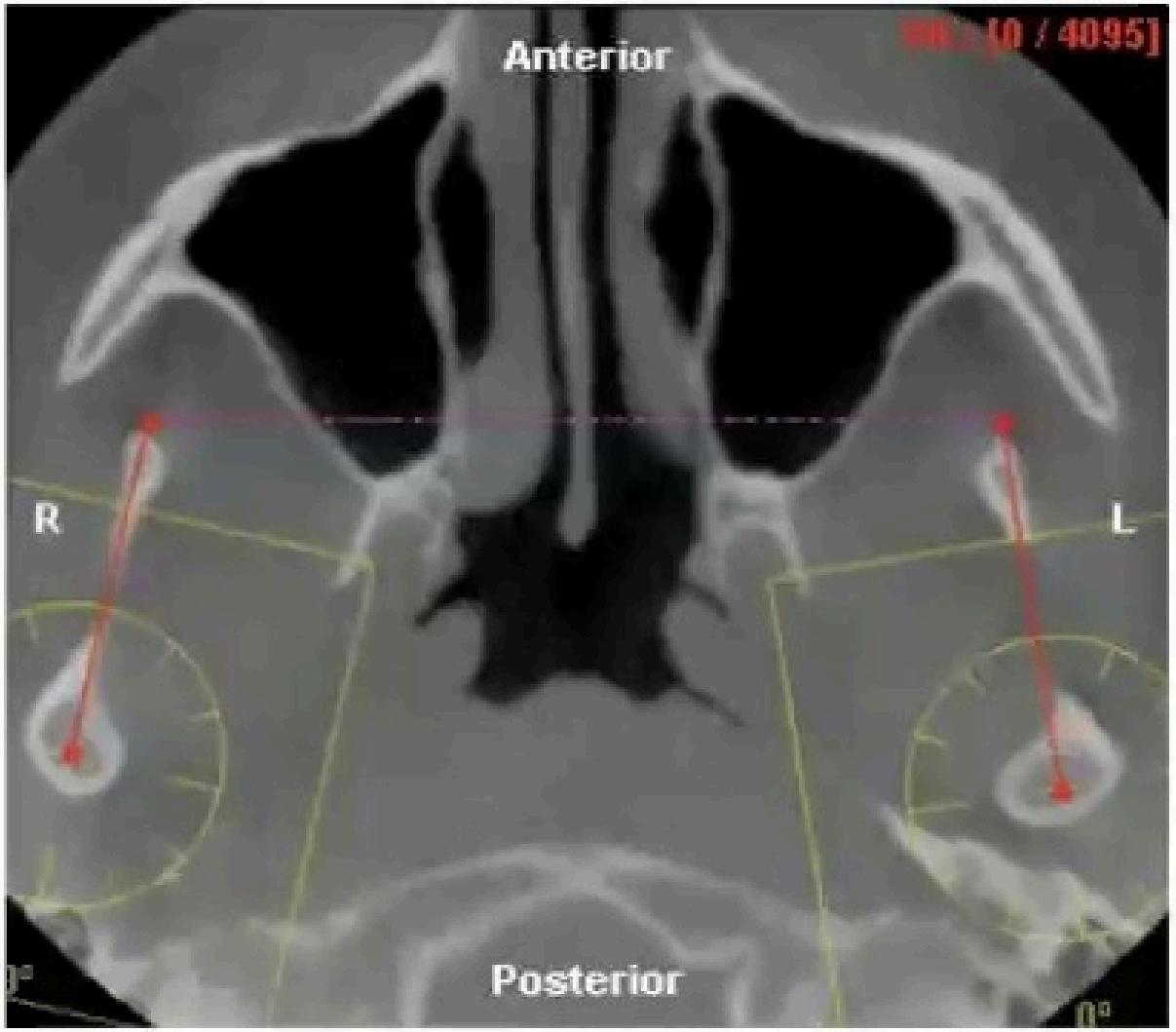


CBCT TMJ view



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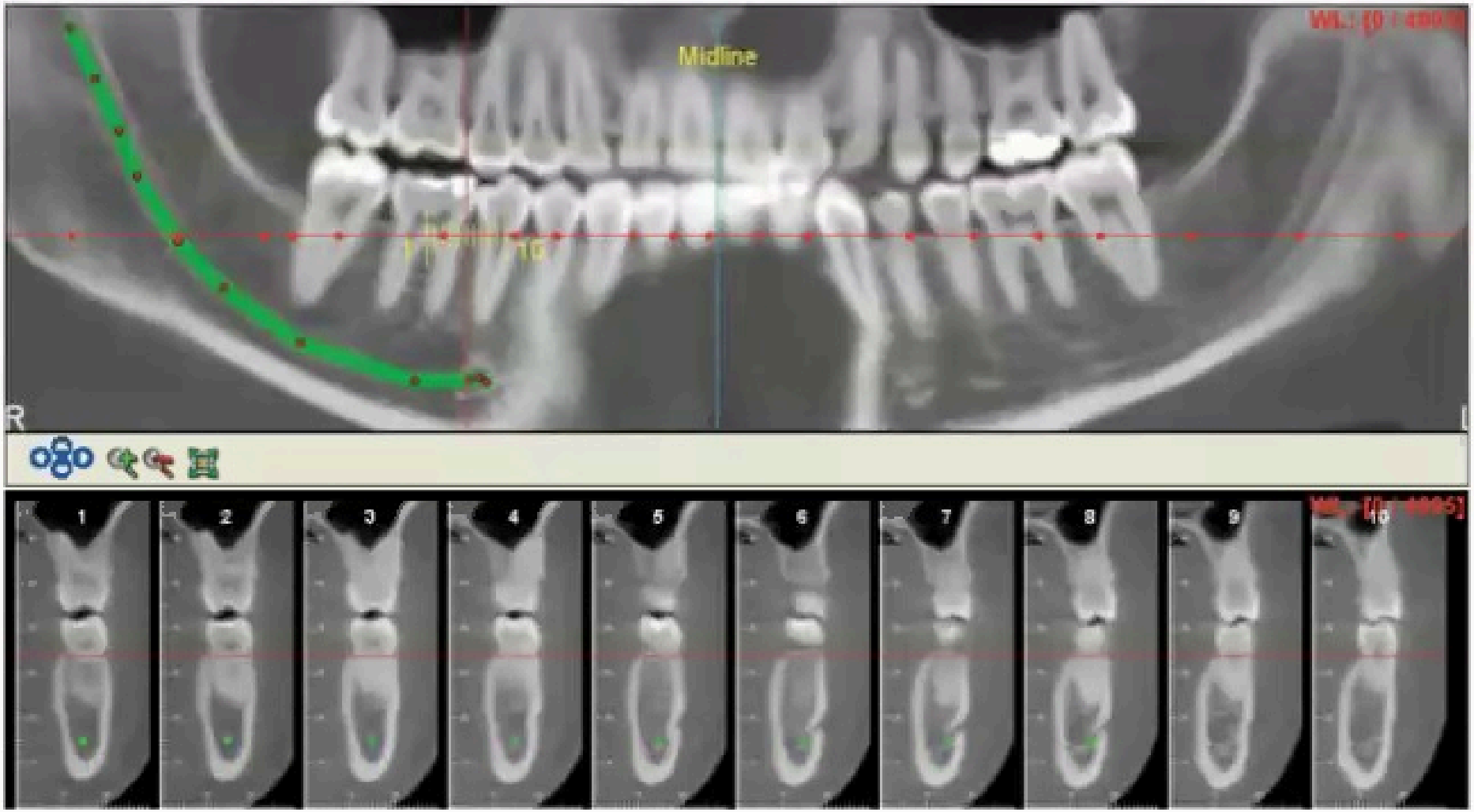
C B C T

Nerve Mapping



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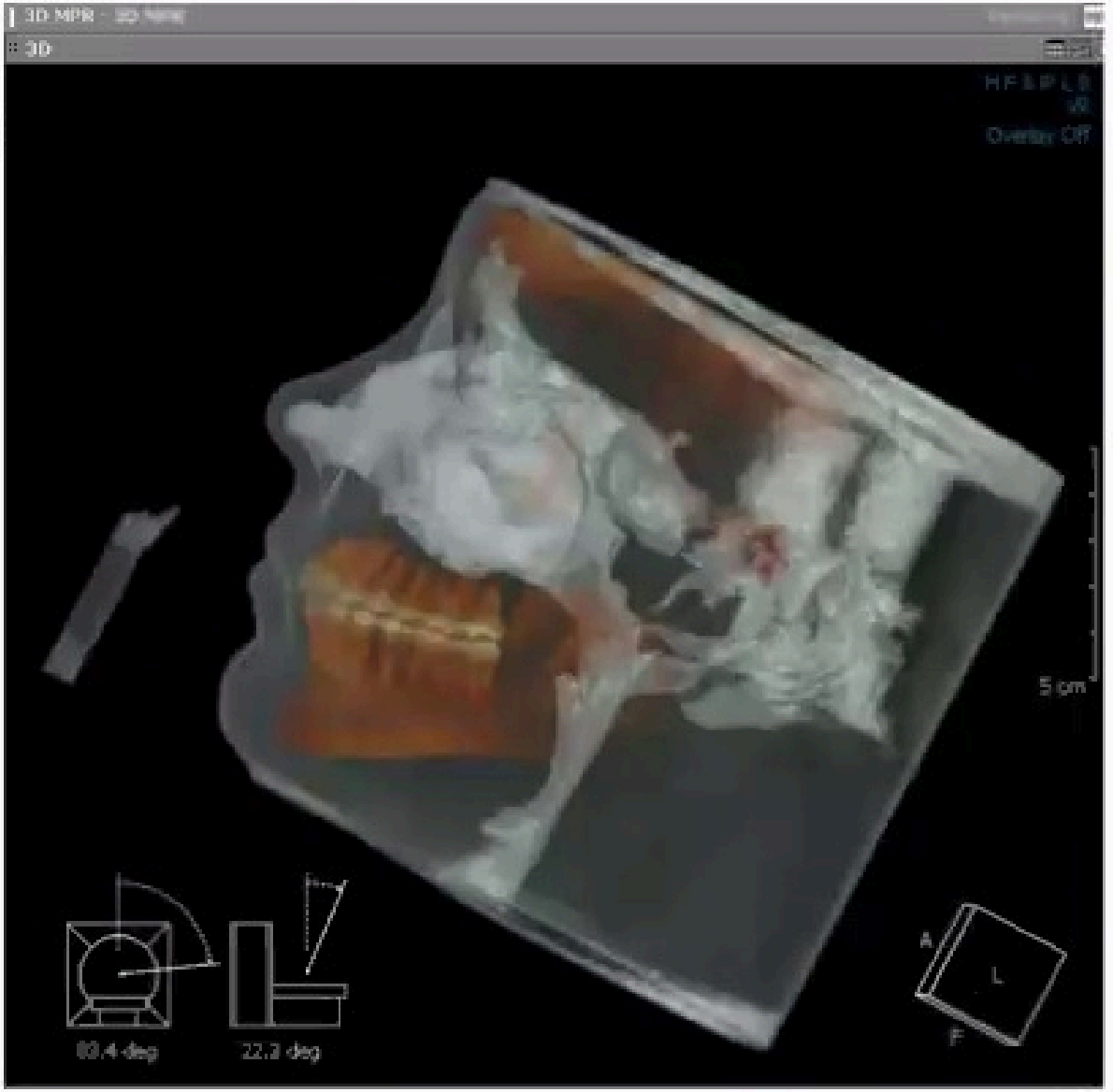

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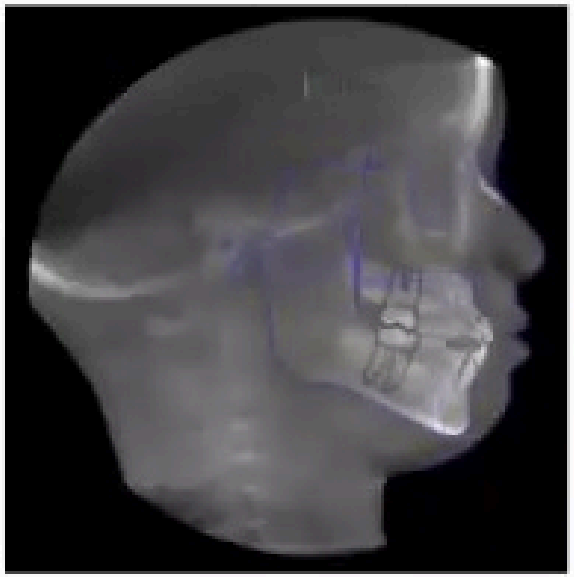
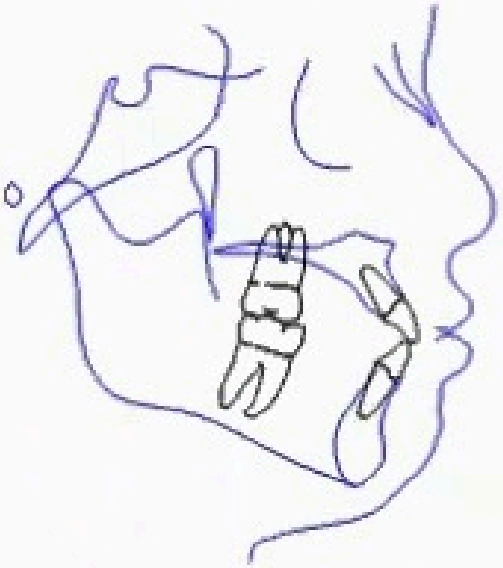
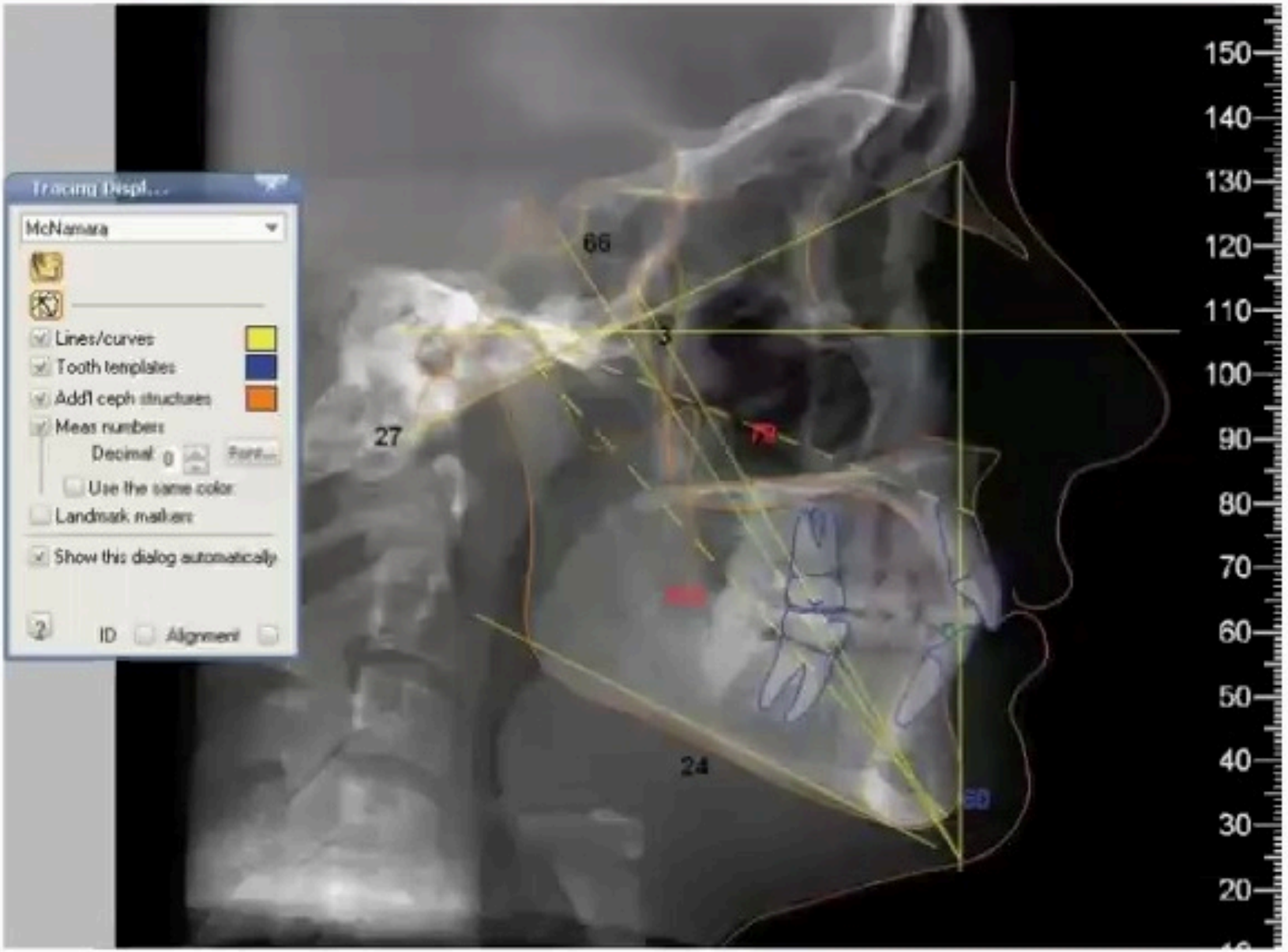




C B C T - ORTHO

Ceph Tracing



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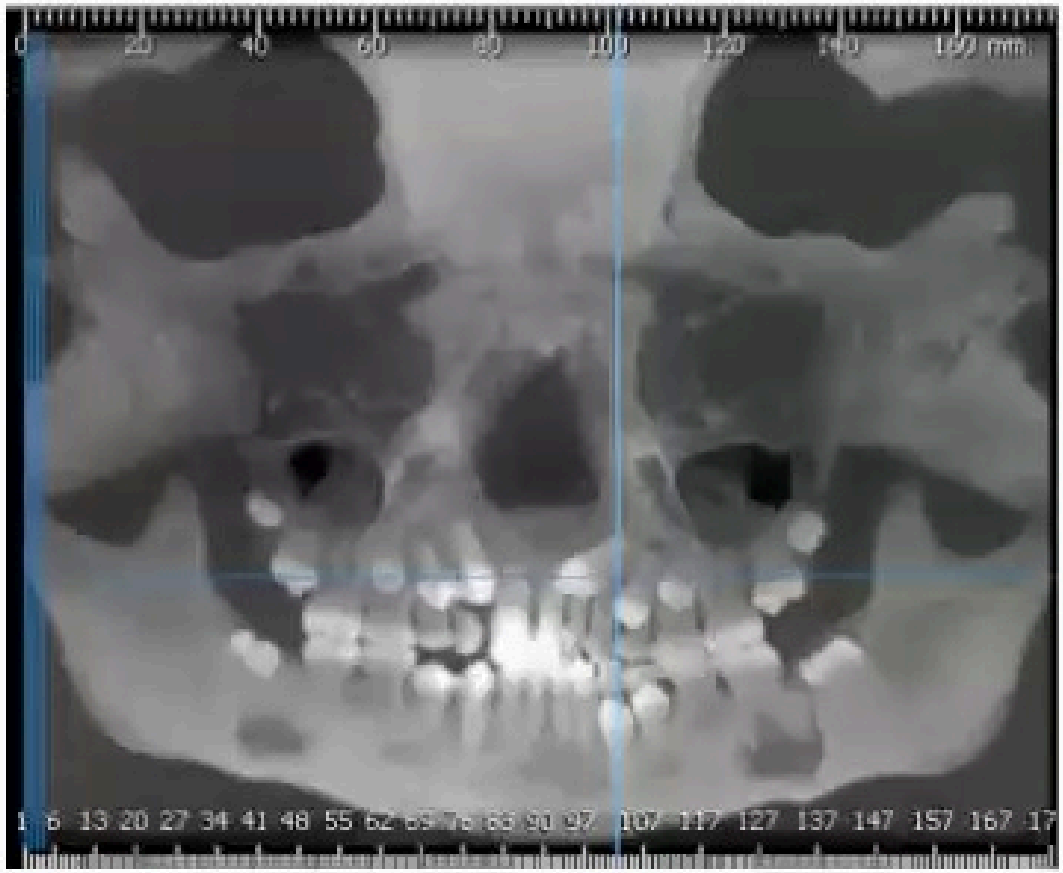
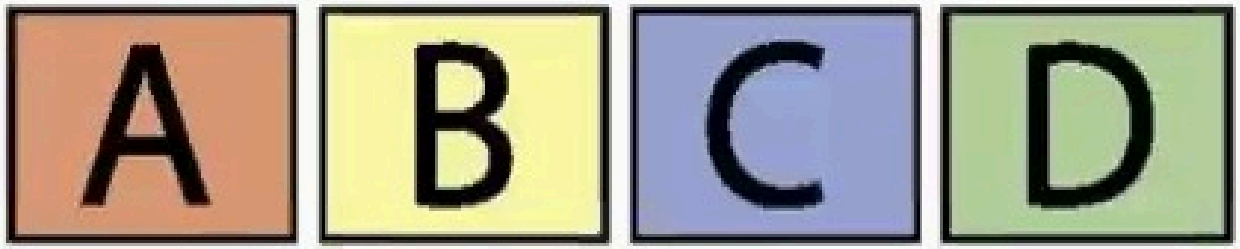
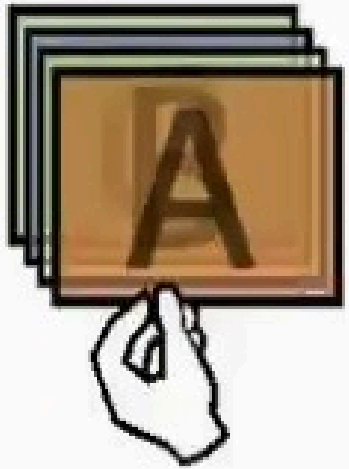
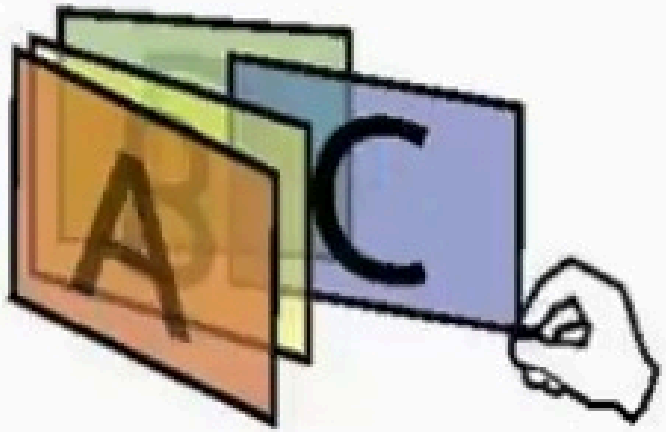


3D Volumetric Imaging vs. 2D Panoramic Imaging







With 2D imaging, the letters are superimposed making it difficult to make out detail.

With Volumetric imaging, it is like removing a particular pane (slice) to examine it clearly and accurately.

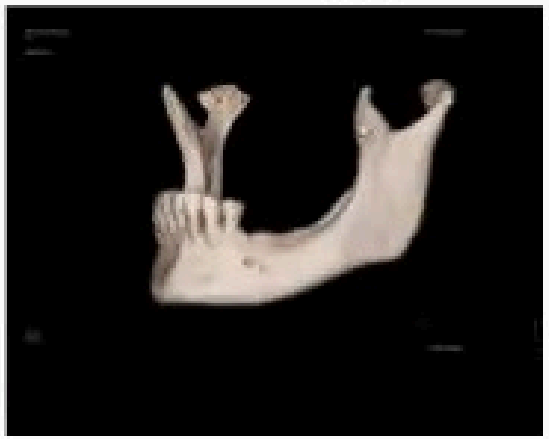
Radiation Doses for Orthognathic Imaging*

Sharon L. Brooks, DDS, MS Diplomate, American Board of Oral & Maxillofacial Radiology

Examination	E μSv (w/o sal gl)	E μ Sv (w sal gl)
Panoramic (film)	4.0-10.0	9.0-16.4
Panoramic (digital)	2.4-6.2	5.5-22.0
Panoramic	2.9-9.6	
Cephalometric (film)	2.3	
Cephalometric (digital)	1.6-1.7	2.2-3.4
CBCT (full FOV) NewTom 3G Mercuray I-CAT	 43.1 950.3 68.7	 56.5 1116.1 101.5
Conventional CT	42-657	
Background Radiation	3mSv/yr, ~8 μSv/day	

*references available on request

Advantages of Cone Beam Technology:



ADVANTAGES-

- Lower dose than helical
- Compact design
- Superior images to Panoramic
- Low cost
- Low heat load
- High speed scanning (less than 30 secs)

IT PORTRAYS THE ANATOMIC TRUTH !!

Barriers to CBCT Use

DISADVANTAGES-

- Worse low contrast detectability
- Poor soft tissue contrast
- Long scan times = motion artifacts
- Slightly Inferior quality to conventional CT
- Image noise
- Metal artifacts

Better Understanding for Better Choices