CBCT

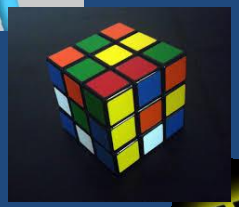
more than a panoramic, less than a panacea

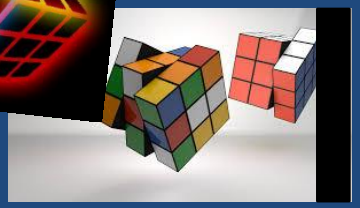
AGD 2015 SAN FRANCISCO

a golden opportunity

June 18 to 21, 2015 Moscone West Convention Center *www.agd2015.org*

Academy of General Dentistry™



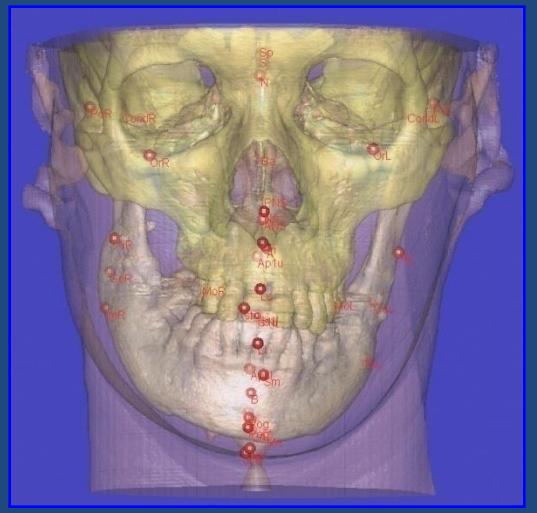


Richard Monahan, DDS, MS

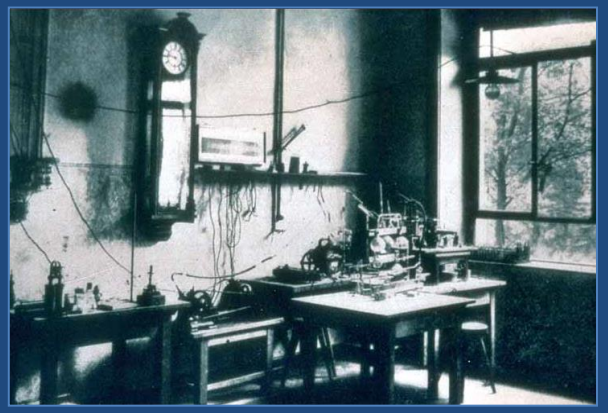
Stated Goals and Objectives

- Recognize the strengths and weaknesses of traditional imaging systems
- Discuss diagnostic yield and radiation dose
- Appreciate the spectrum of advanced imaging modalities
- Understand the advantages and disadvantages of three-dimensional CBCT imaging
- Recognize when 3D imaging will assist the doctor in achieving superior outcomes
- Establish a diagnostic appreciation for maxillofacial - PNS pathology
- Recognize when findings within a CBCT volume necessitate referral

Imaging: the power to dissect

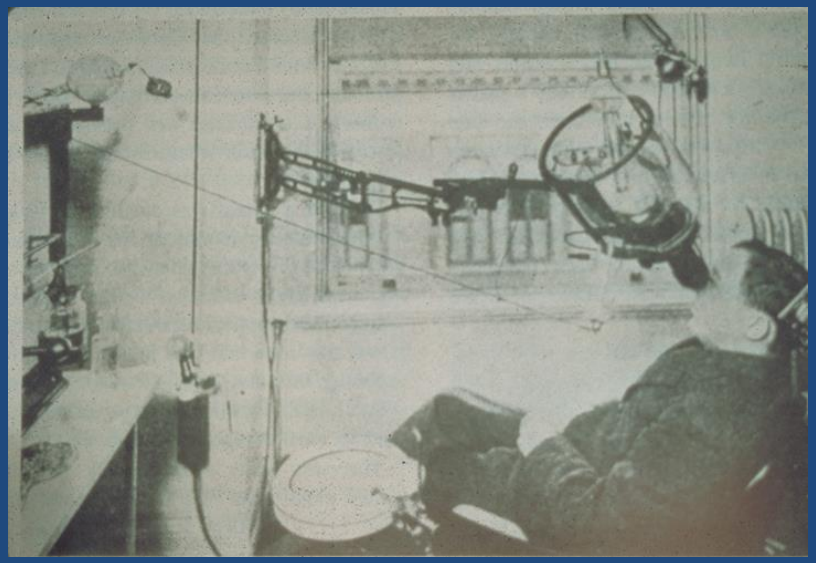


The beginning…

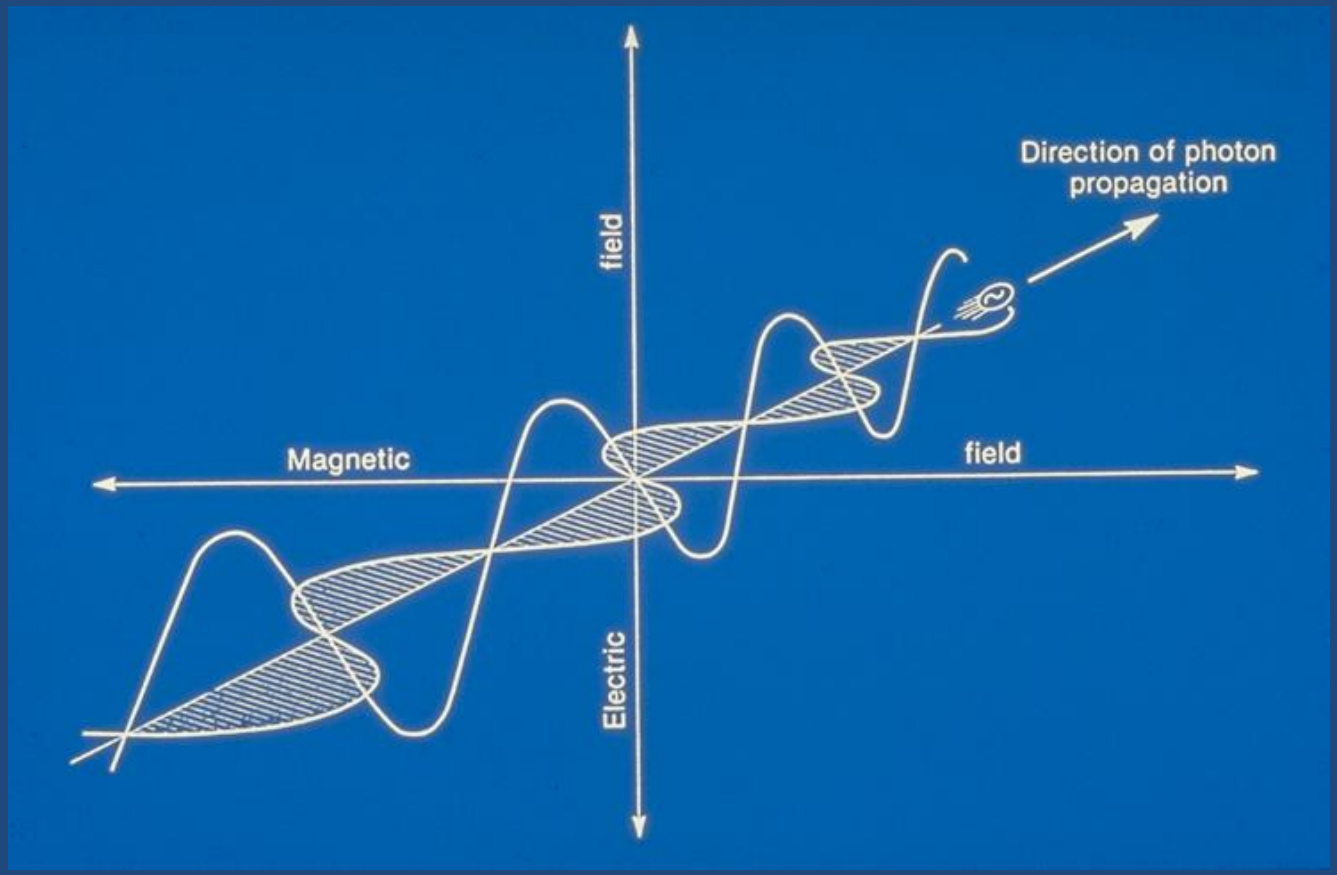


Wilhelm Roentgen

Discovered X-Rays Nov 8, 1895

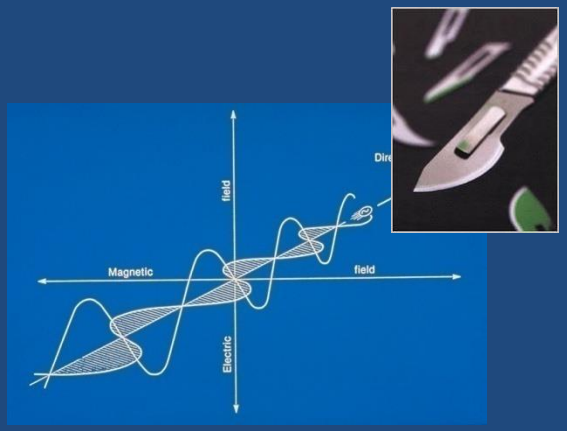


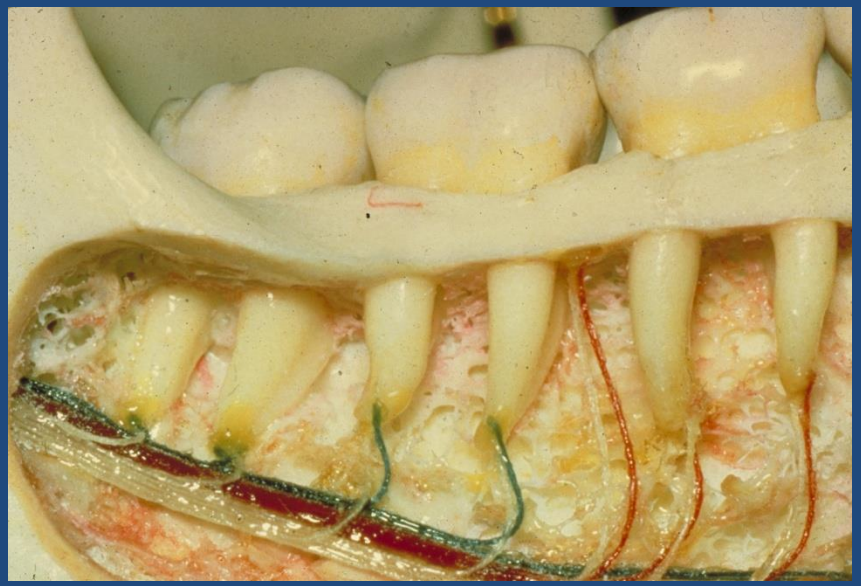
ElectroMagnetic Radiation



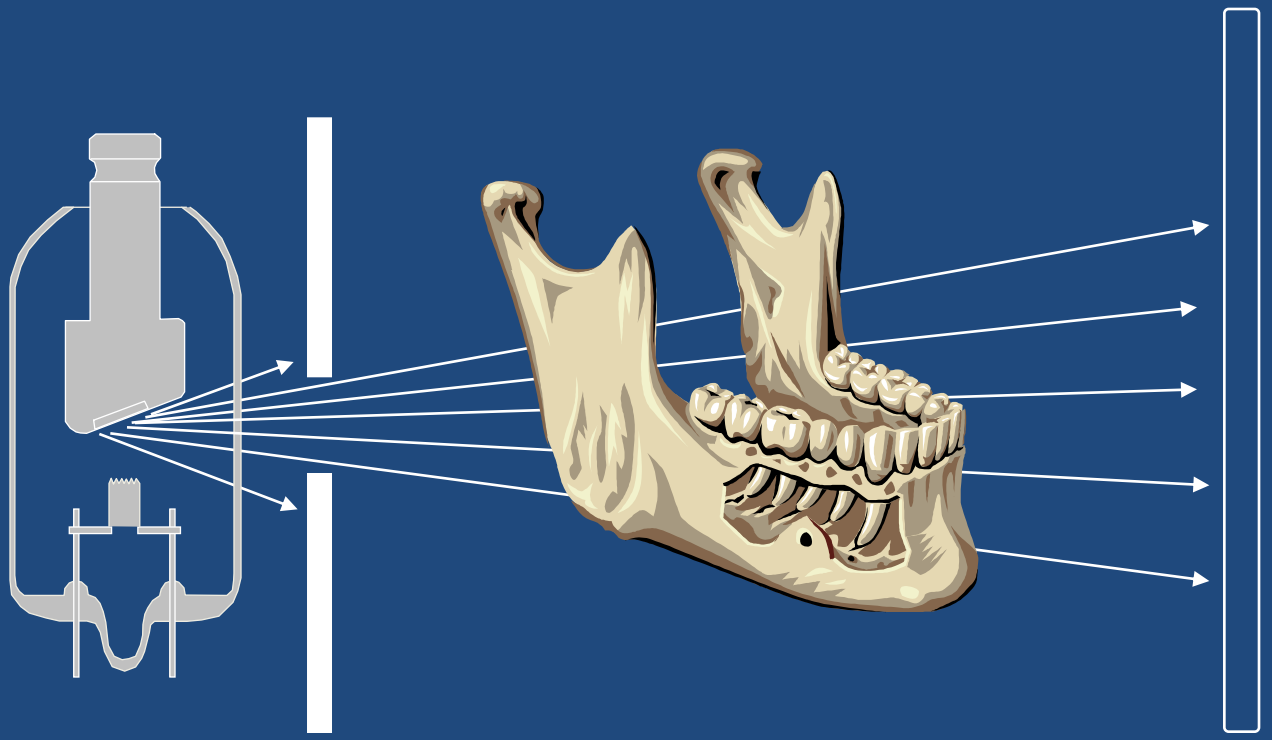
Properties of X-rays

- Weightless packages of pure energy
- Cannot see, hear, or feel x-rays
- No mass or electric charge
- Travel in straight lines/diverge from source


field
Magnetic
field
Electric



The Intraoral radiographic process: source - patient – image



Resolution and Grayscale

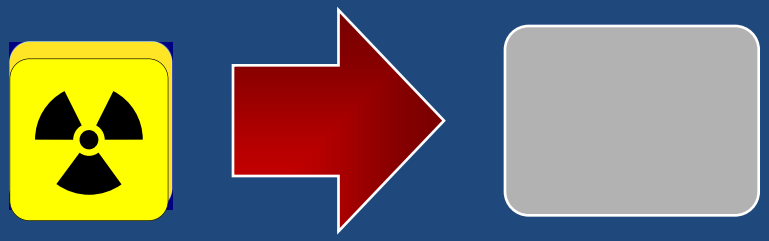
Public Domain

I

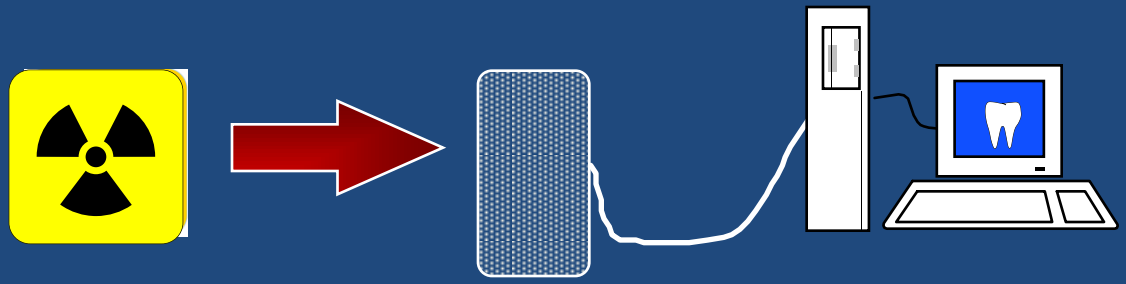
Intraoral Images

Intraoral Imaging 2015

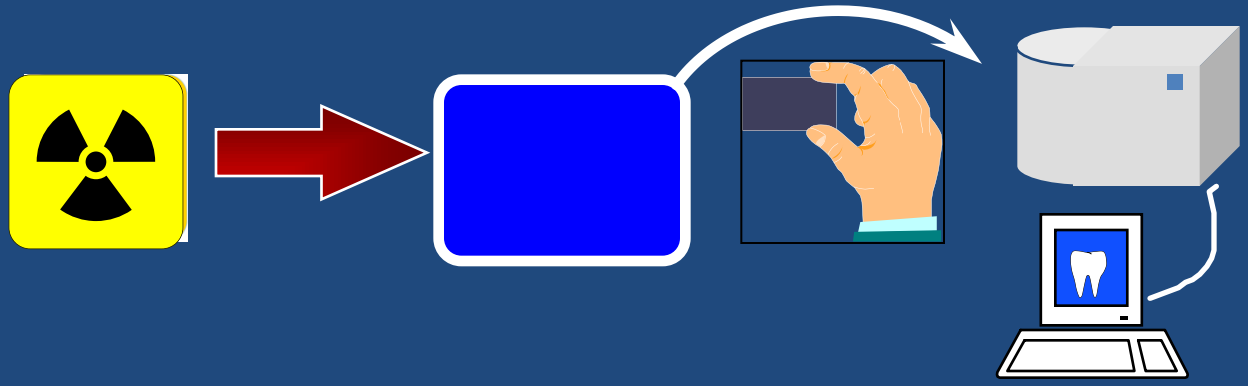
Traditional (Film)



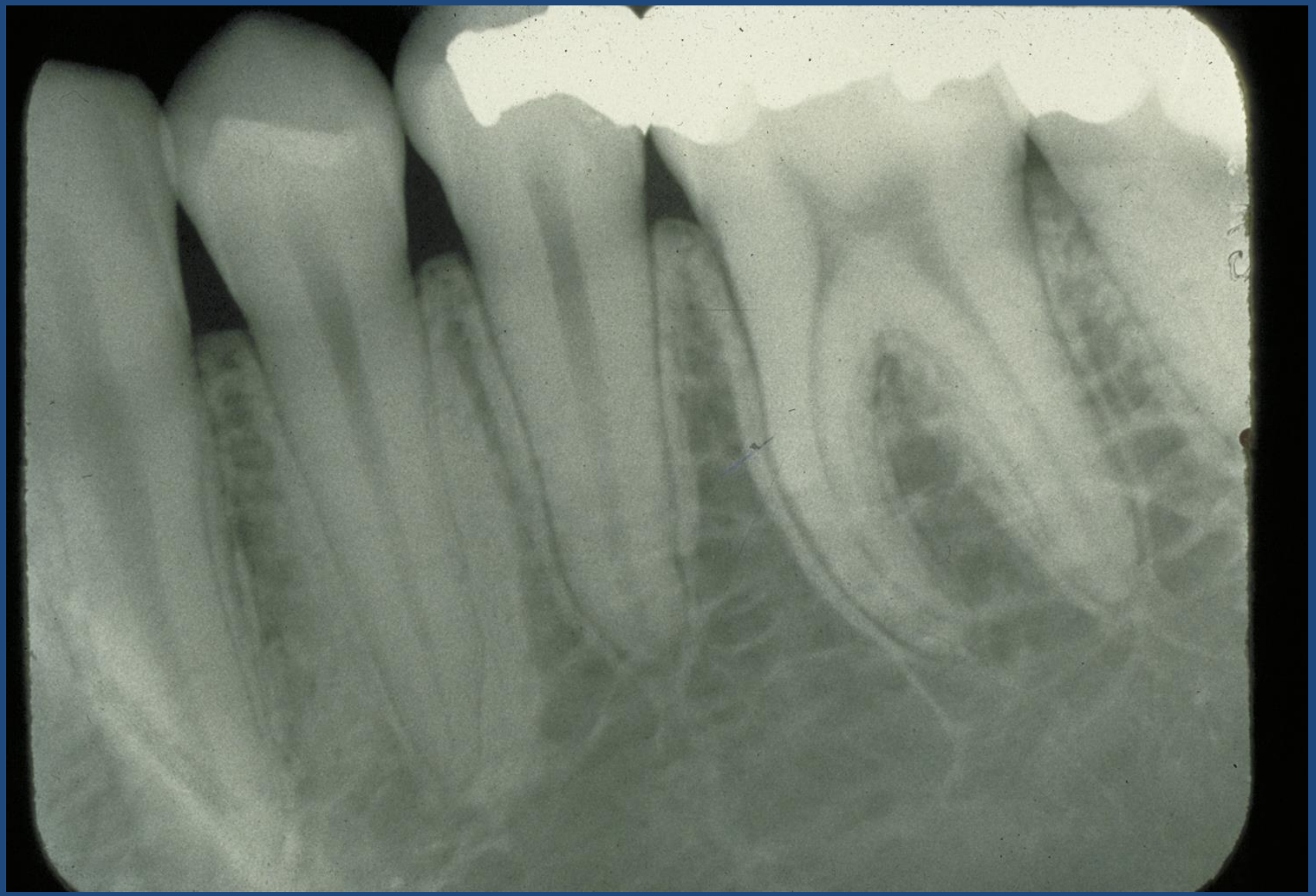
Digital Direct (hard sensor)



Digital Indirect (imaging plates)



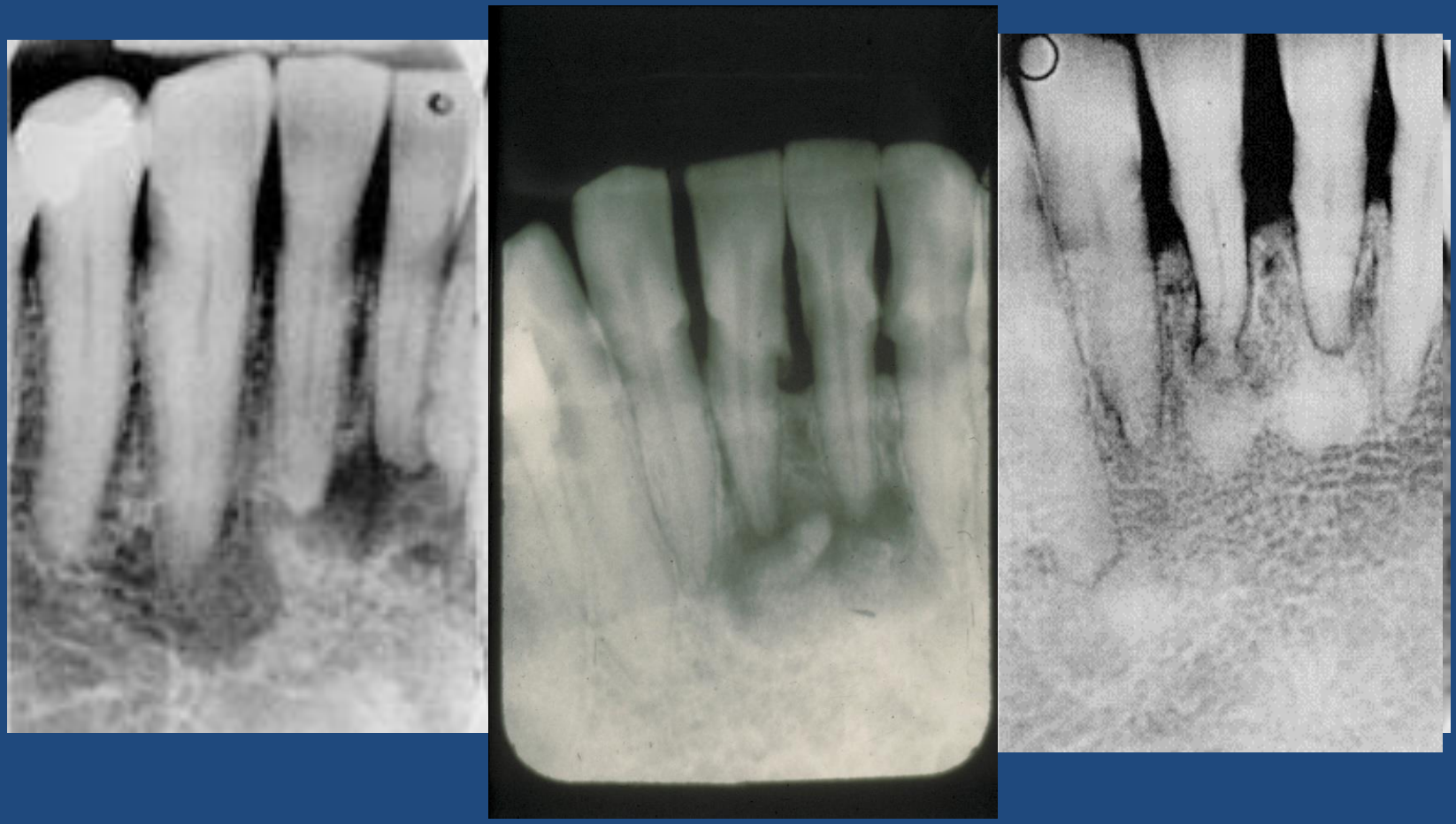
RADIOLOGY
Top Ten List 2015



Ex - Cementoblastoma

PCD Stages

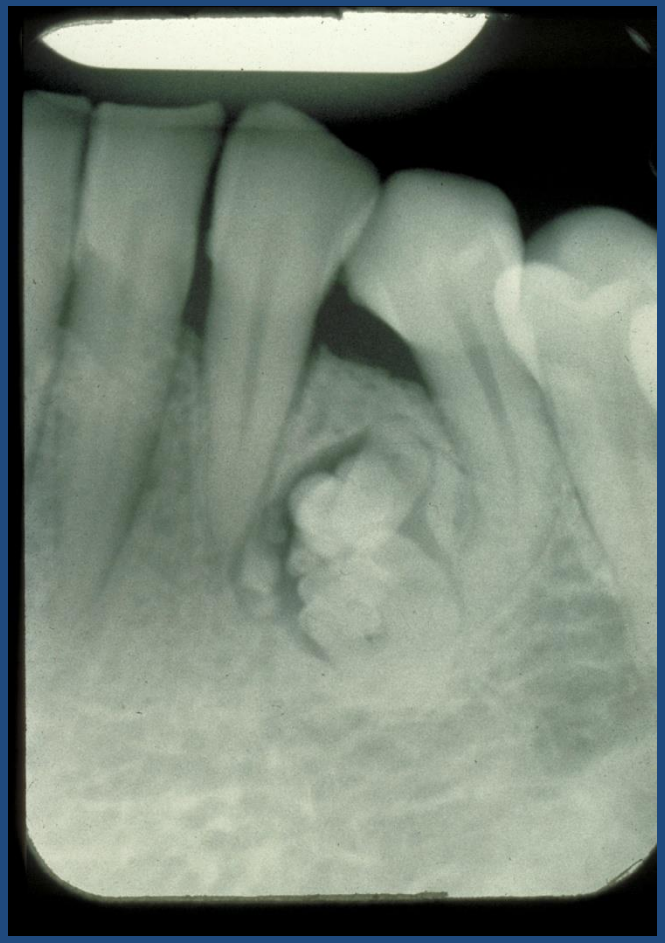
1 2 3

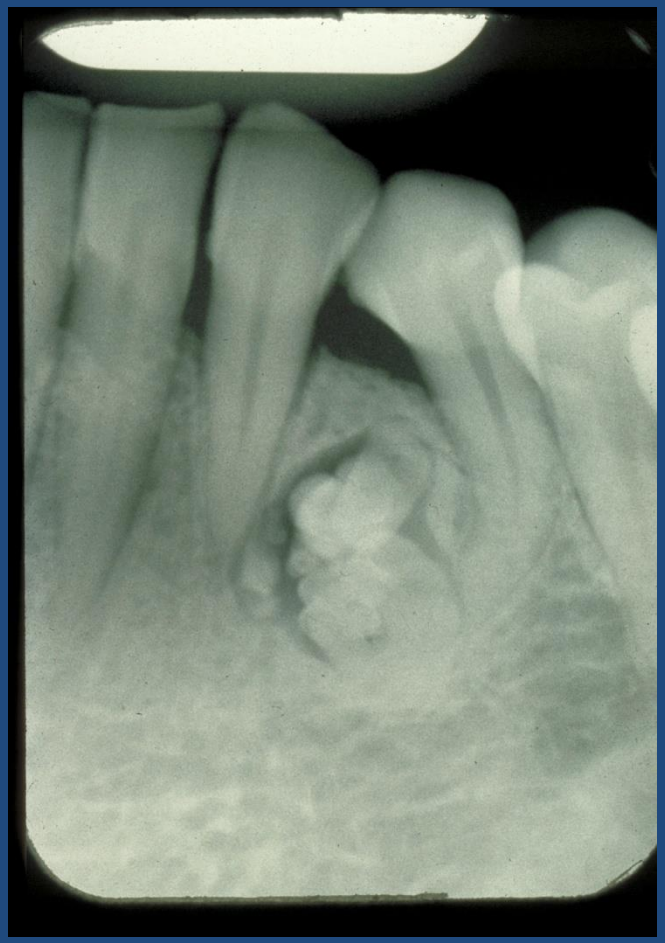


Mucus Retention Cyst

Traumatic Bone “Cyst”
note relation to the roots

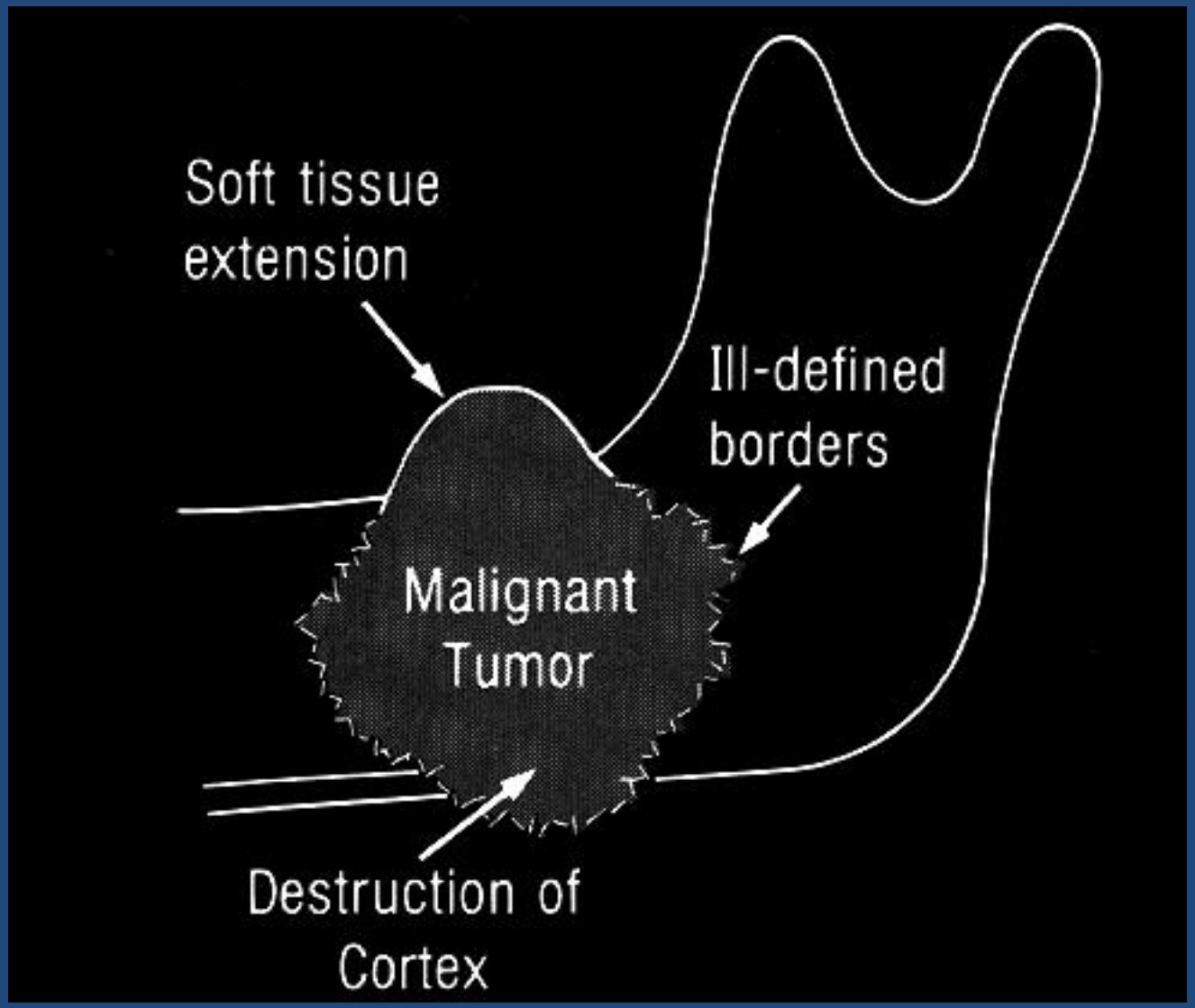
Describe this lesion !

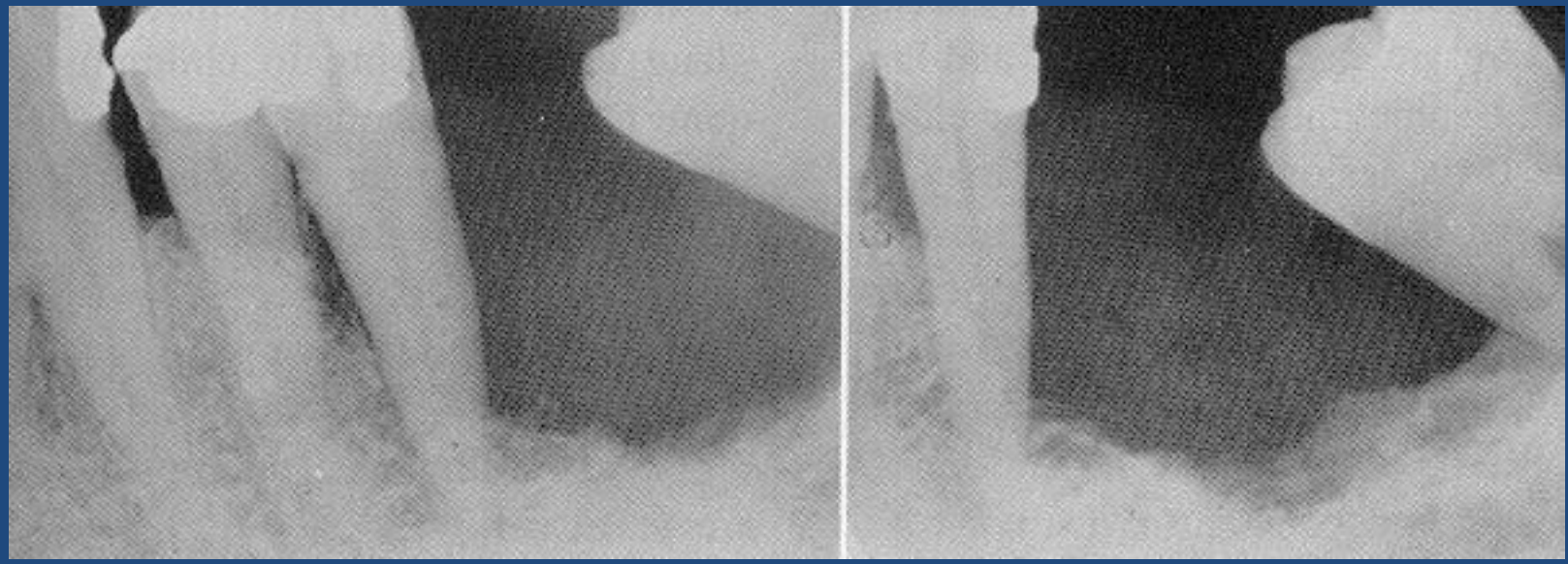


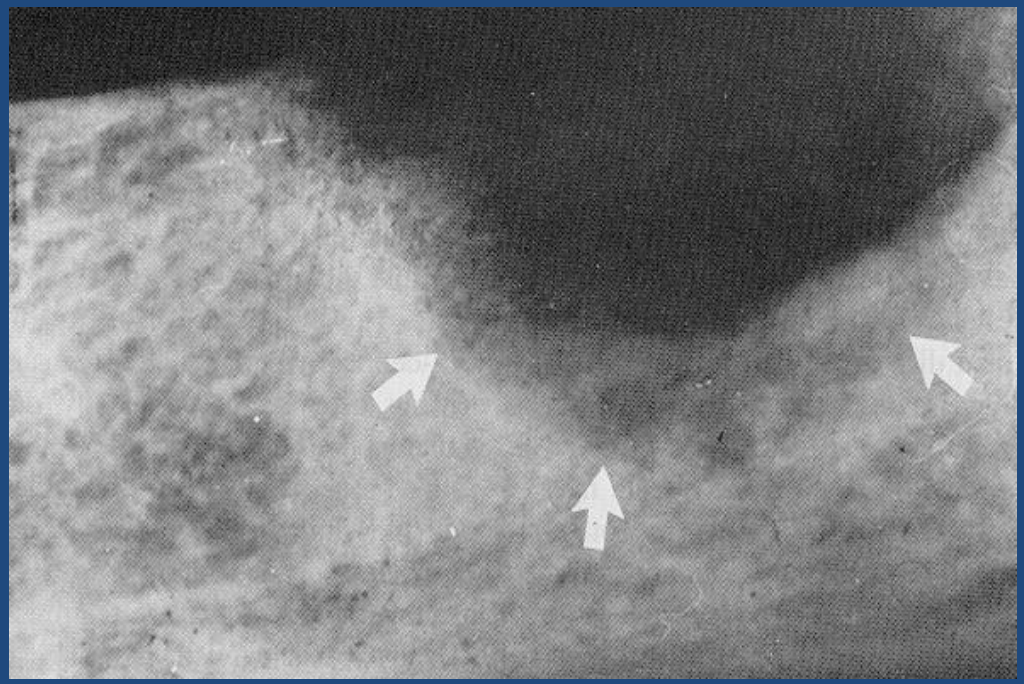


Public Domain

Periphery and Shape - BORDERS

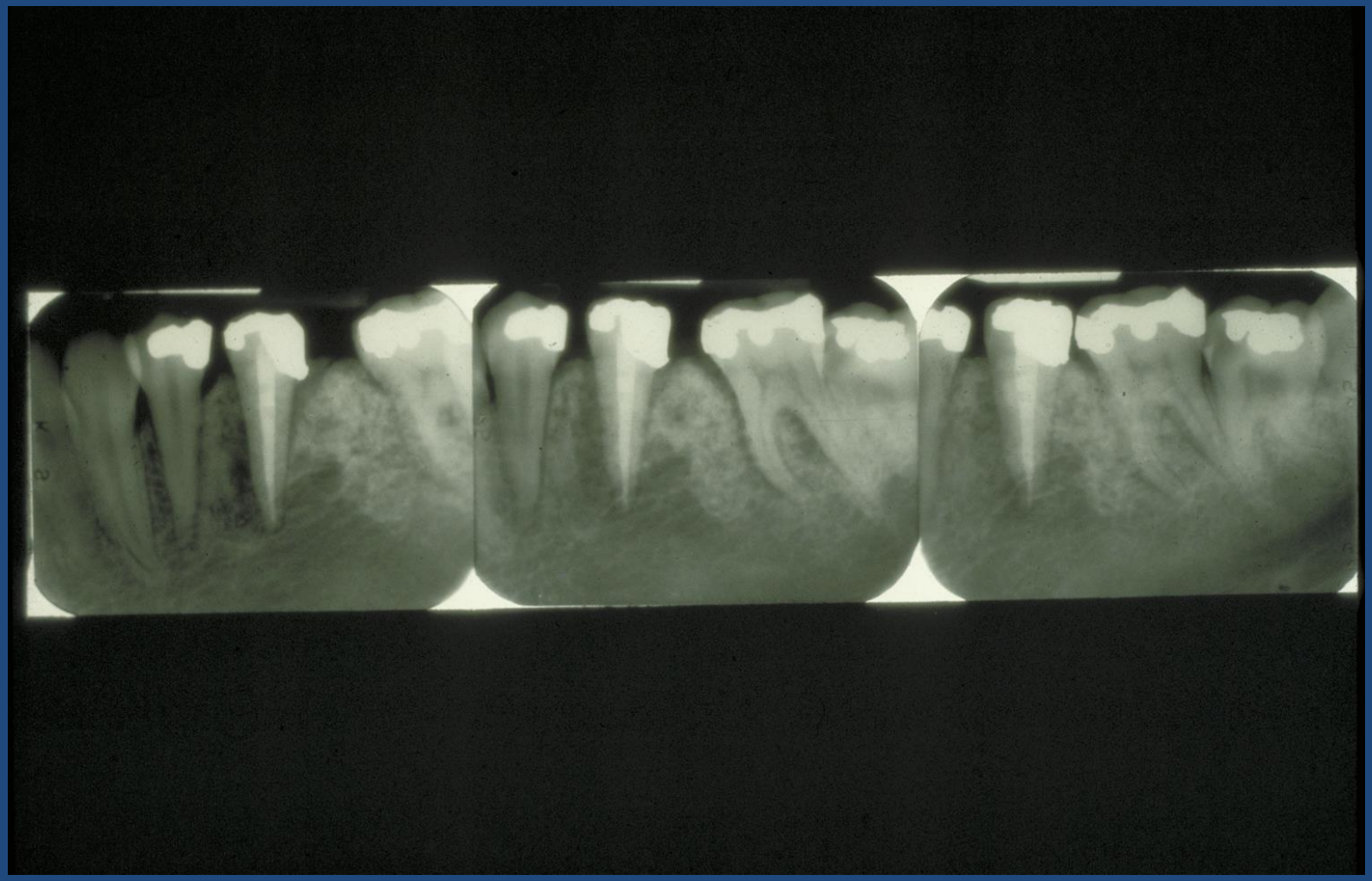




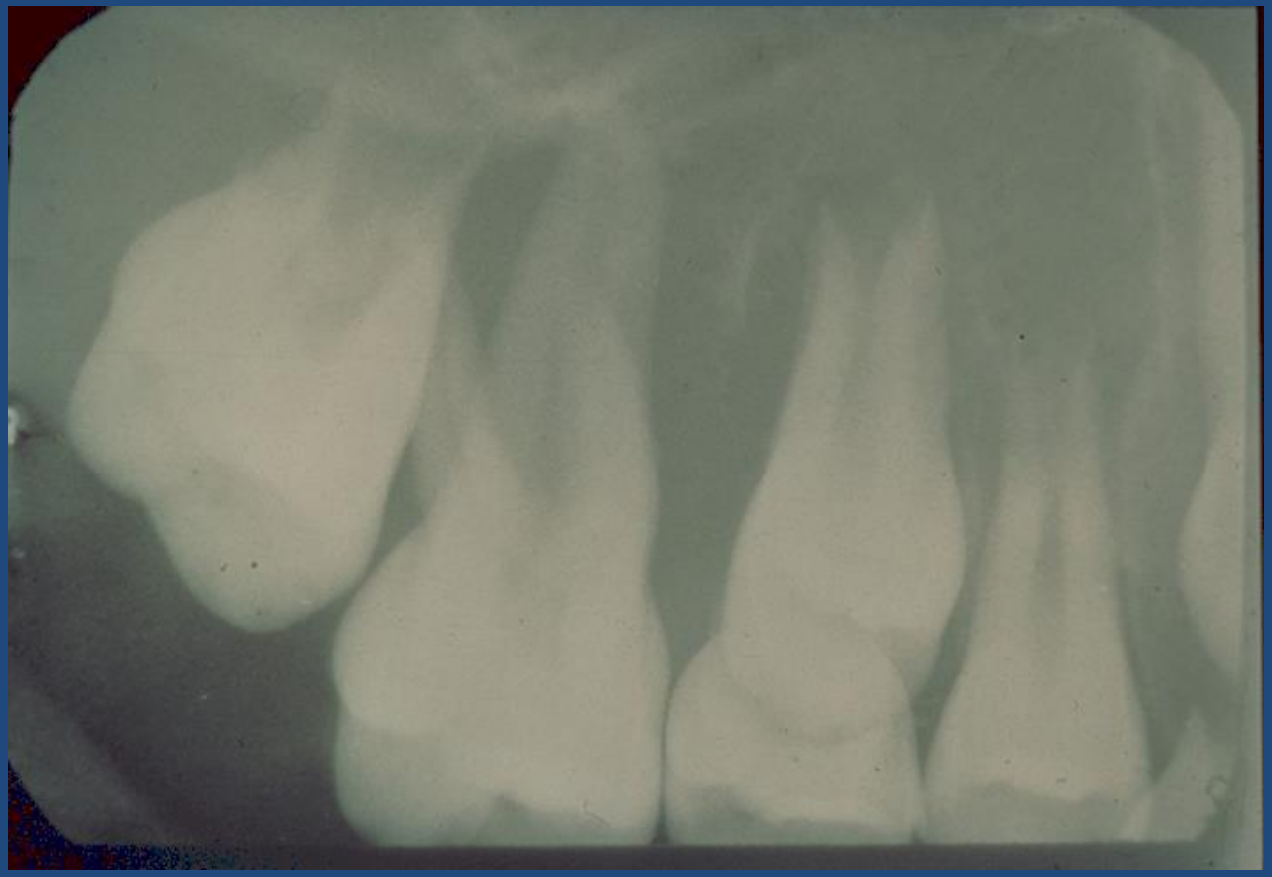


Hyperparathyroidism

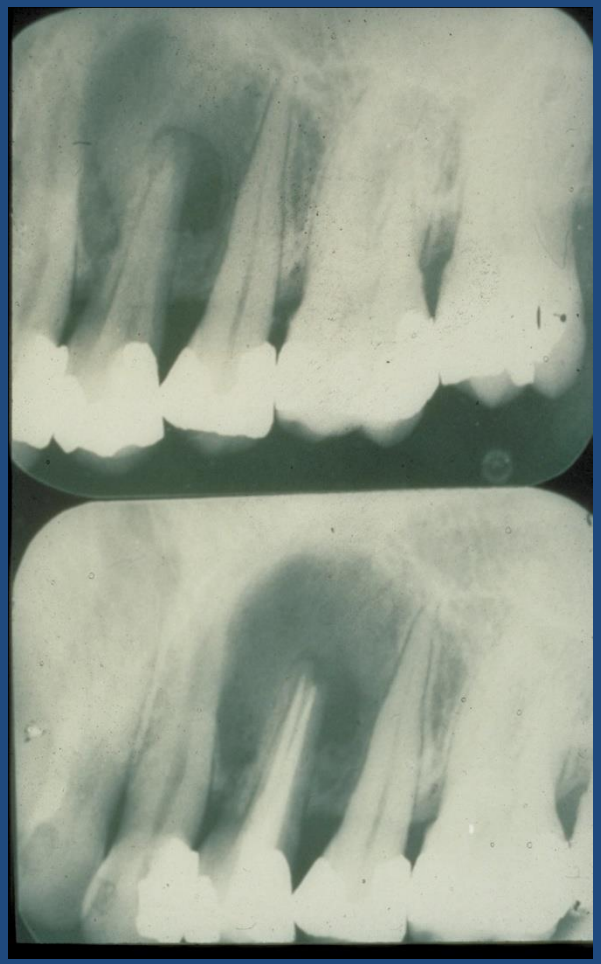
Scleroderma

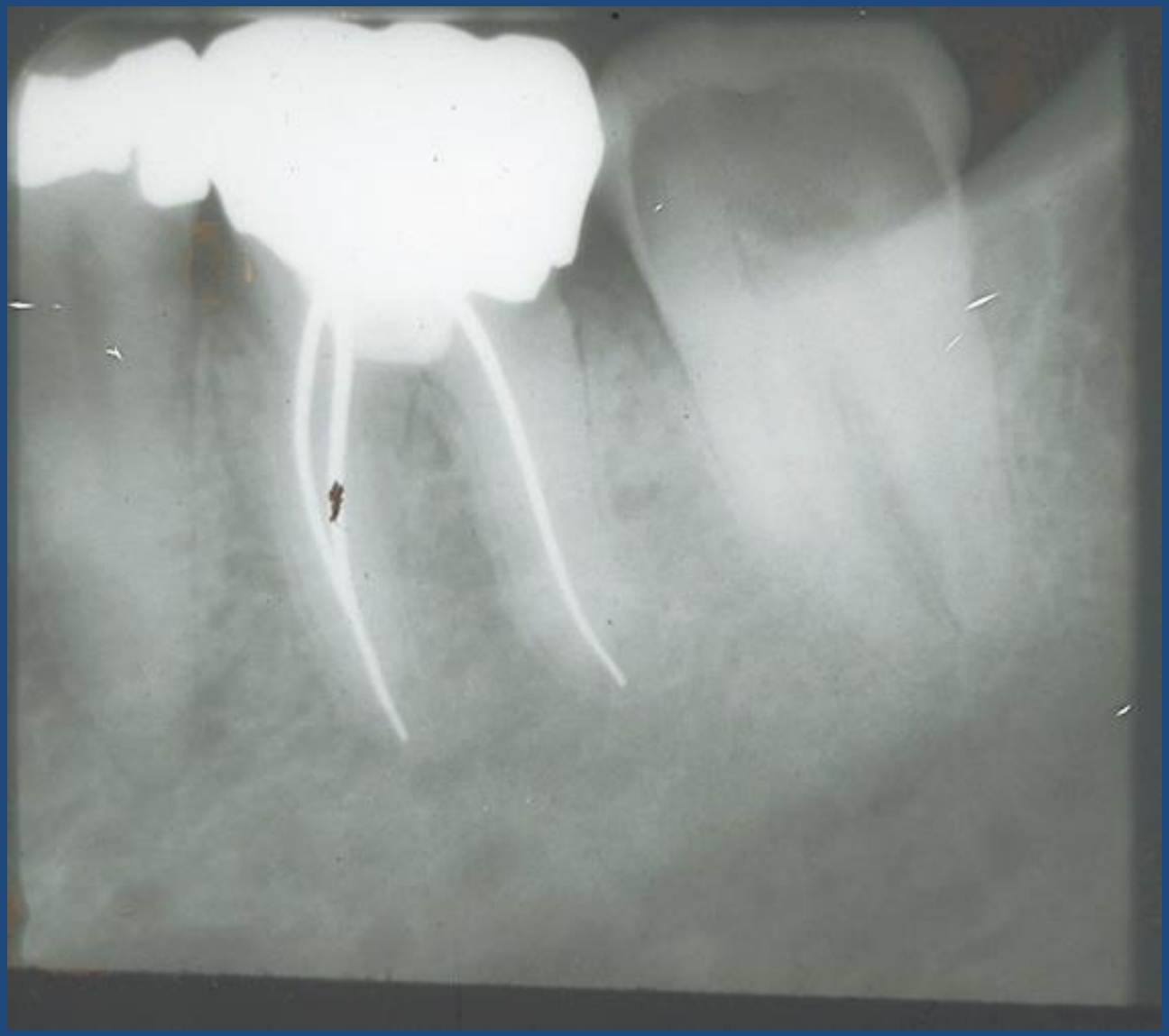


The Image



Top film: preop
Bottom film 2 years post-op

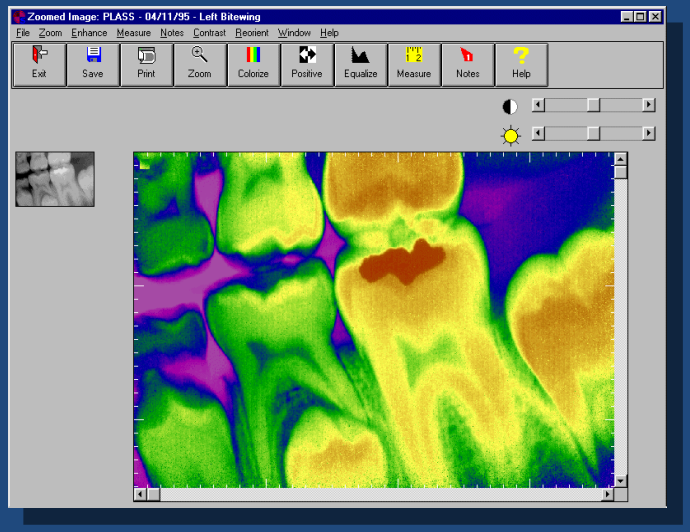


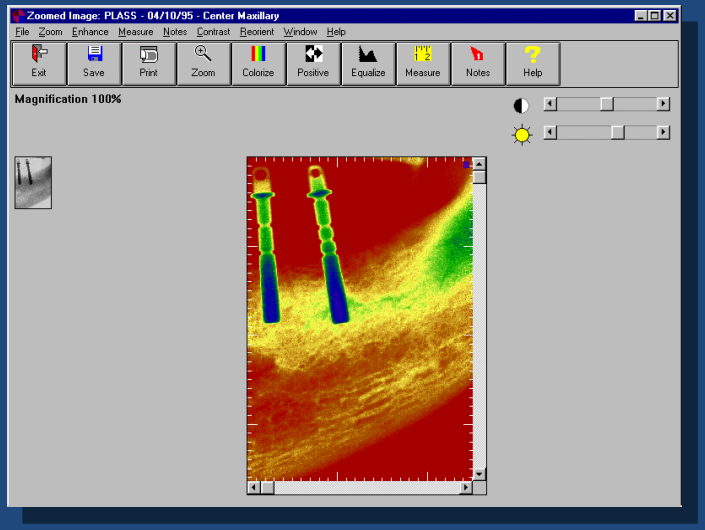



A Beautiful Thing

Digital Image Processing

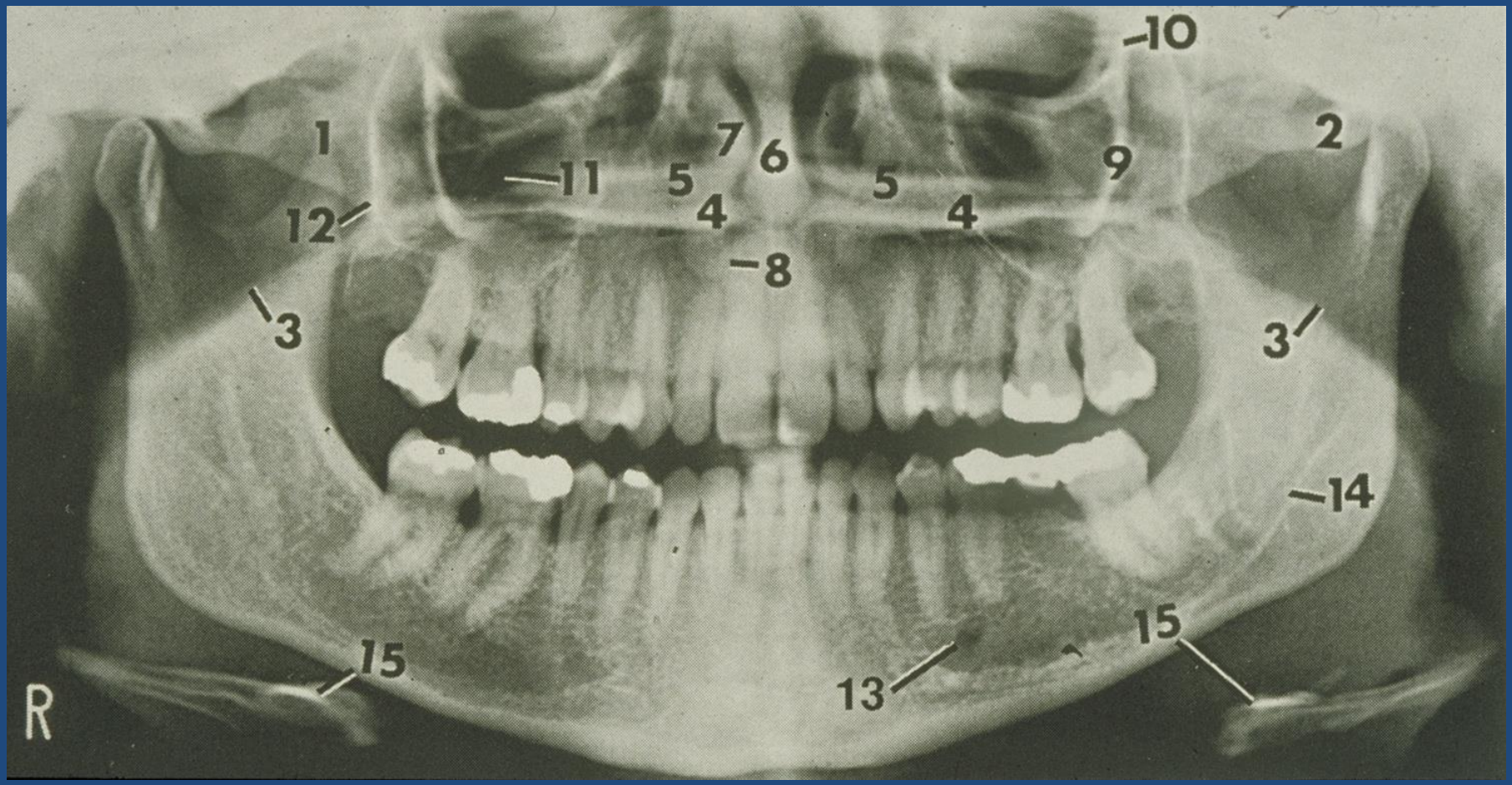
- Does not increase diagnostic yield…it may even lower it





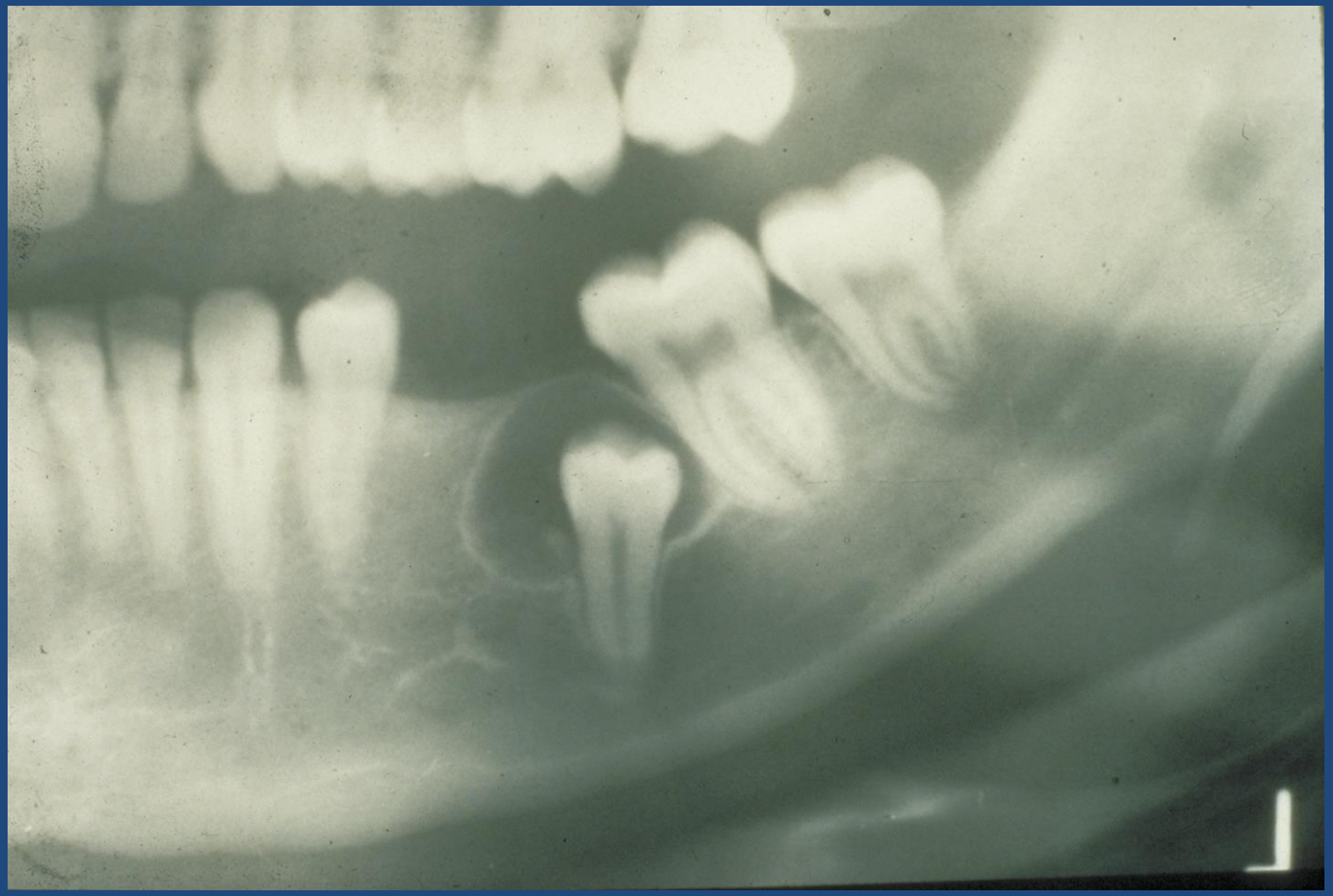
Panoramic Imaging

Panoramic Imaging

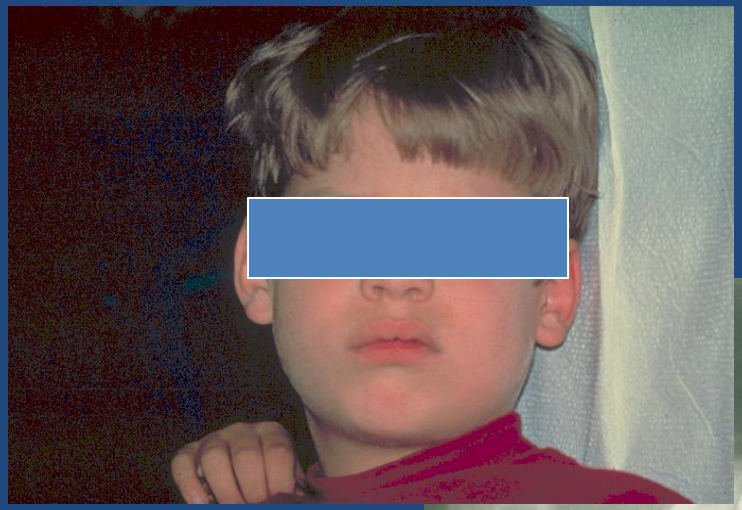


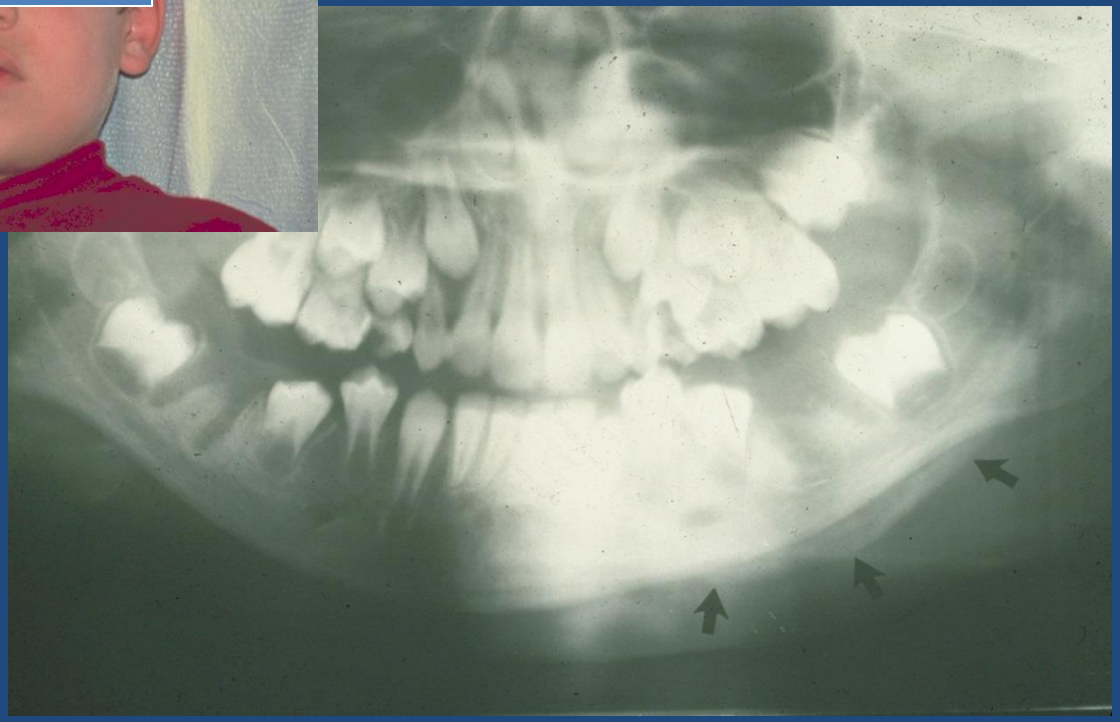
Odontogenic Cyst

note characteristic hyperostotic border

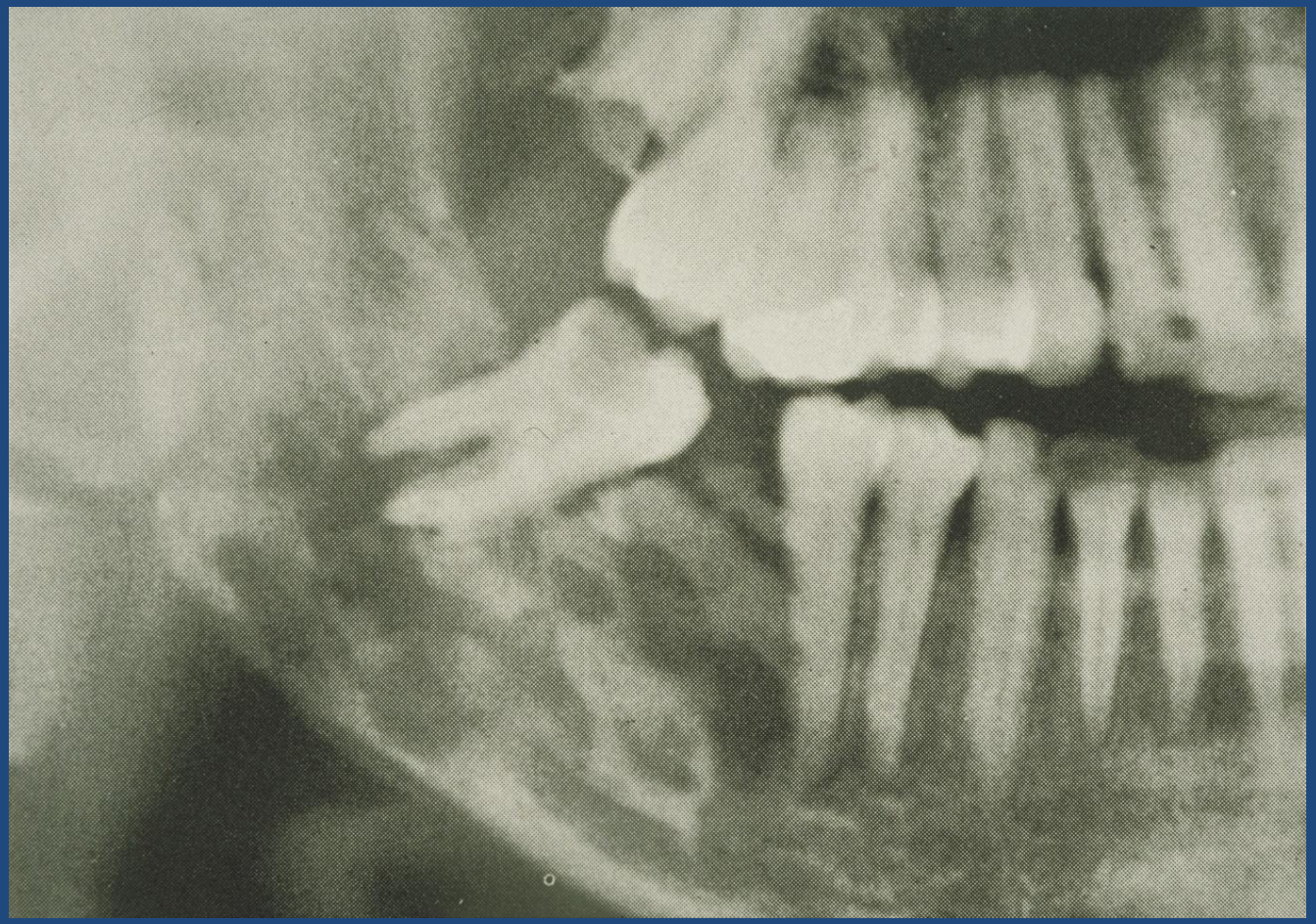


Infection

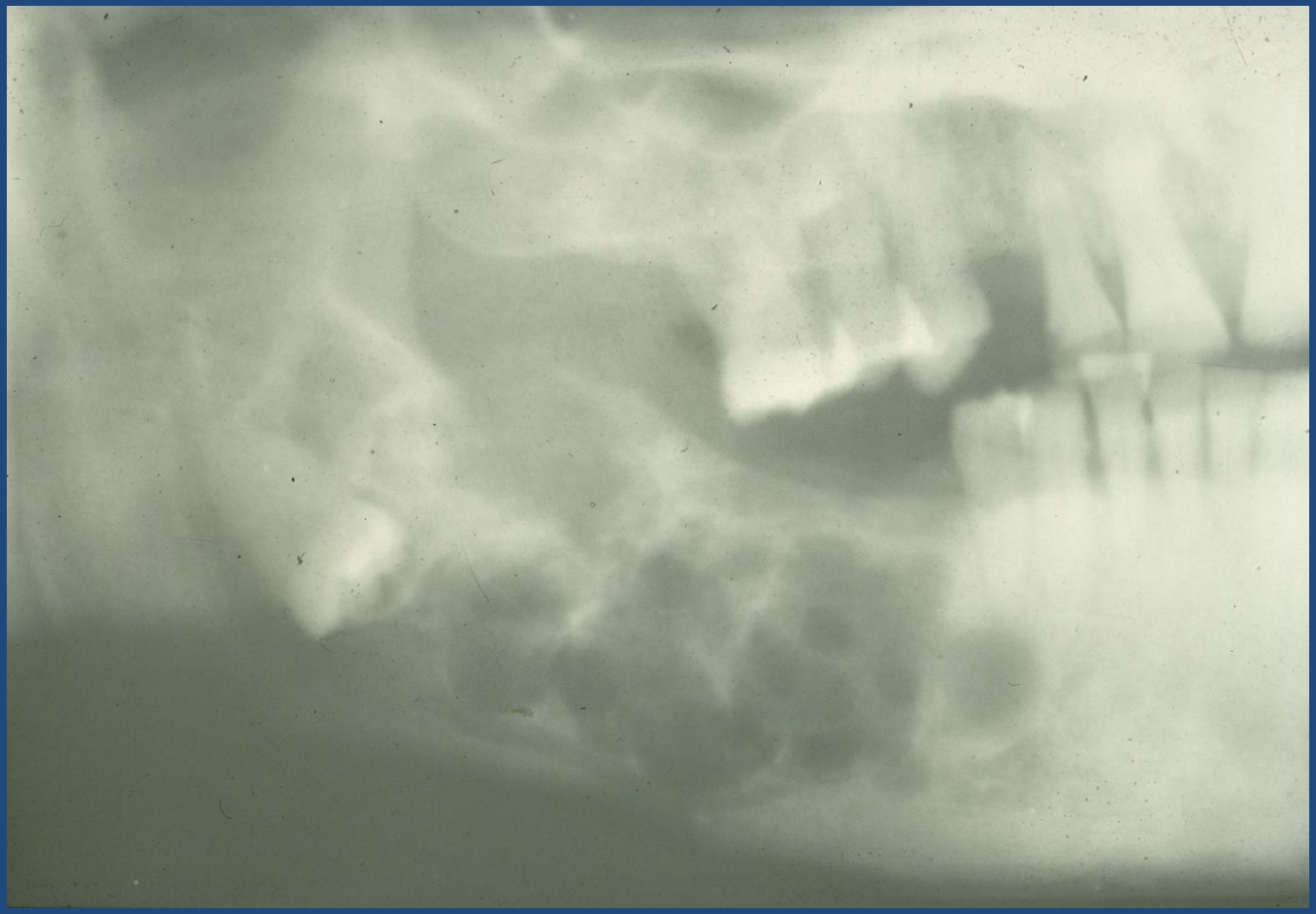




Osteomyelitis



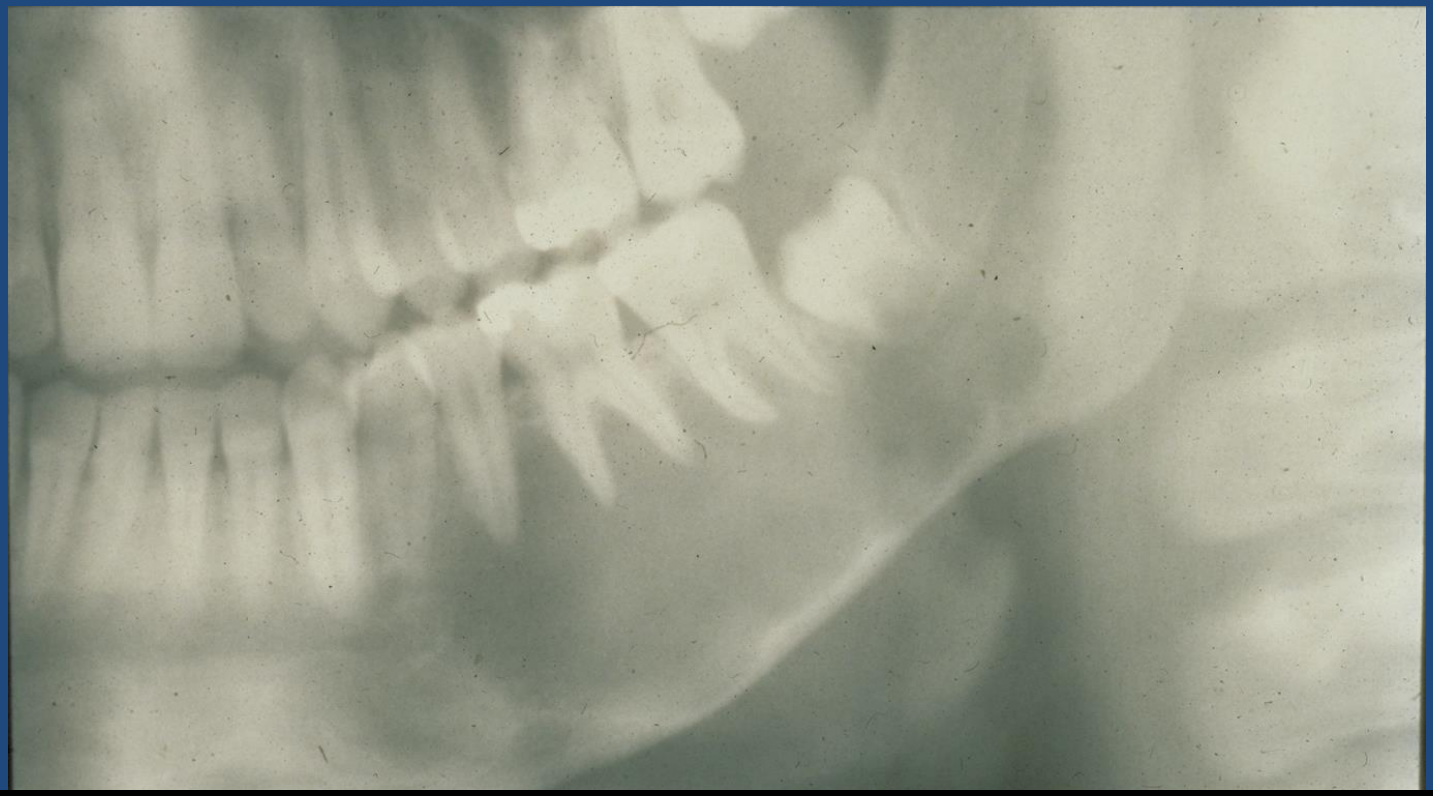
Diffuse borders



Keratocystic Odontogenic Tumor

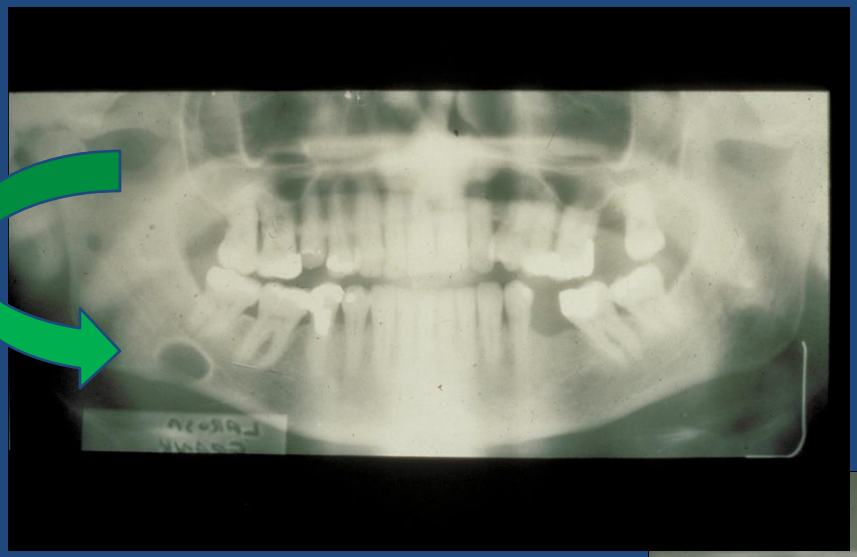
previously called Odontogenic Keratocyst

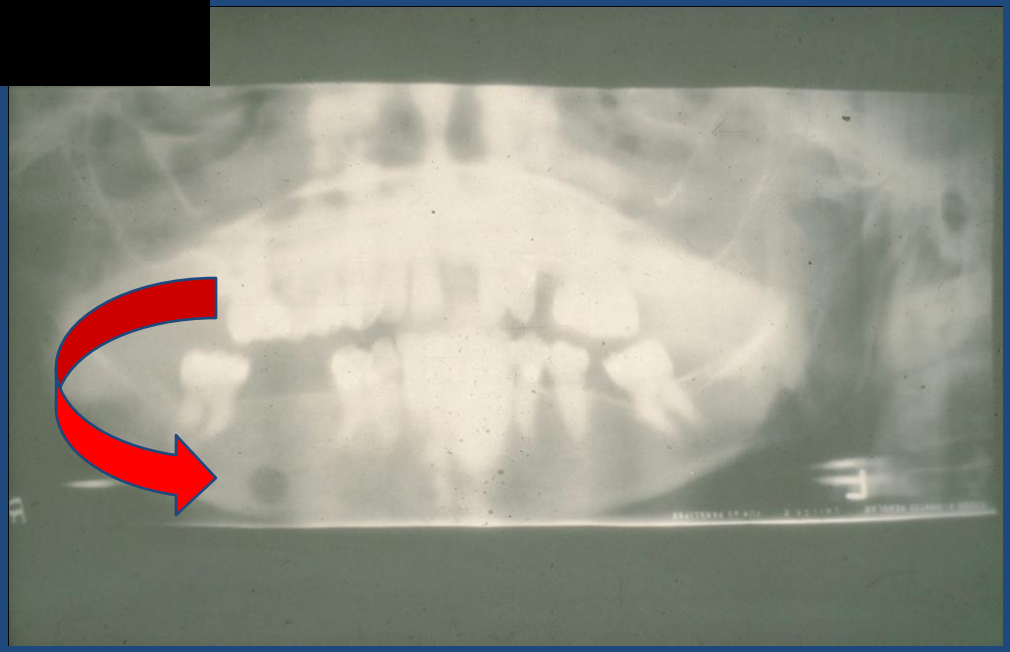
Always note effects on surrounding structures



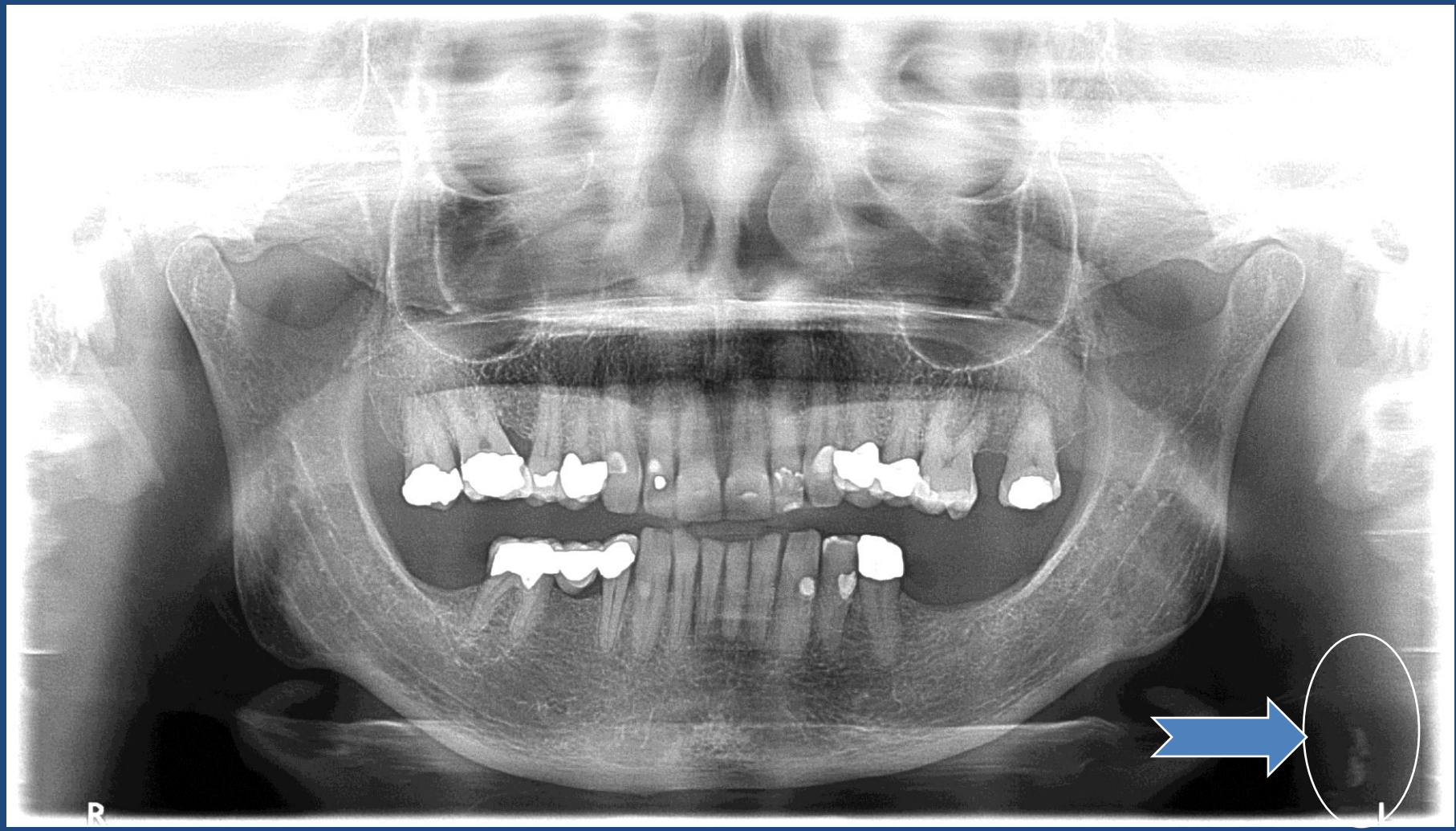
If Multiple Odontogenic Keratocysts: Think possible Syndrome

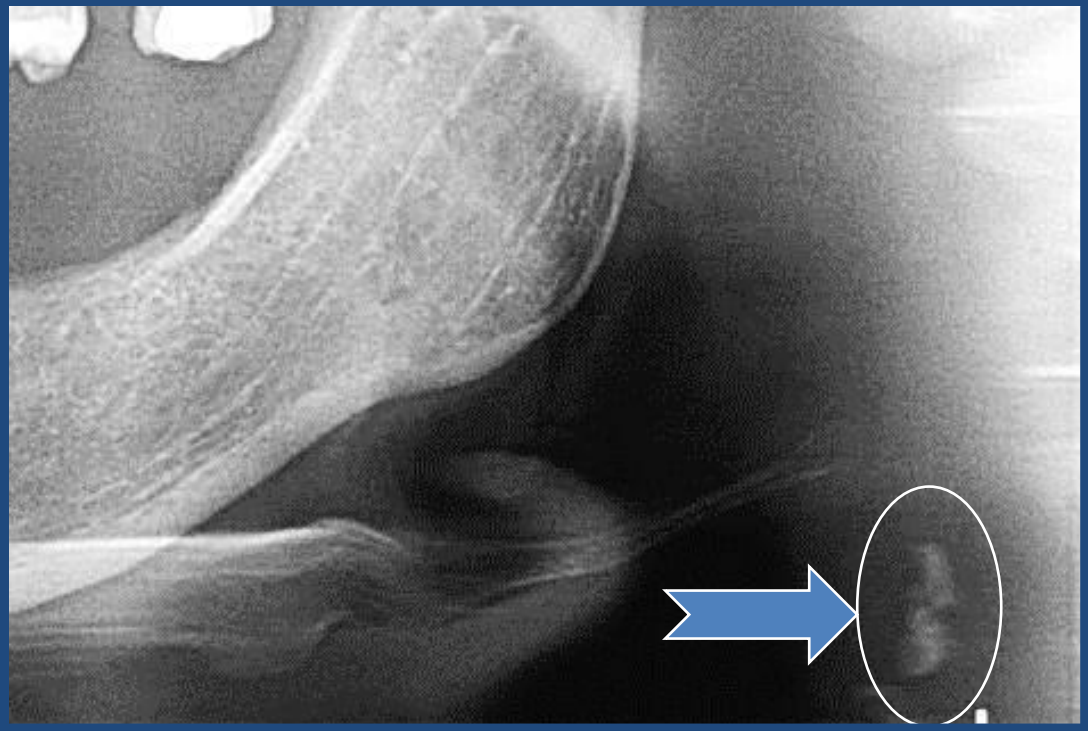
If Multiple Osteomas:
Think possible Syndrome





Carotid Artery Atheroma



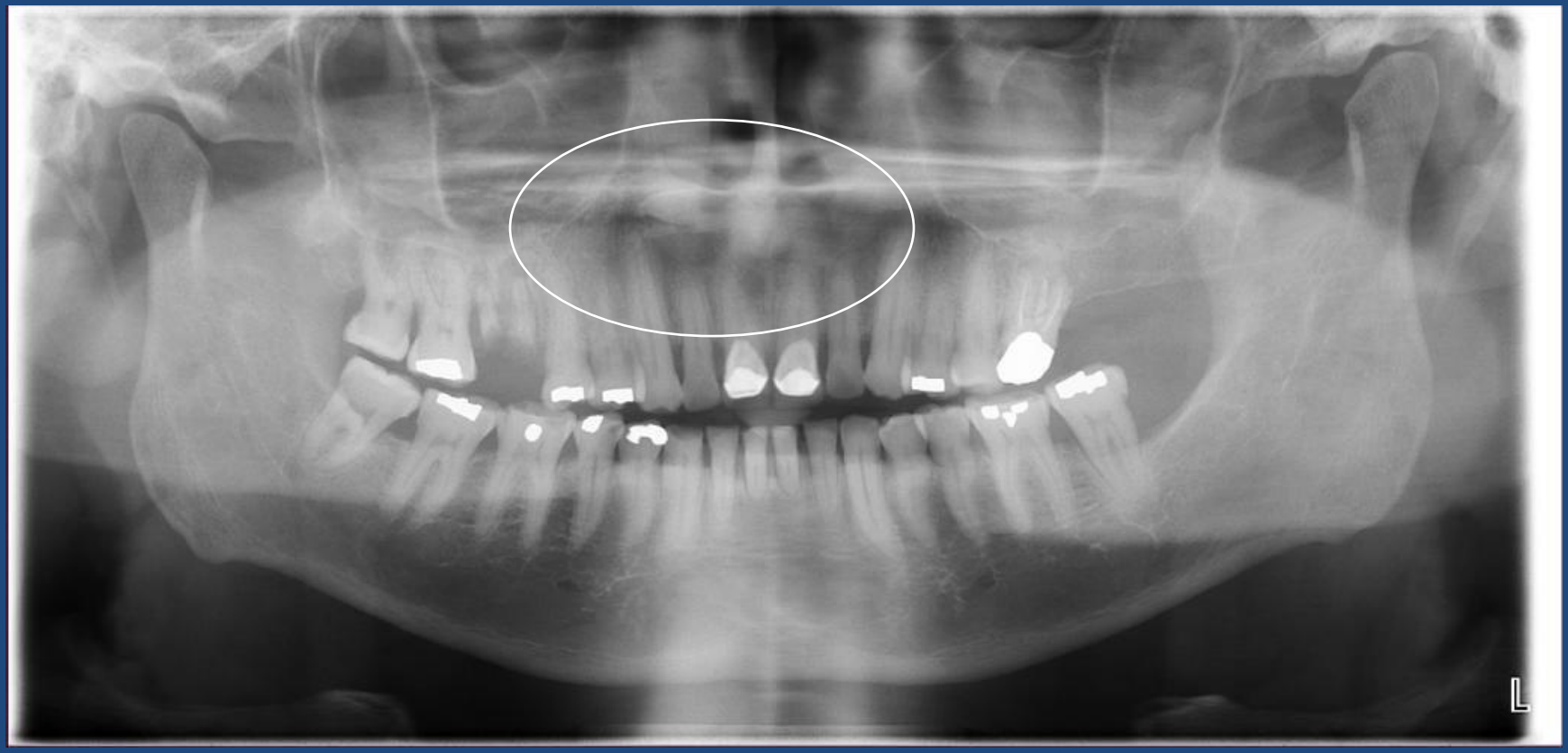


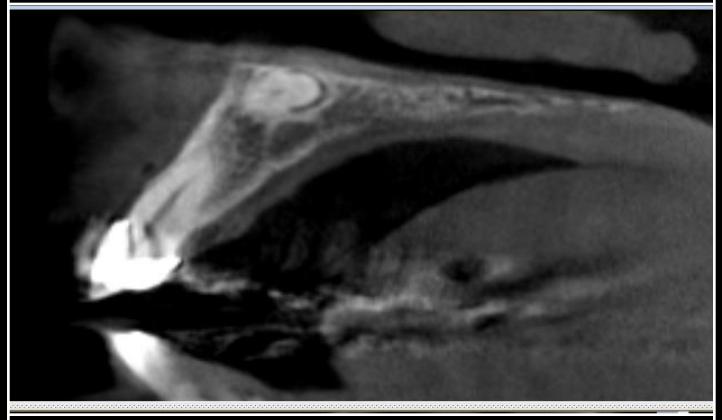
I  panoramics, however …

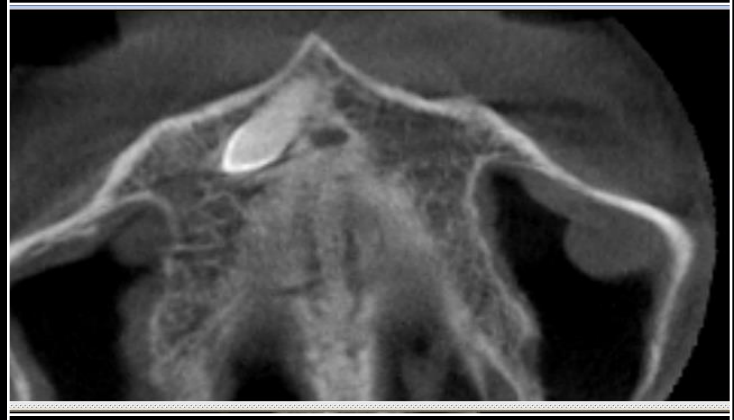
1. extremely position sensitive
2. unequal and varying magnification
3. lack of buccal-lingual visualization
4. inability to measure accurately
5. 2D view of 3D patient

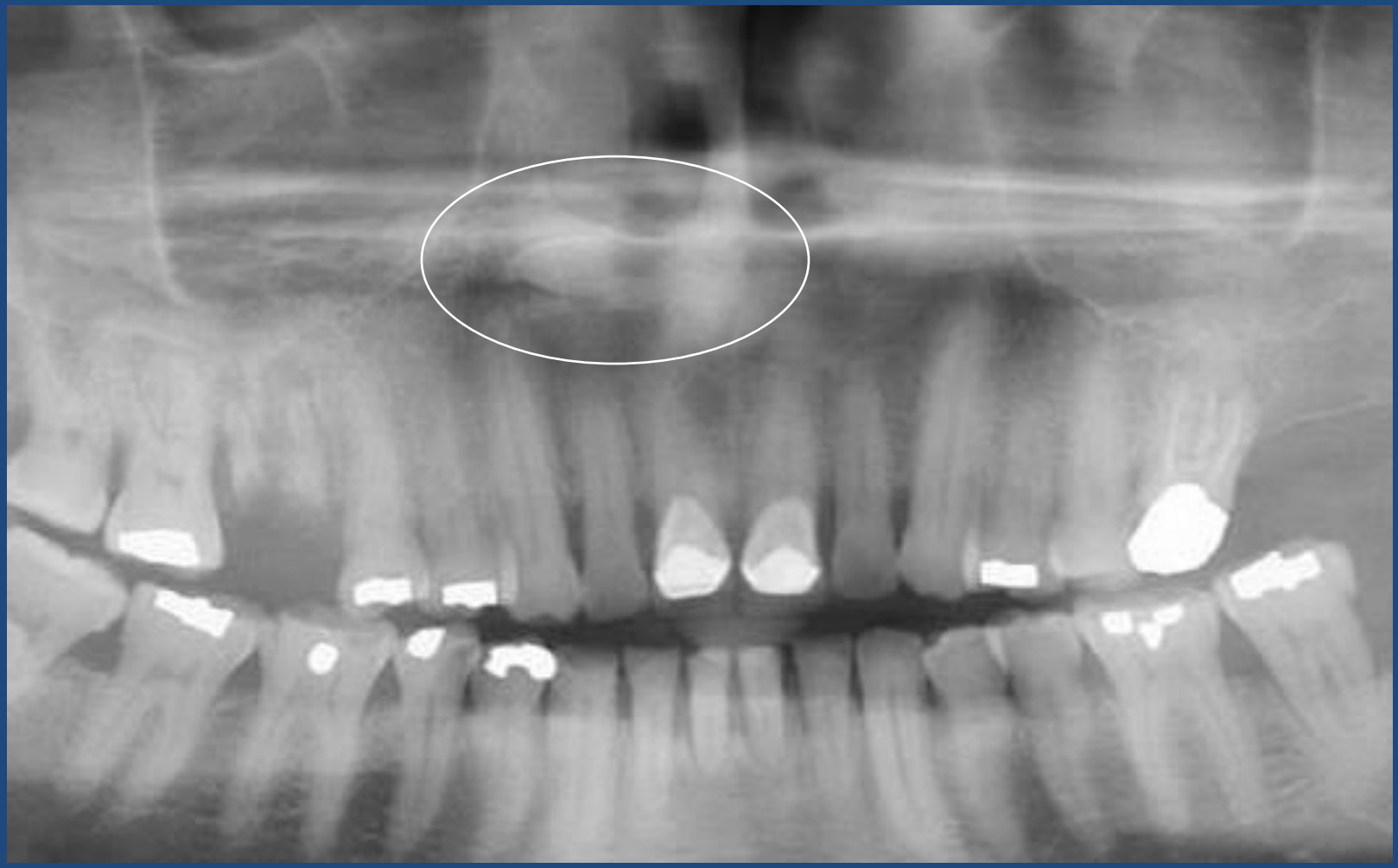
Public Domain


L

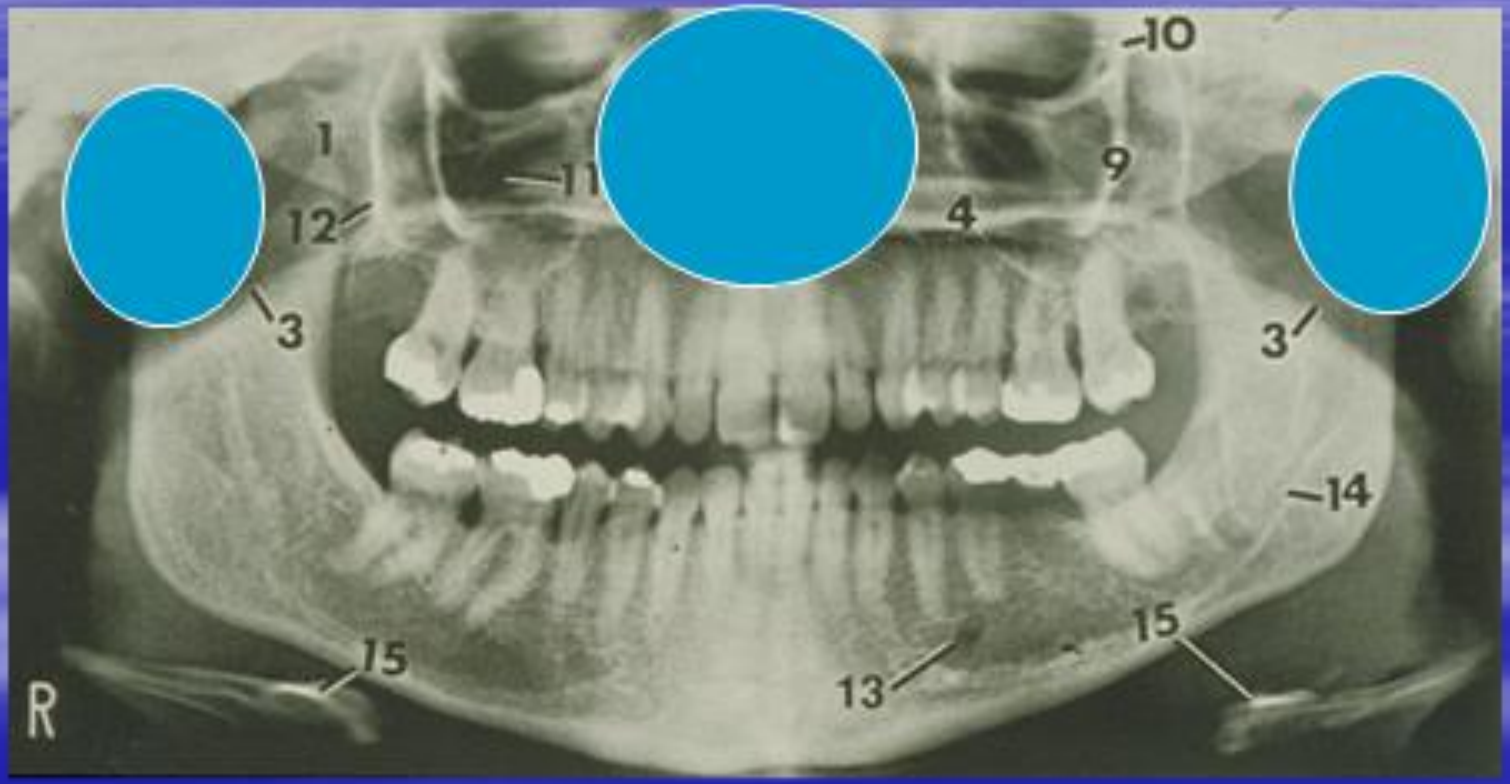

L



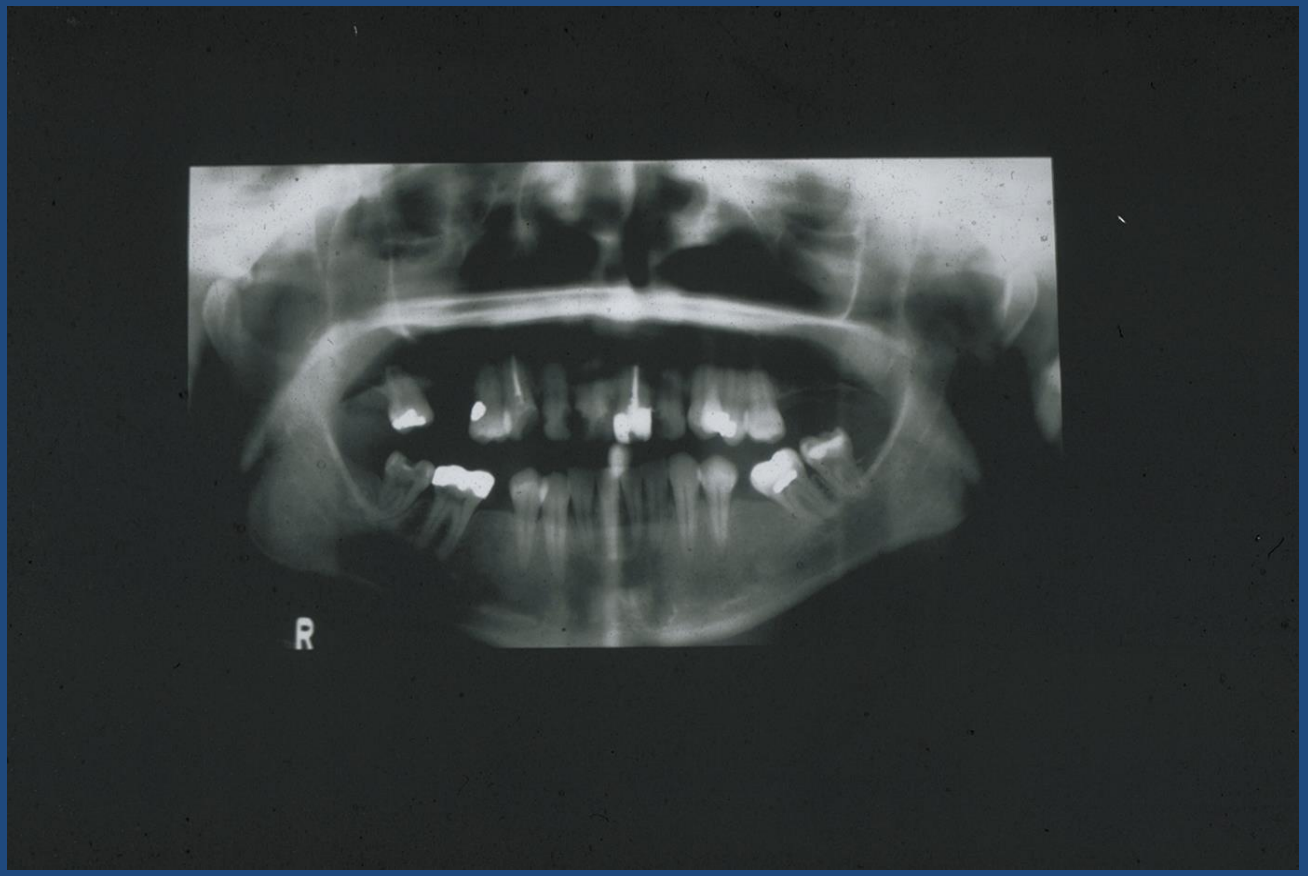




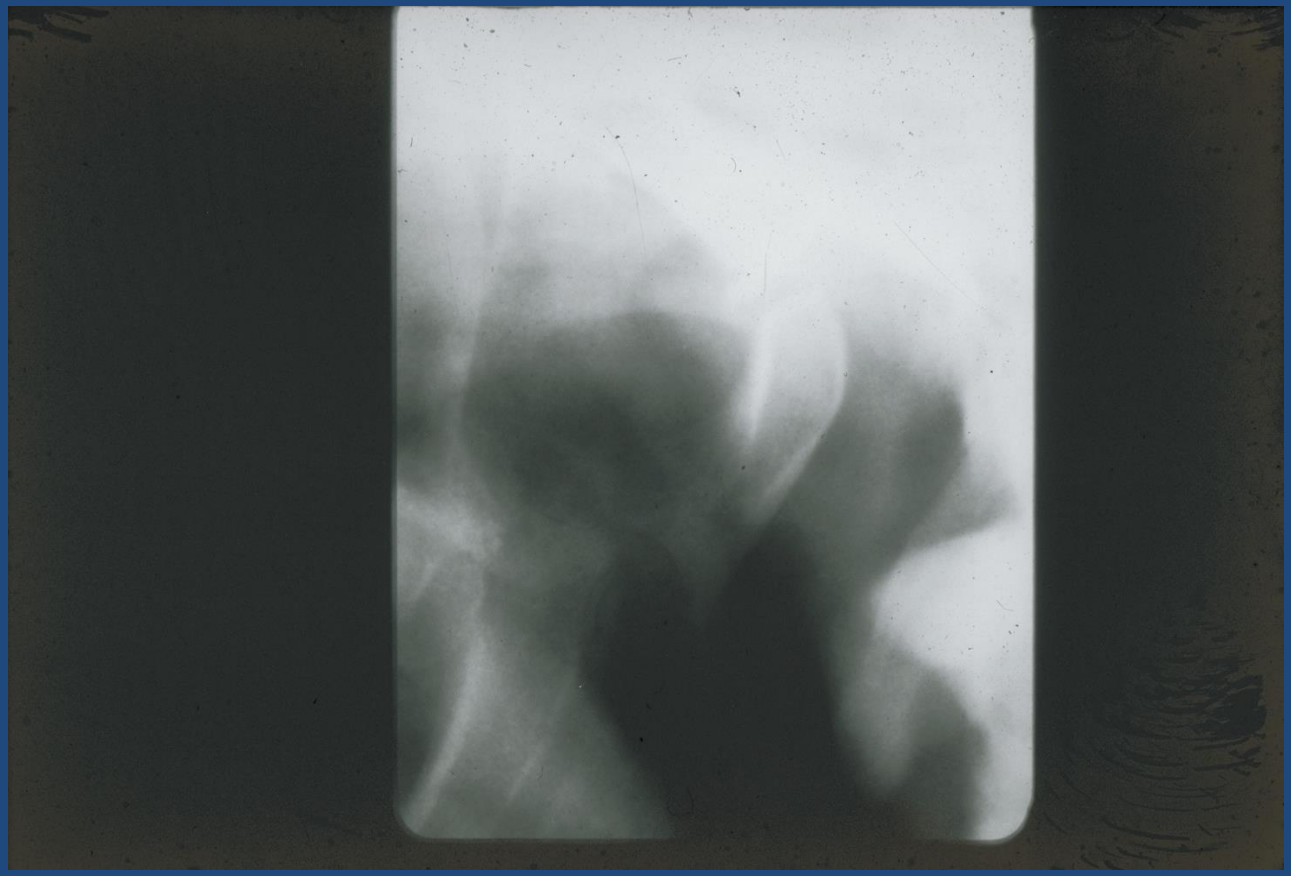
Panoramic Anatomy: blue = bad



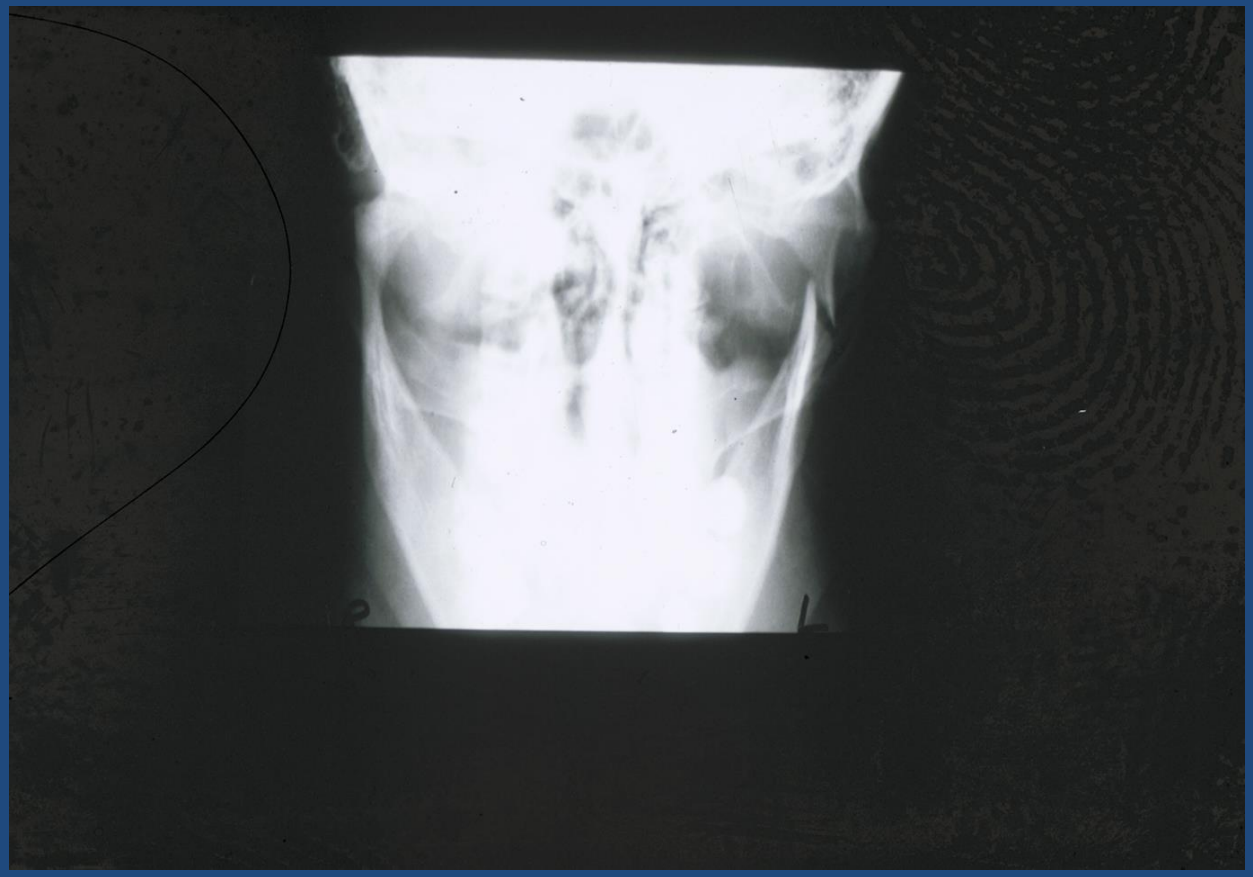
24 hours PBRB (Dallas, Texas)

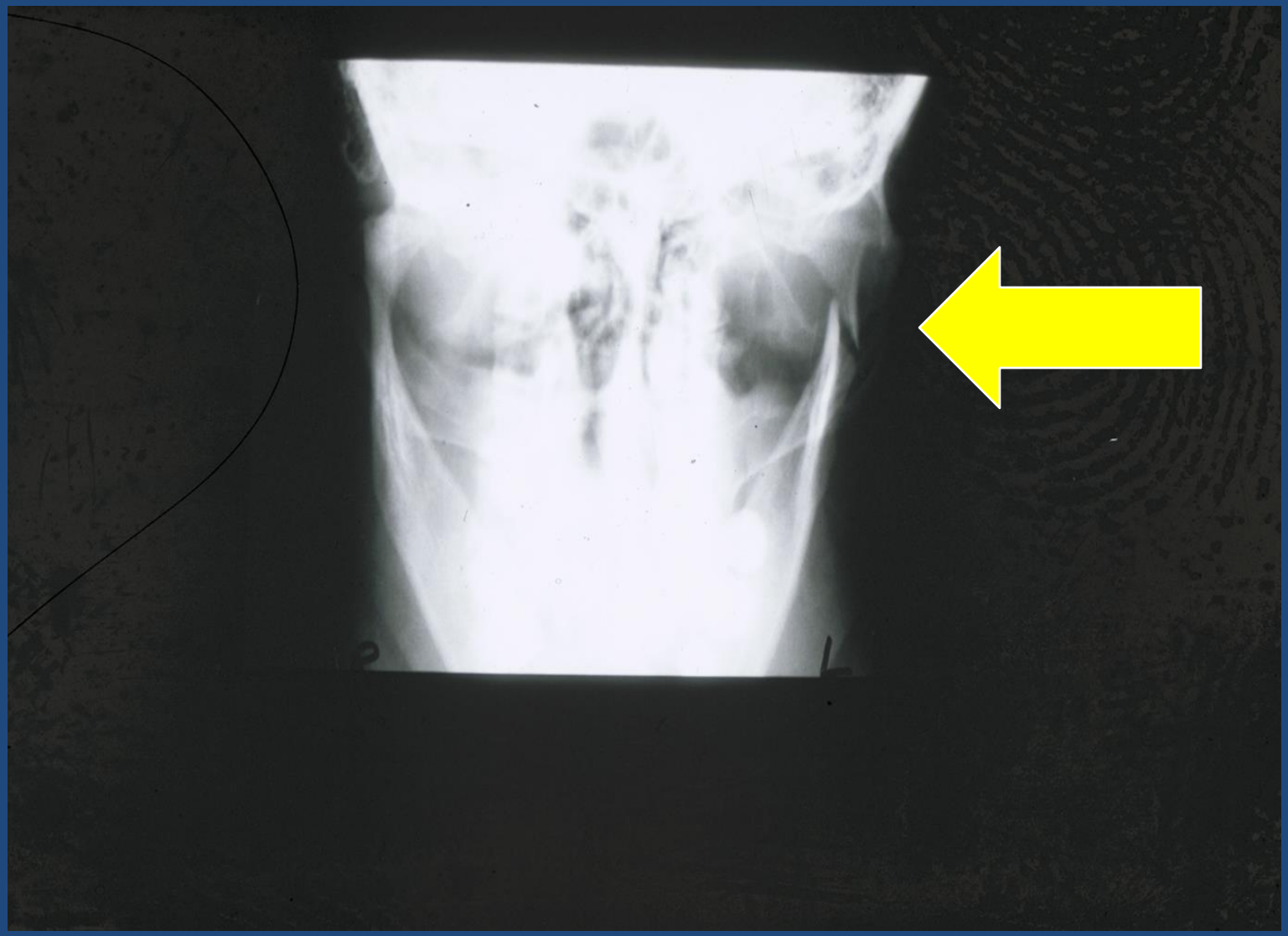


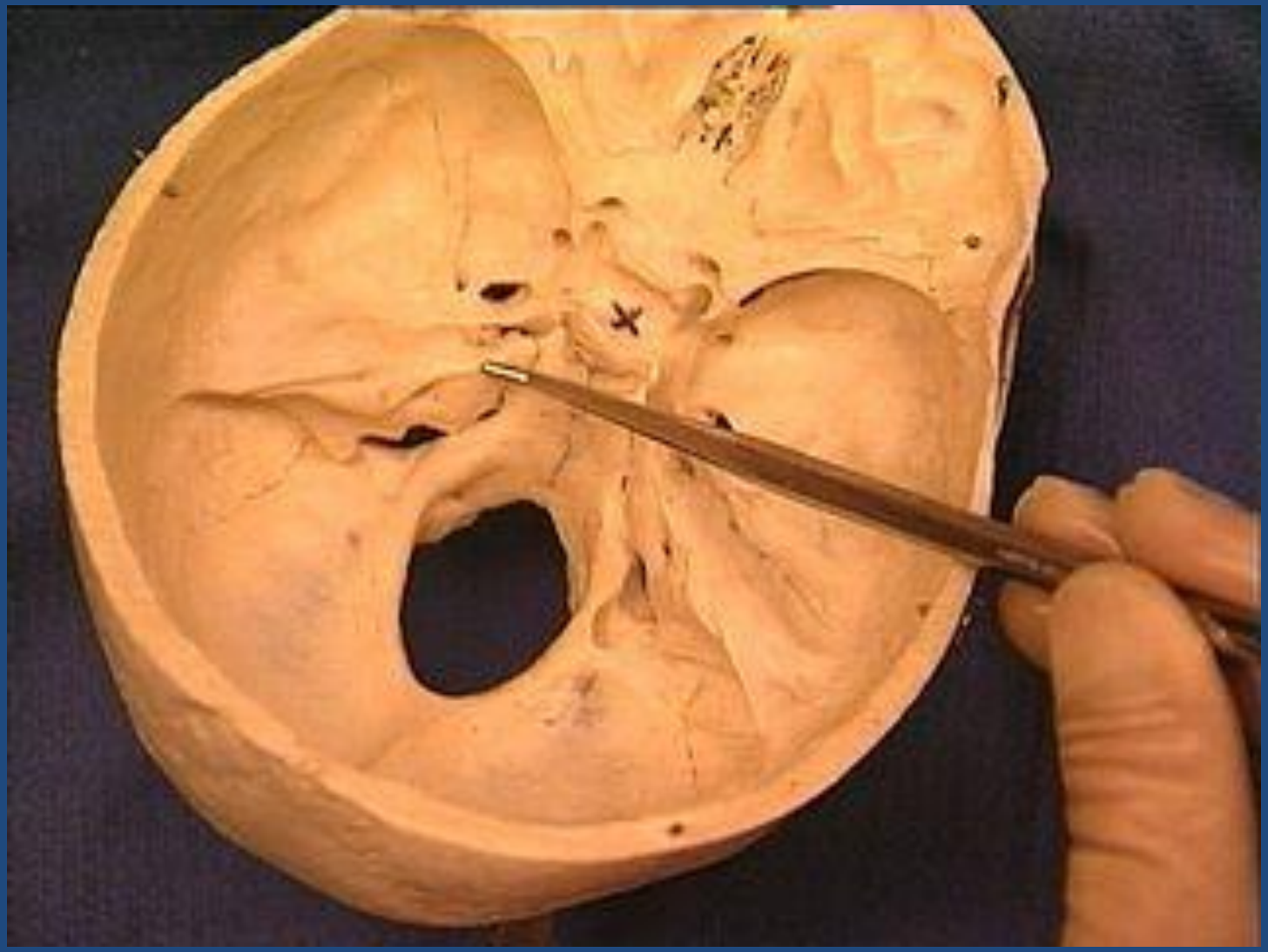
Close up panoramic of Left TMJ
(looks WNL to me)



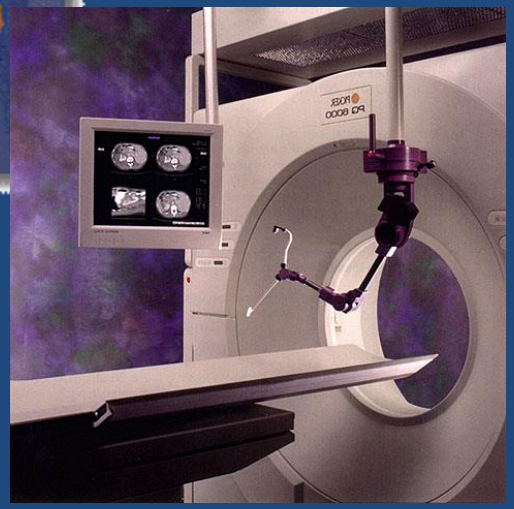
Skull projection taken same appointment as panoramic



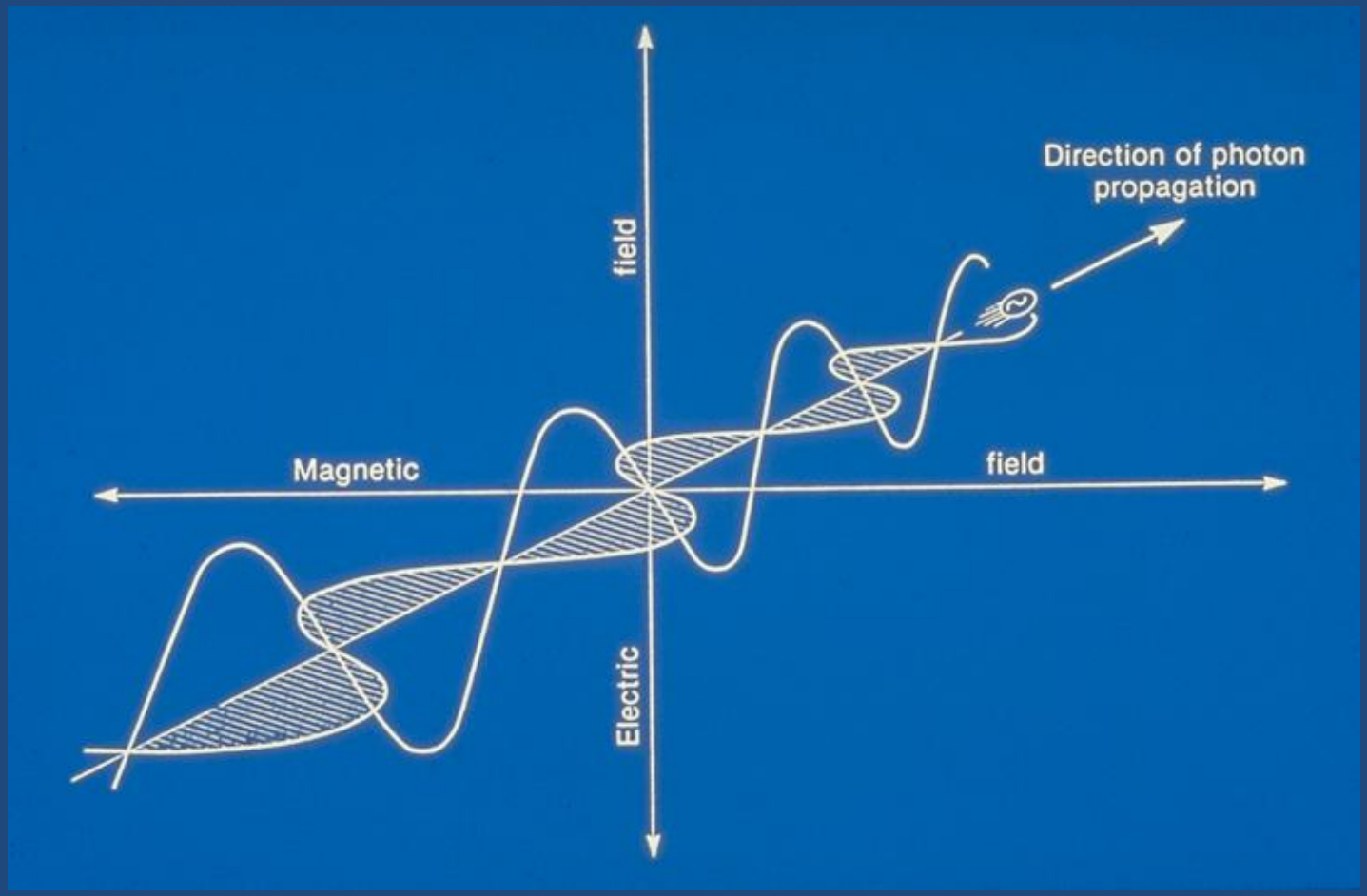




Advanced Diagnostic Imaging



ElectroMagnetic Radiation



The Joy of Radiation Biology

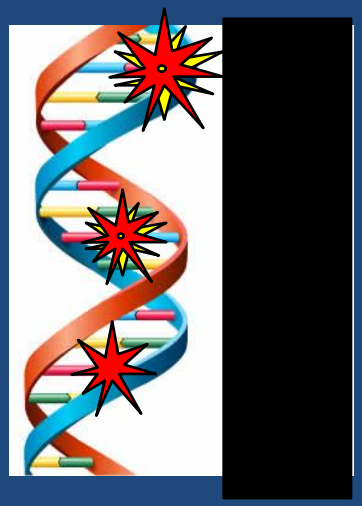
Three Minutes of Educational Ecstasy

X-rays

R **BAD** 4 U

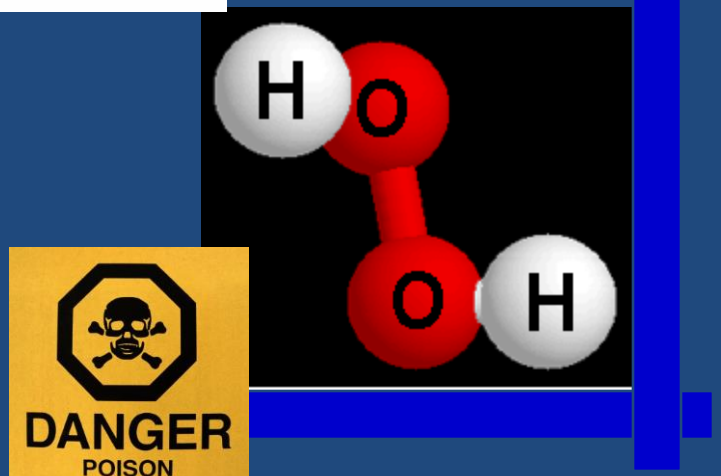
Direct Effects of X-rays

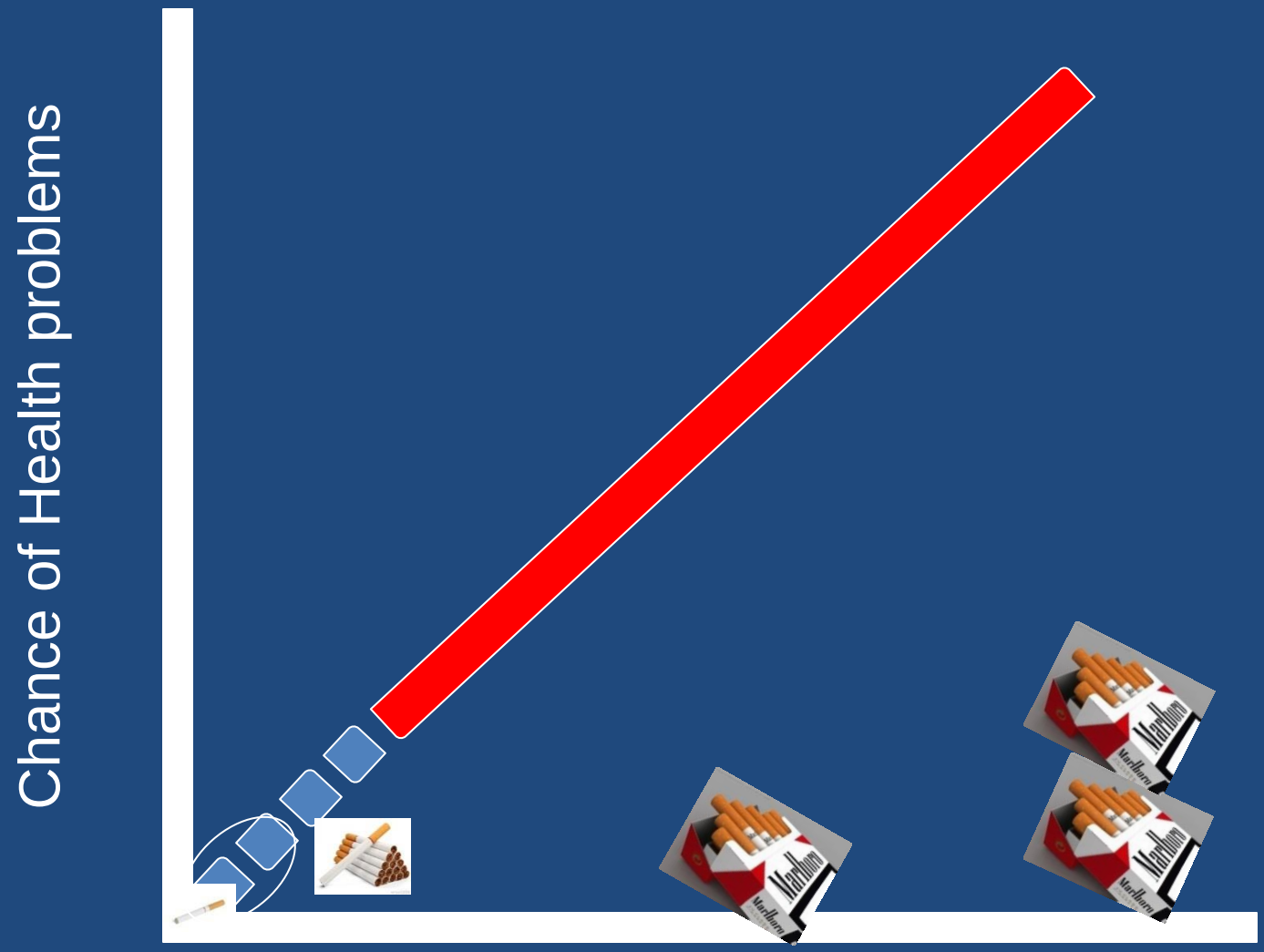
- direct collision with biological macromolecules
- result in altered structure and function



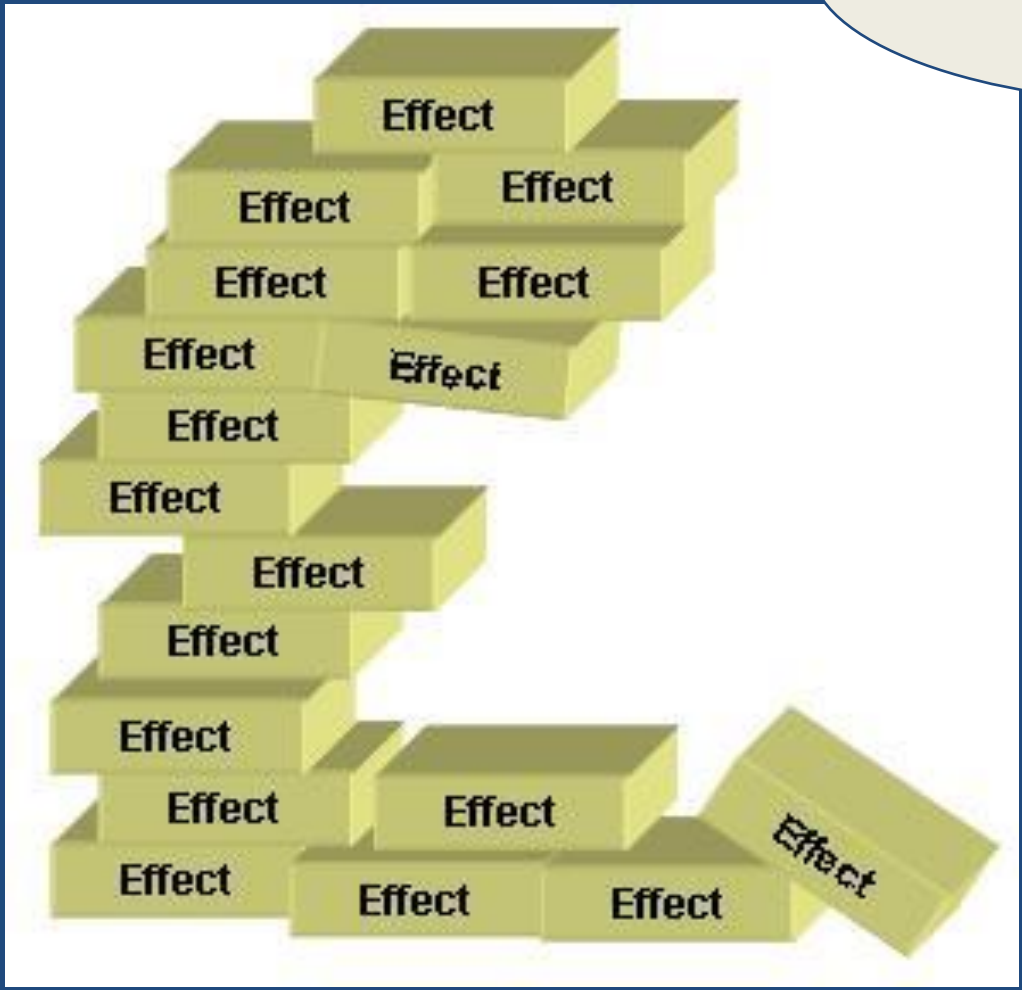
Indirect Effects of X-rays

- Ionization (break-up) of water molecules
- formation of H* and OH* ions
- production of hydroperoxyl (H_2O_2)

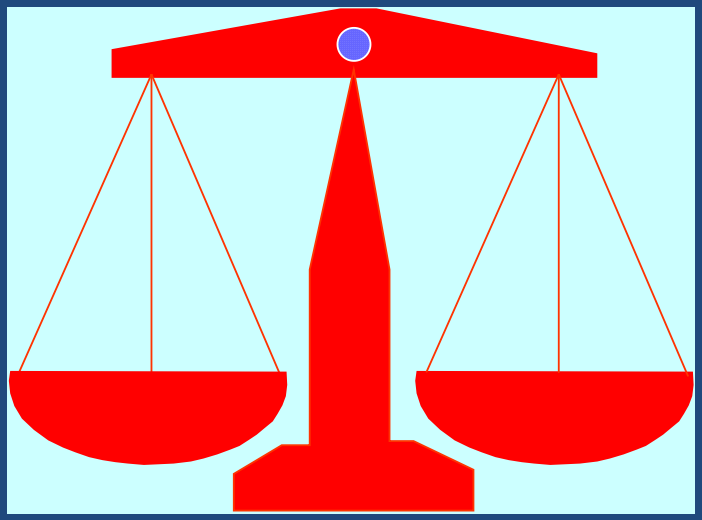



Chance of Health problems
Number of cigarettes smoked
Marlboro
Marlboro
Marlboro

Cumulative


Effect
Effect
Effect
Effect
Effect
Effect
Effect
Effect
Effect
Effect
Effect
Effect
Effect
Effect
Effect
Effect
Effect
Effect
Effect

ALARA Principle



- As
- Low
- As
- Reasonably
- Achievable

Some are saying….

ALRAP: As Little Radiation As Possible

=

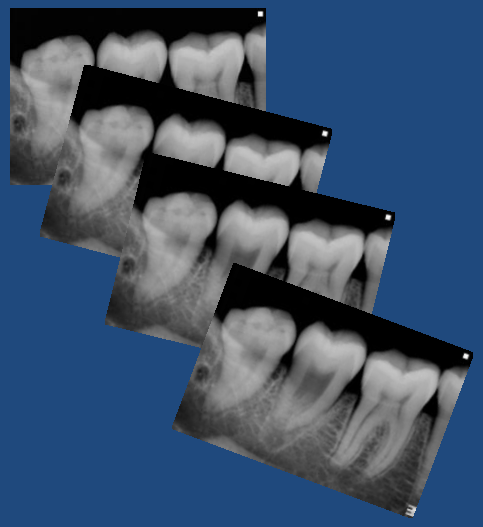
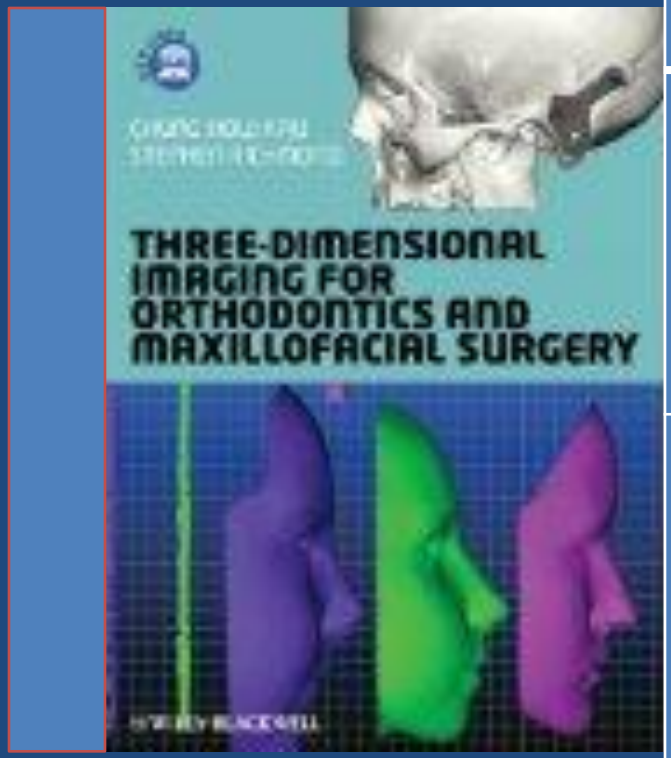


Table 3.2 Comparison of effective doses from cone beam computed tomography

From: Three-Dimensional Imaging for Orthodontics and Maxillofacial Surgery
Edited by Chung How Kau/Stephen Richmond
Wiley-Blackwell Publishers



Technique	Effective dose (uSv)	Dose as multiple of panoramic
Large Field of View	74	6
Medium Field of View	69	5
Panoramic	14	1

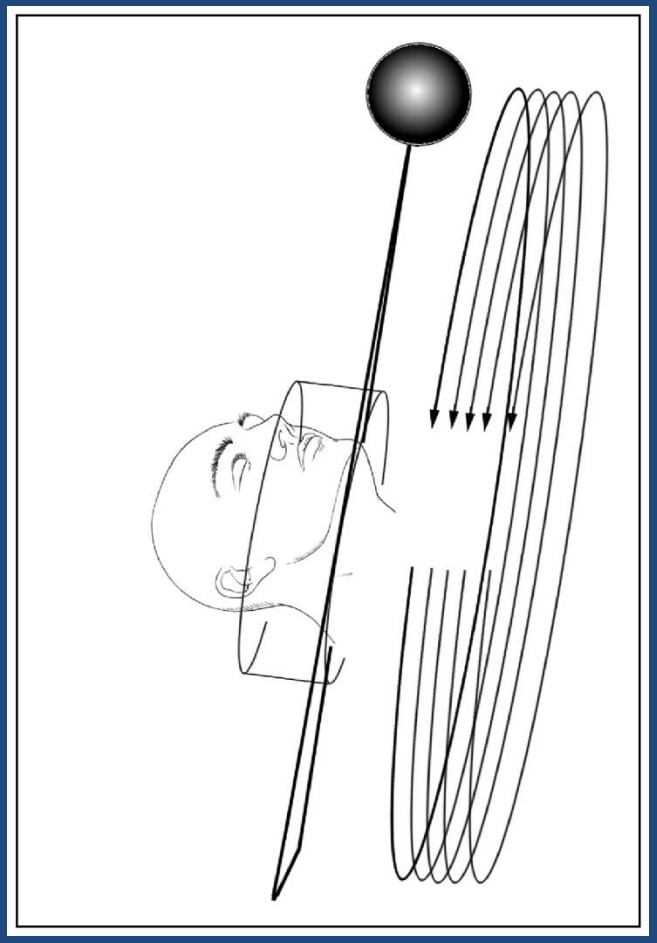
TOMOGRAPHY

Tomography

1. Computed Tomography
(Also called CT or CAT)

2. Conebeam Computed Tomography
(Also called CBCT and CBVT)

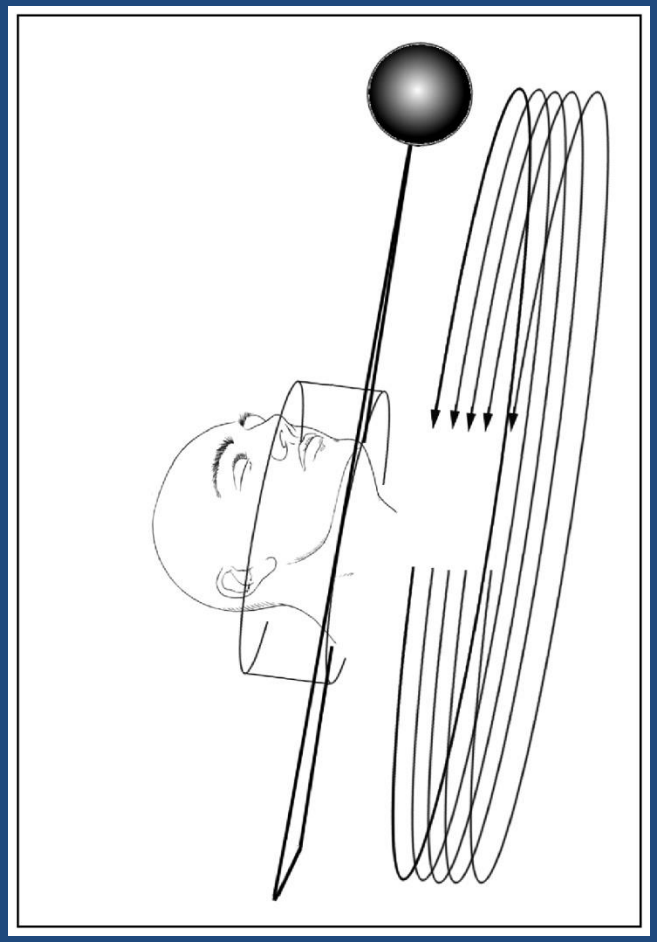
Traditional CT (CAT Scan)



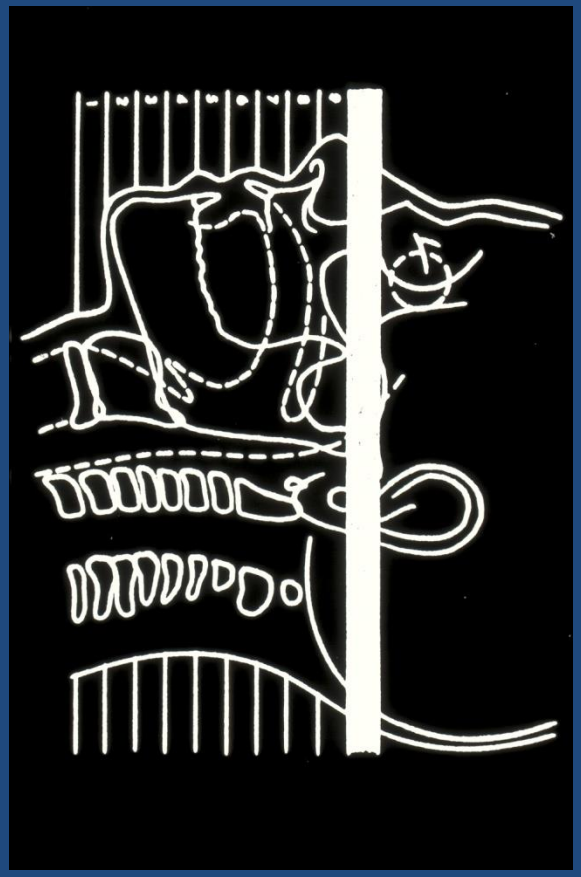
Computer Tomography (CT)

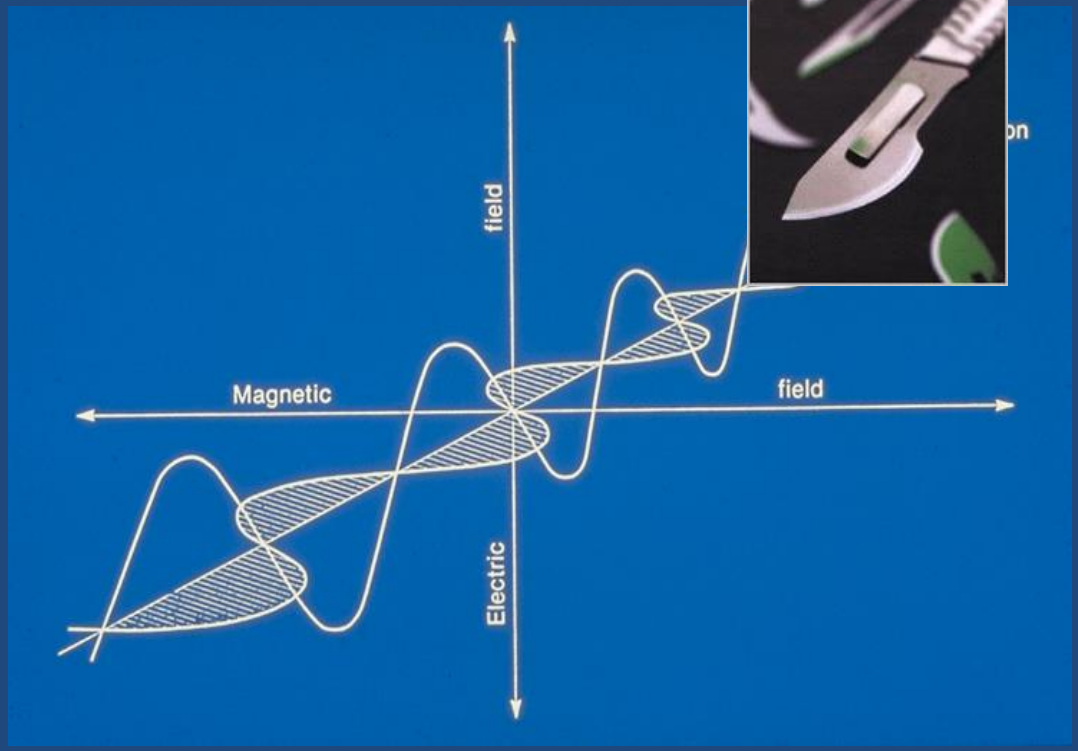
Public Domain

Traditional CT (CAT Scan)

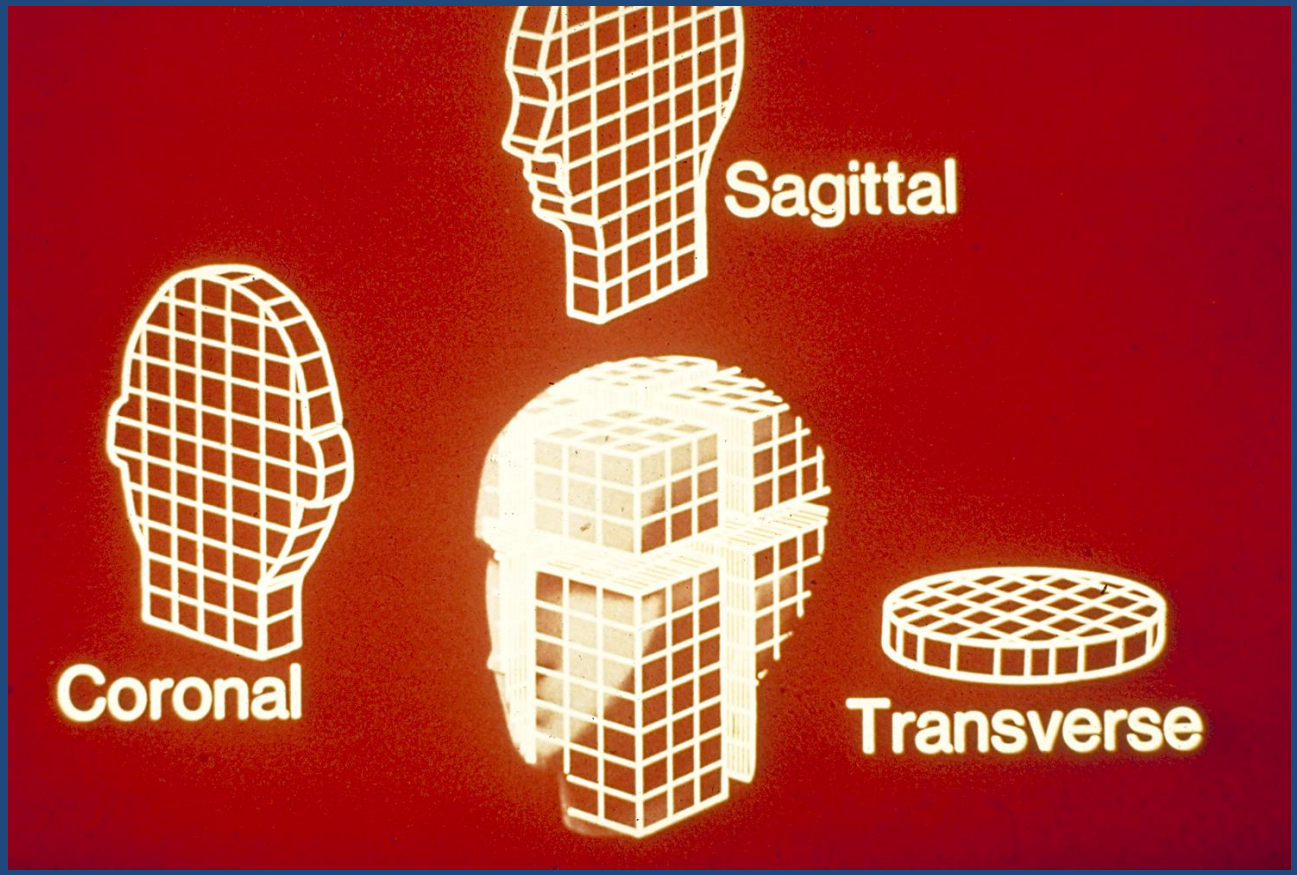


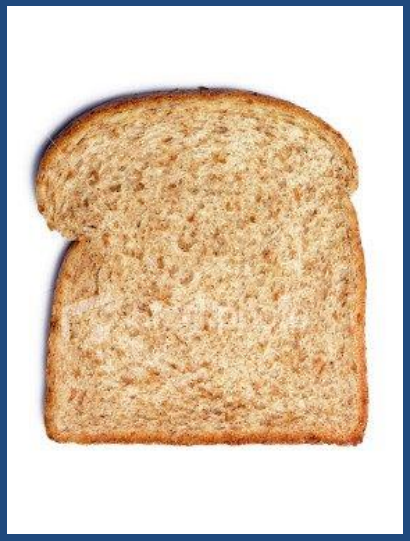
CT takes multiple slices in ROI (region of interest)

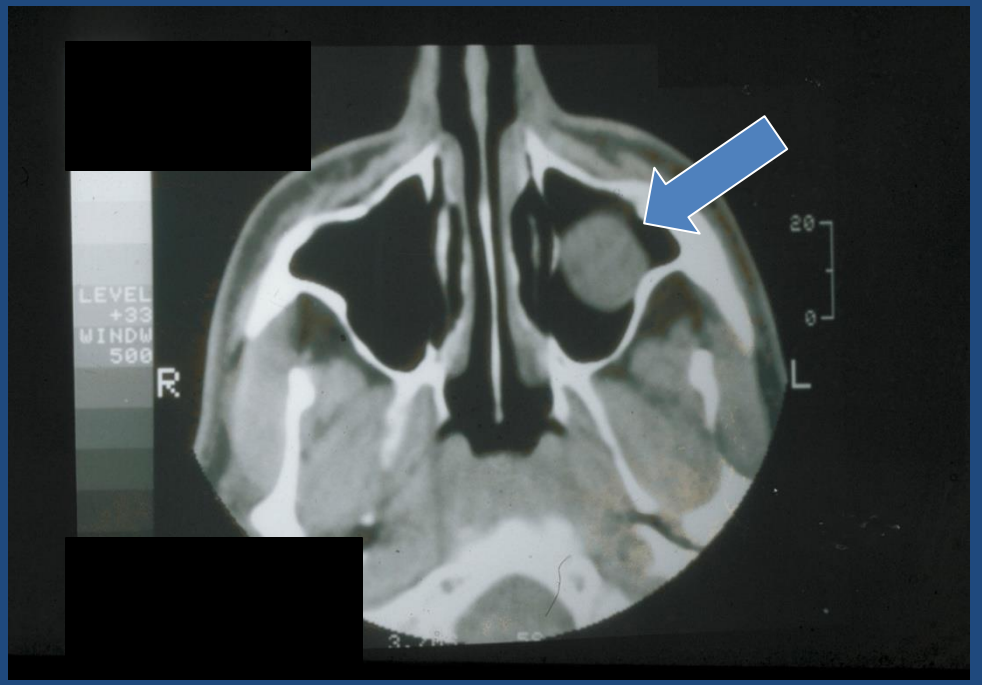


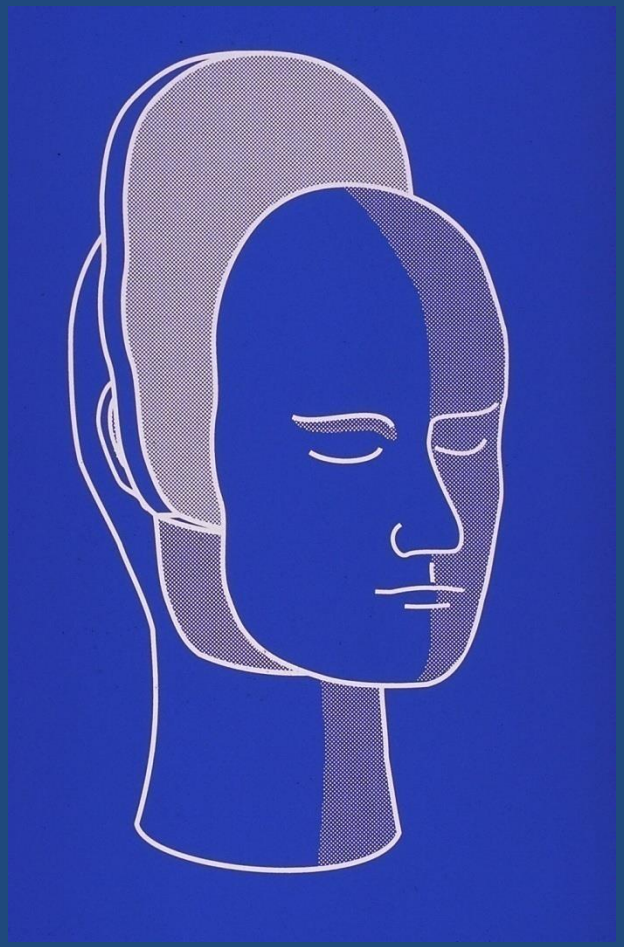

field
Magnetic
field
Electric

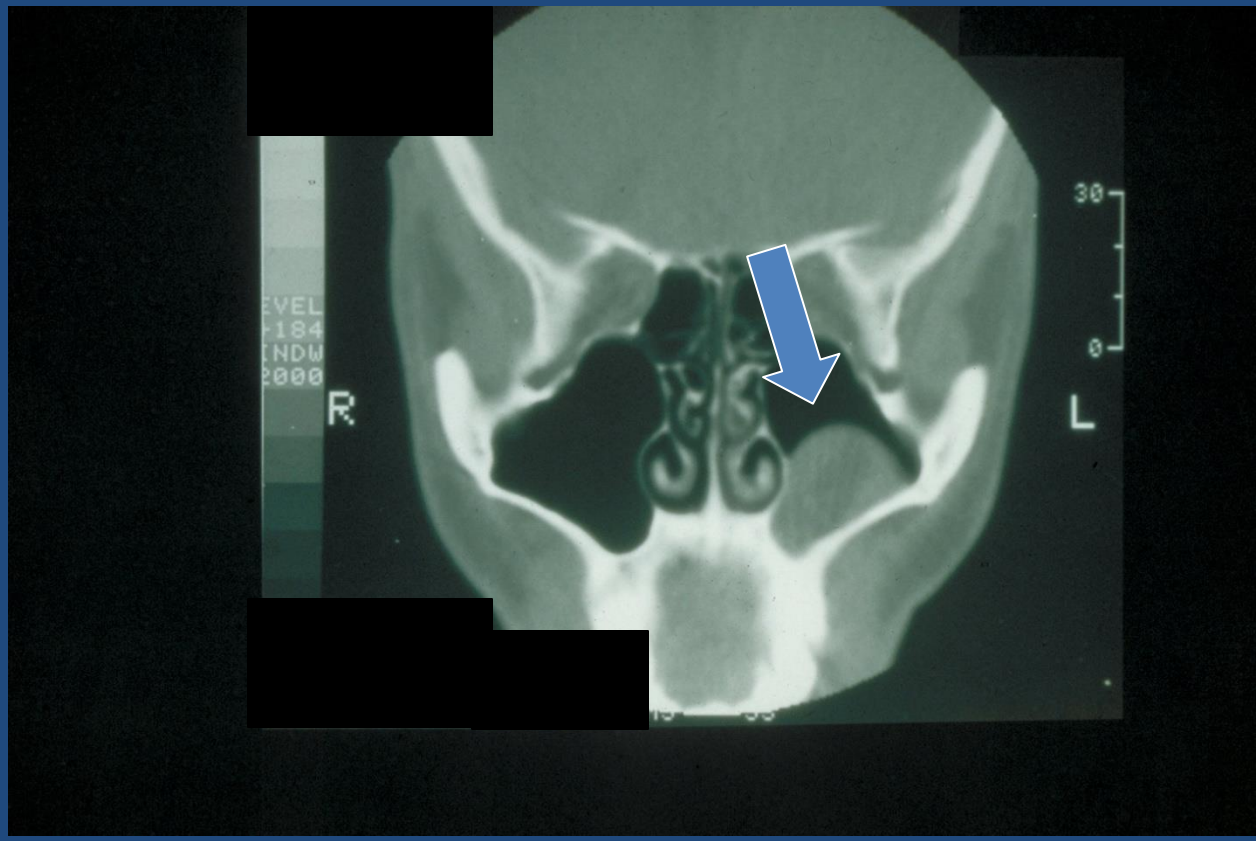
Different Views = Additional Information can result in increased diagnostic yield



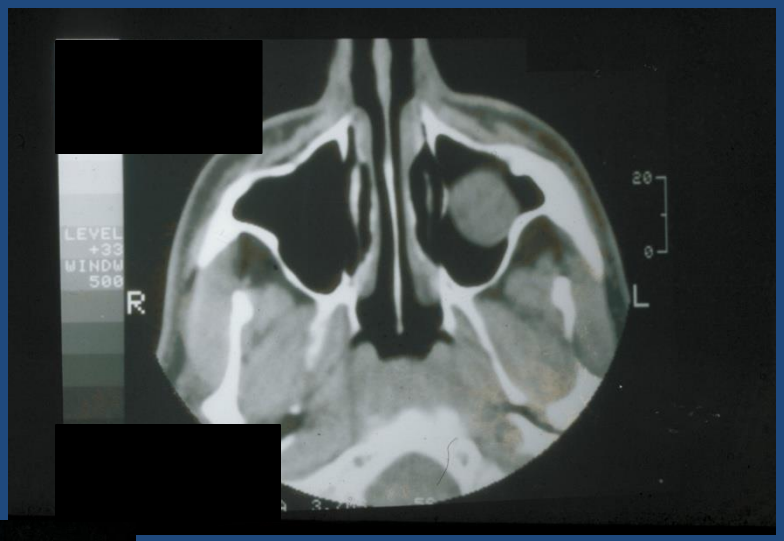


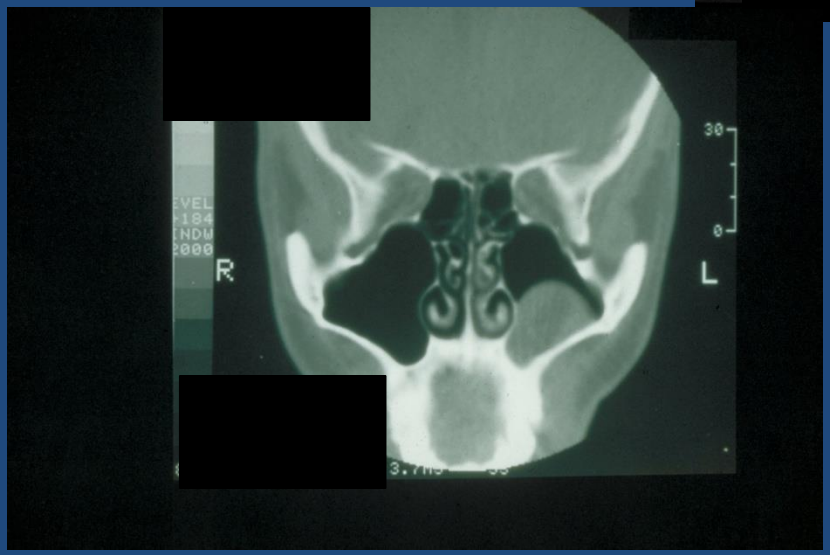

LEVEL
+33
WINDW
500
R
L
20
0



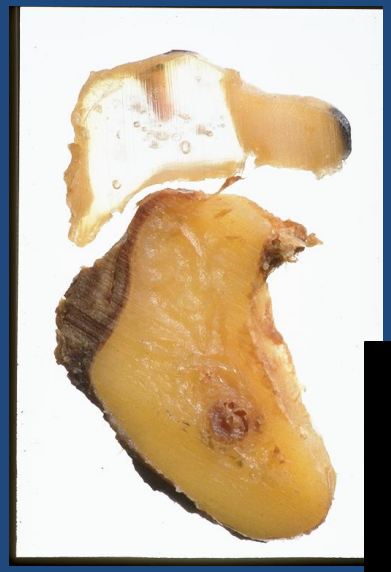

R
L
30
0

Mucus Retention Cyst



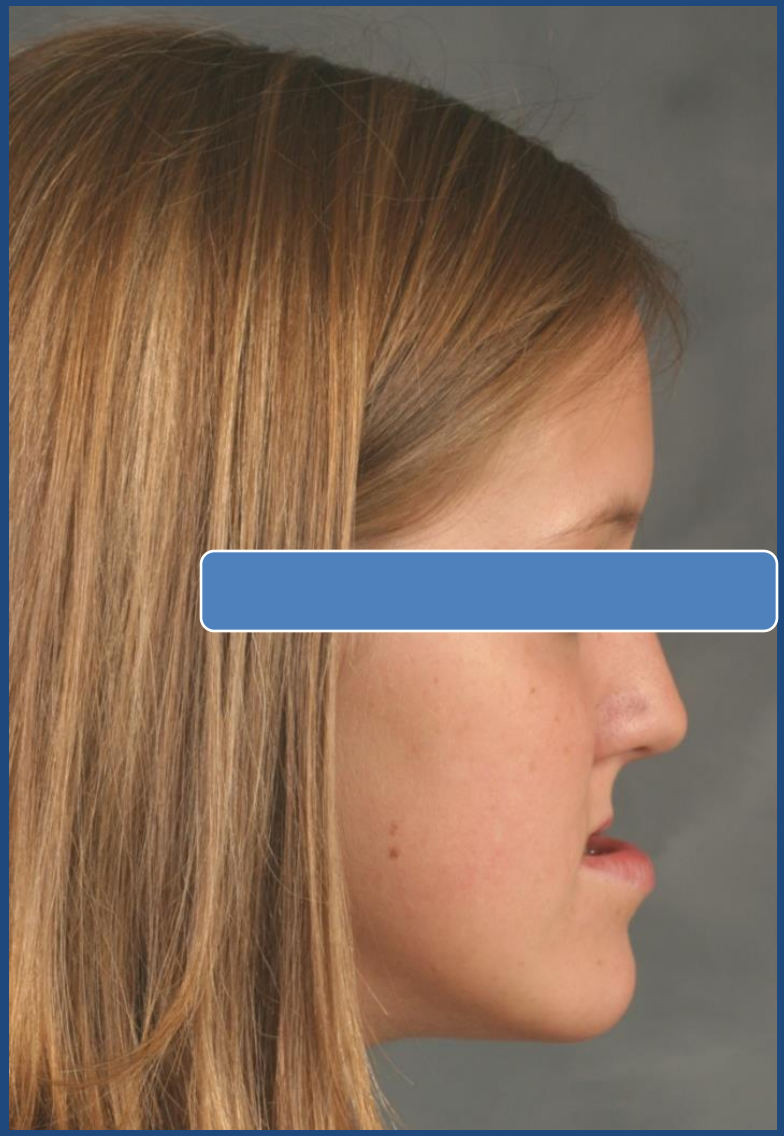


Traditional CT



IMPLANT IMAGING

Applications



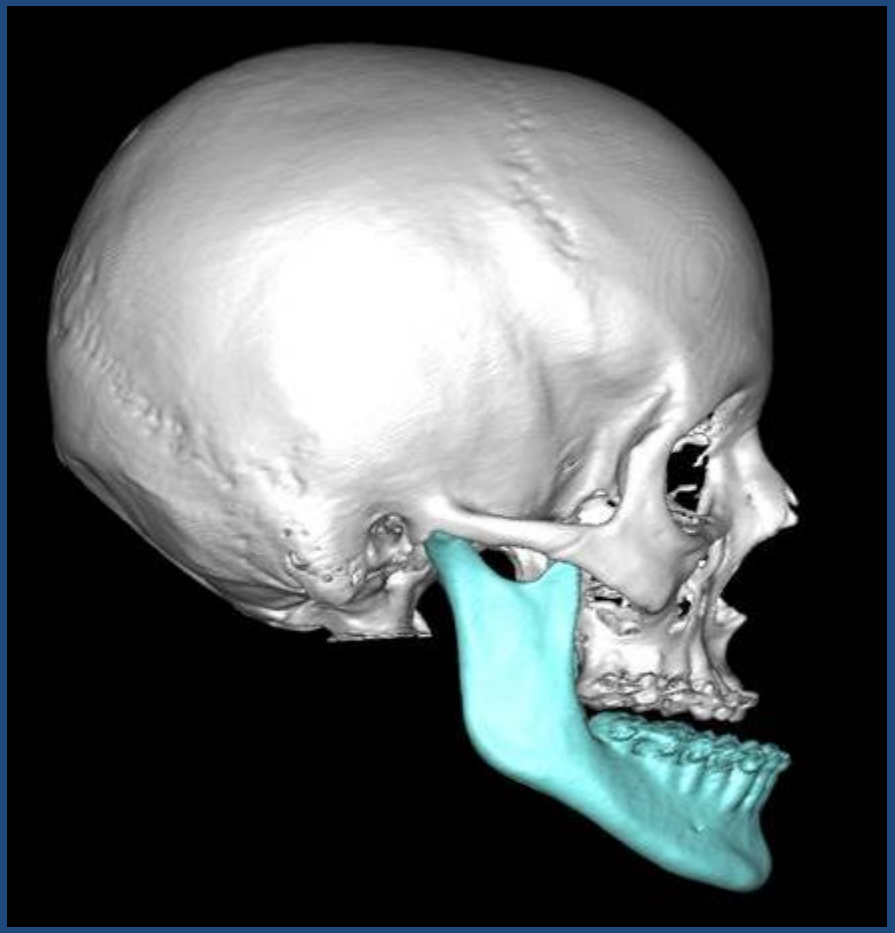
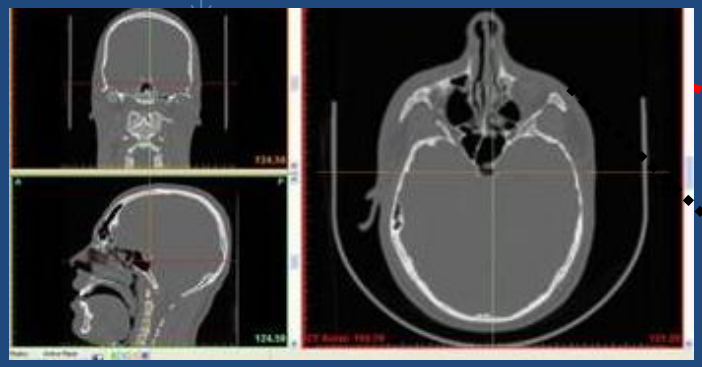
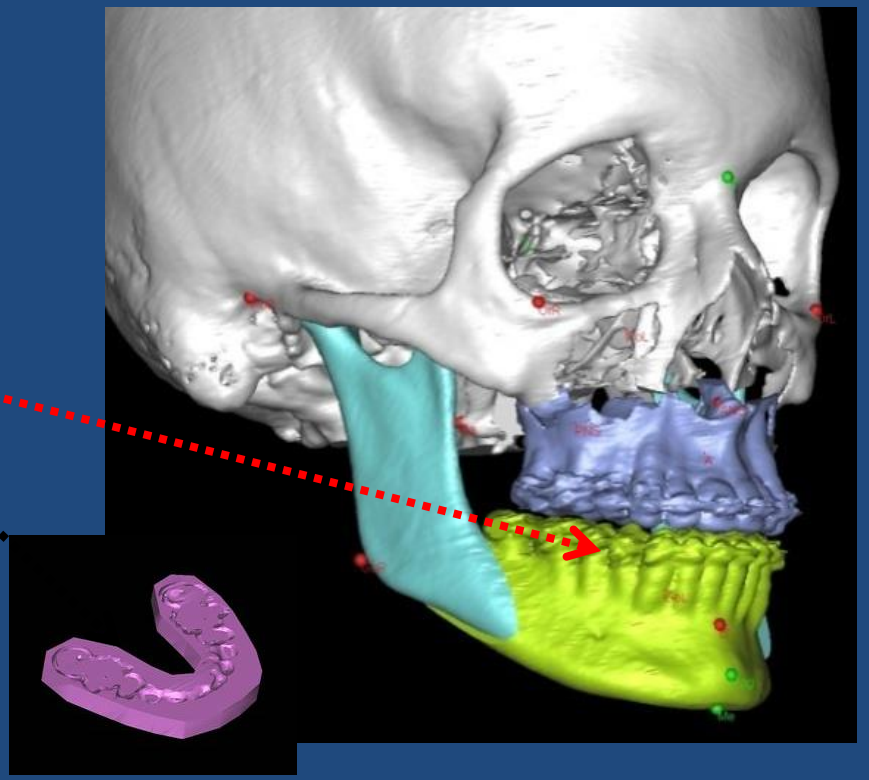
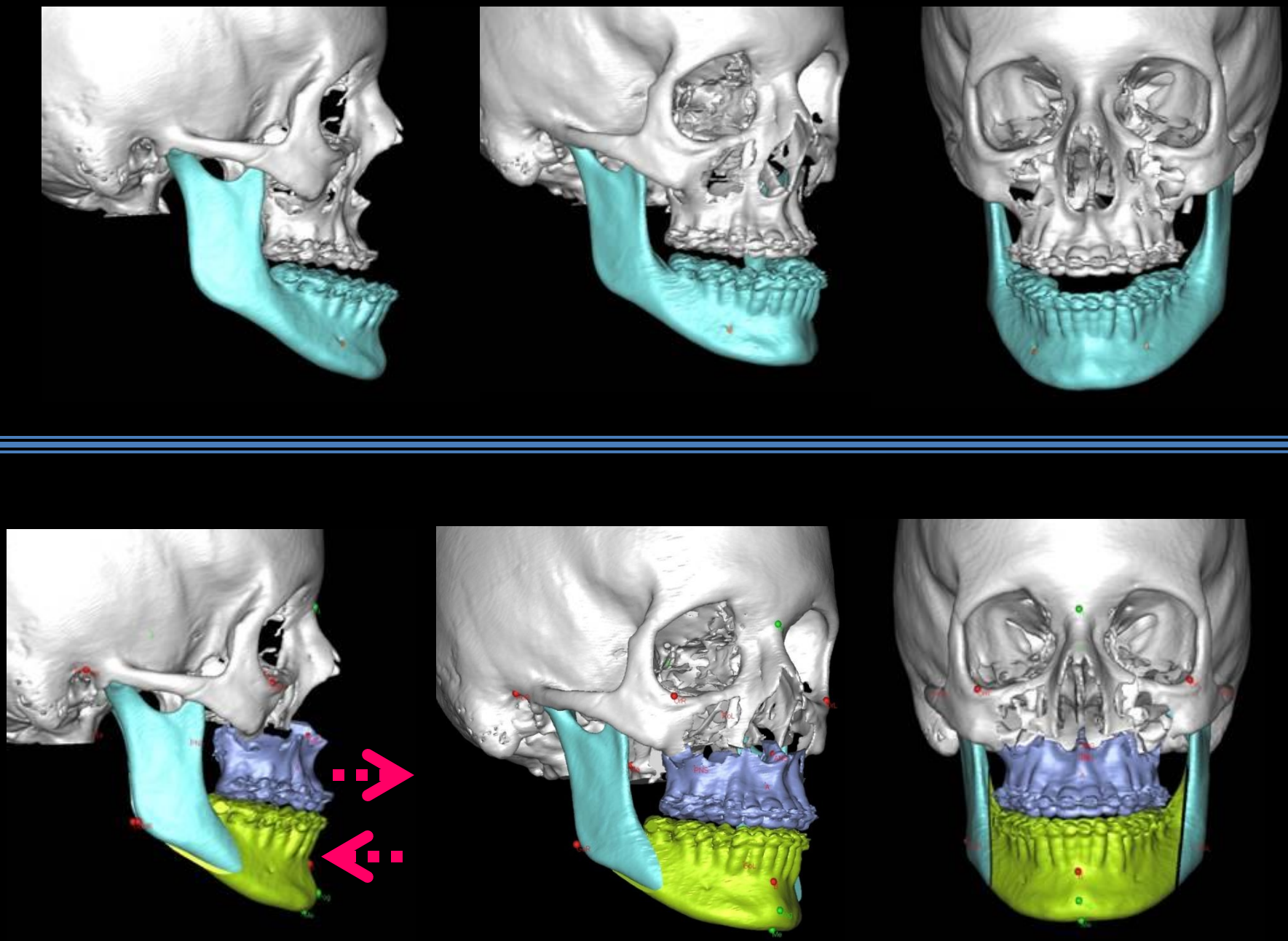
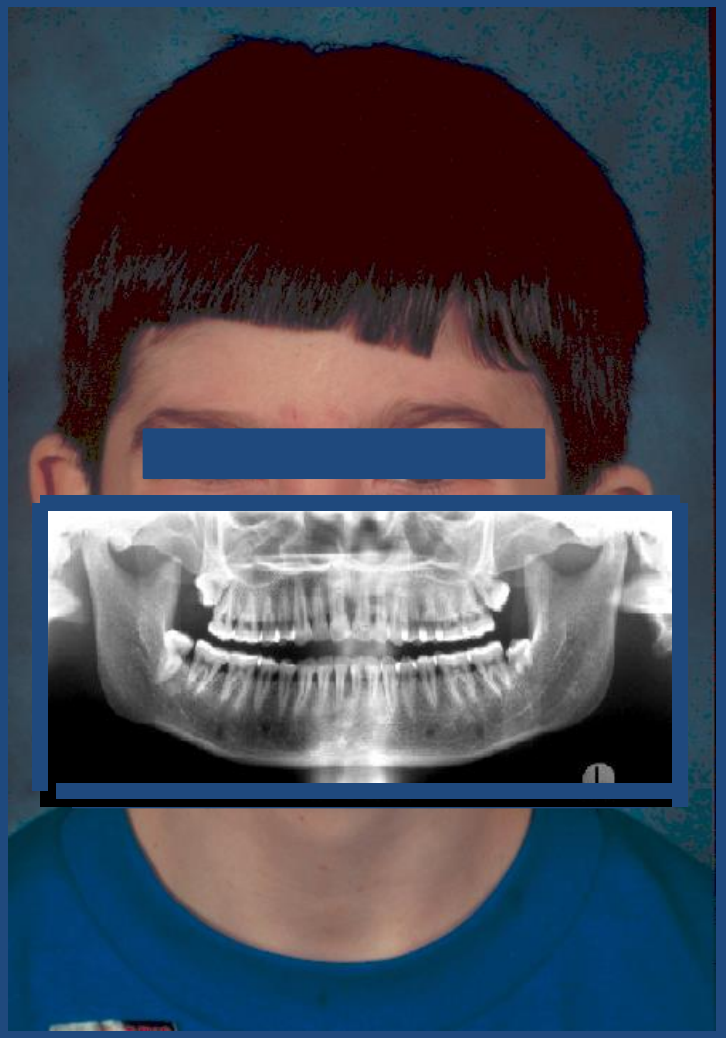


Image Based Surgery

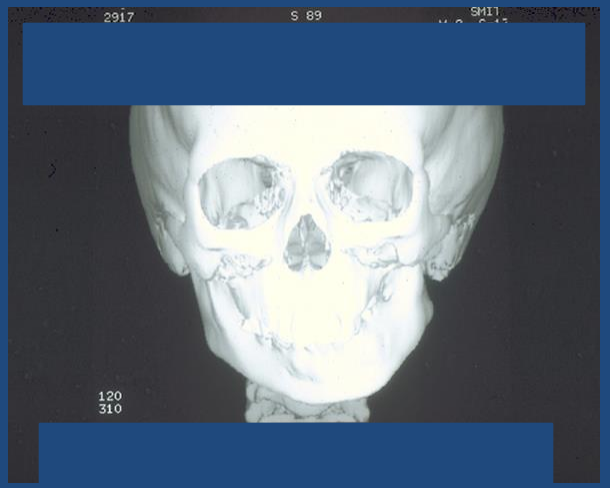


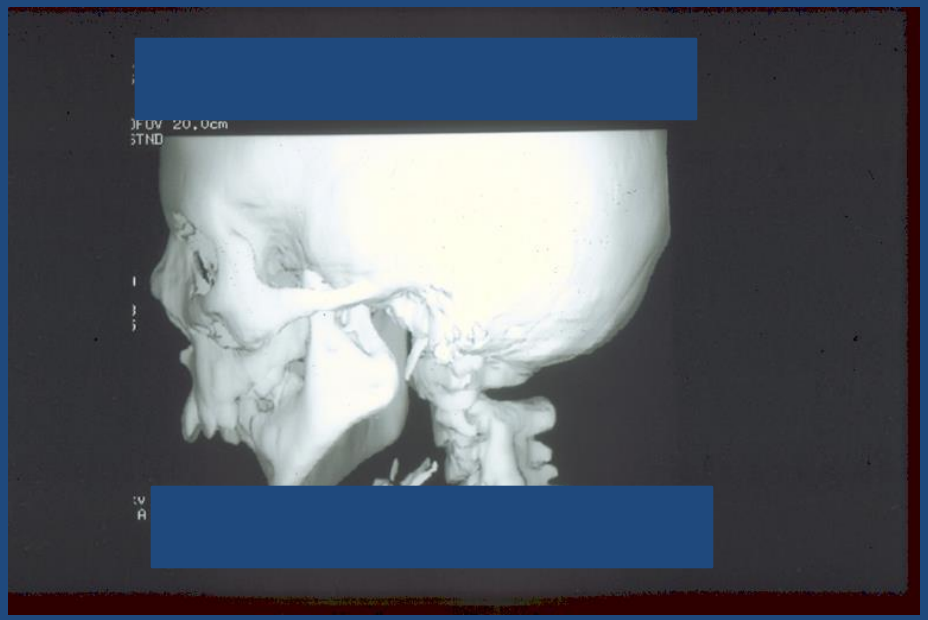






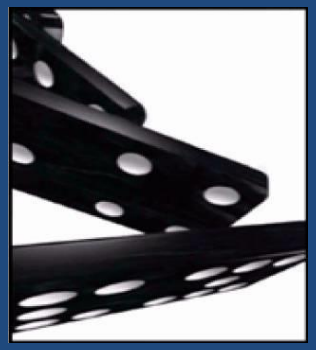
Developmental Malformations





Problems with Medical CT (CAT scan)

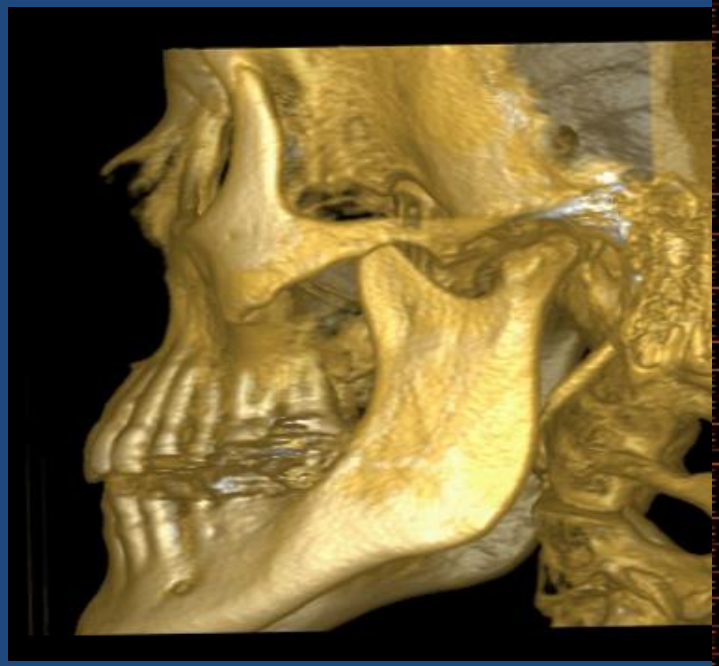
- Time
- Dose
- Point of service
- $$$$$
- Not isotropic

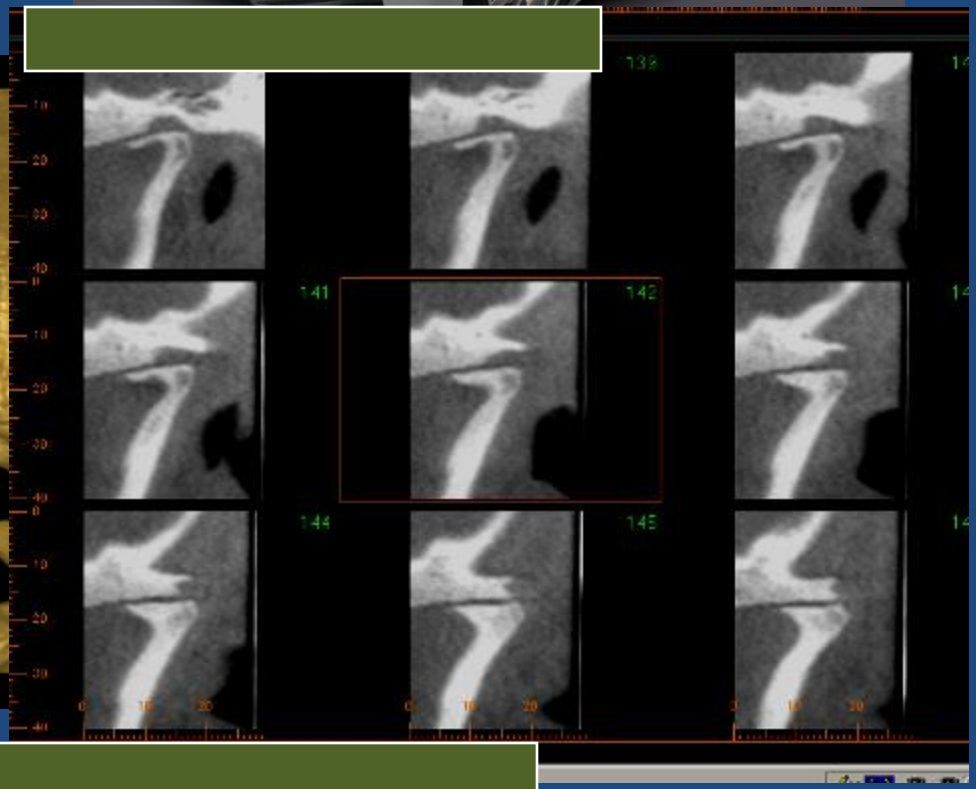


– Cone Beam Tomography

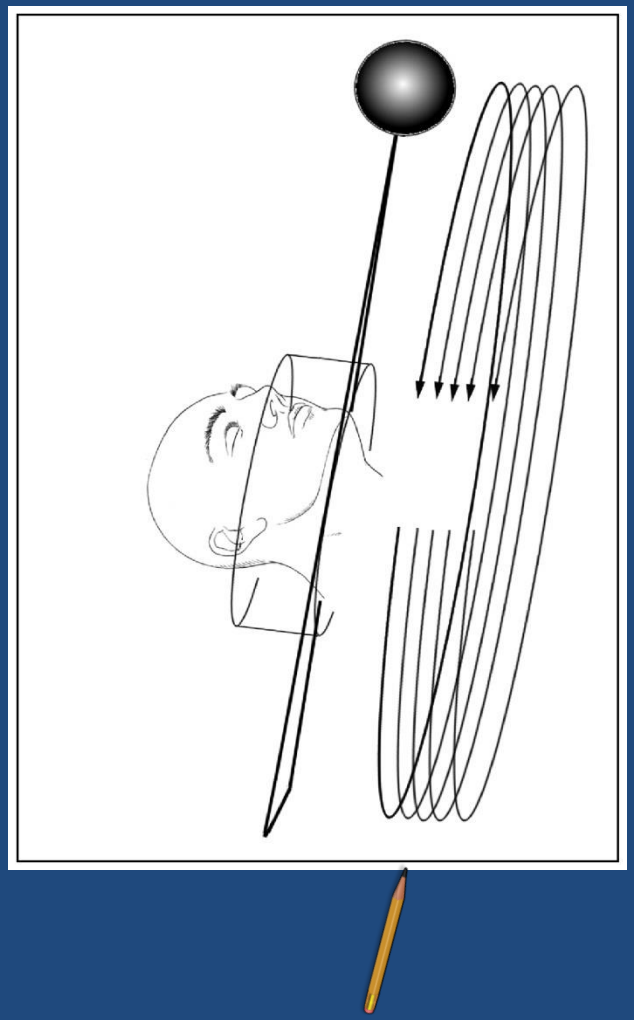
CBCT

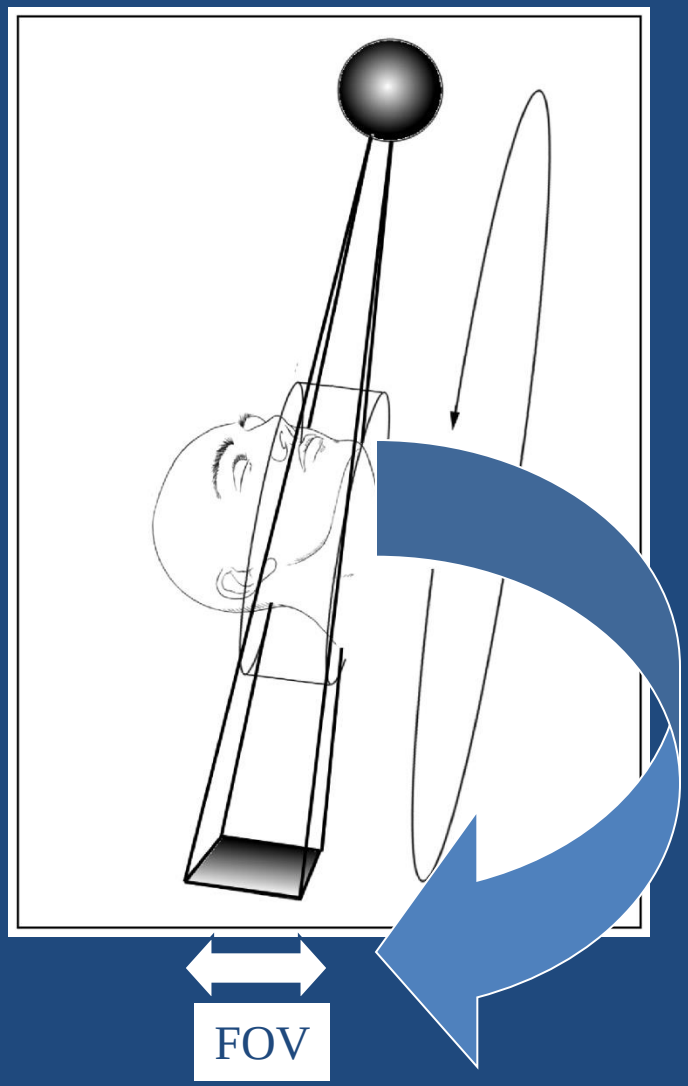
This is a new type of tomography, circa 2000.

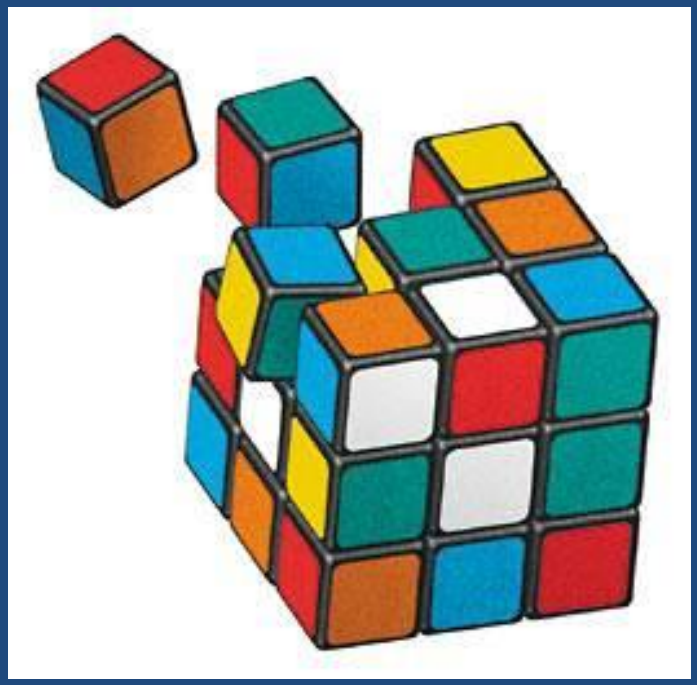




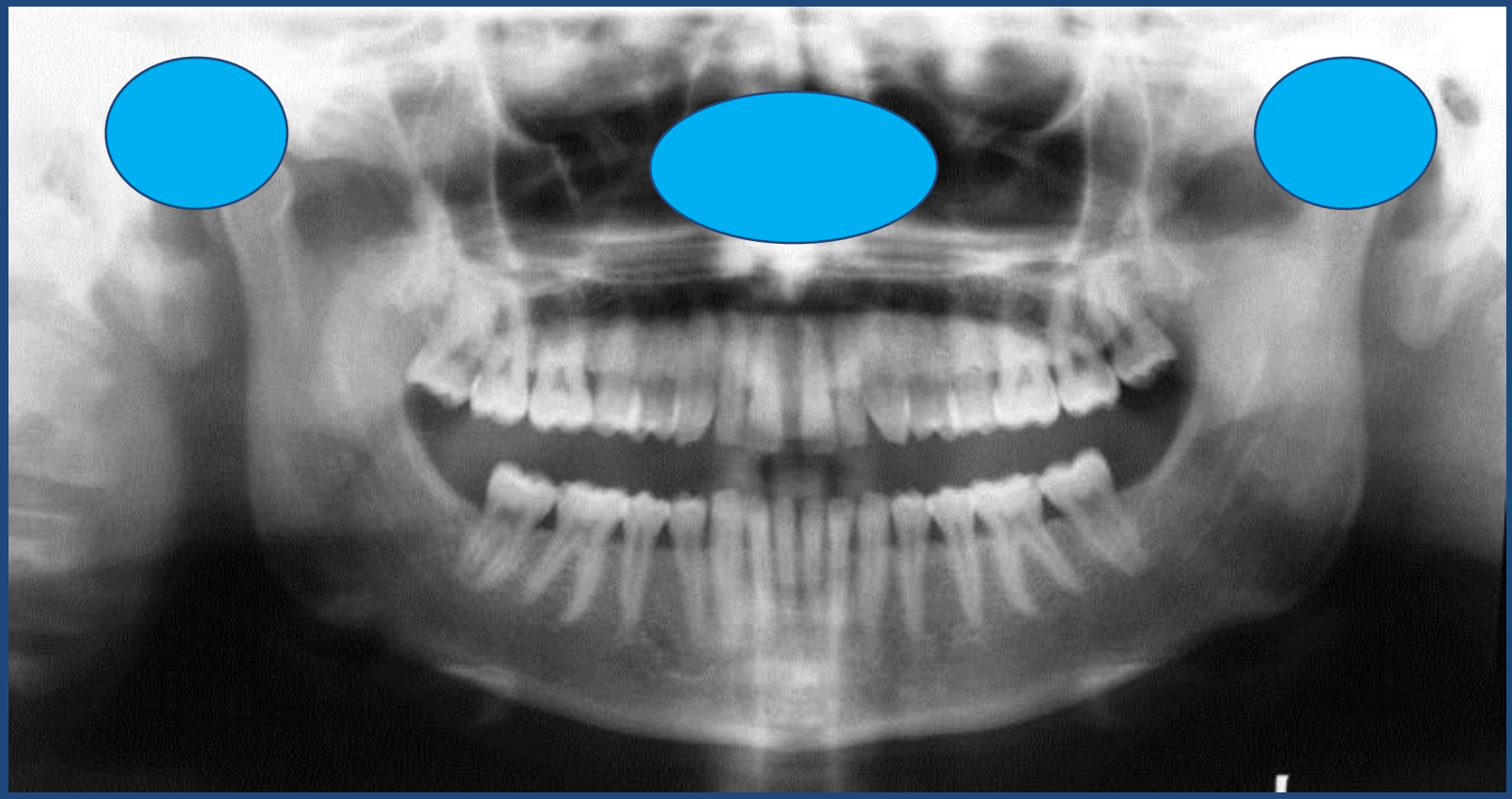
Traditional CT Scan vs. ConeBeam CT



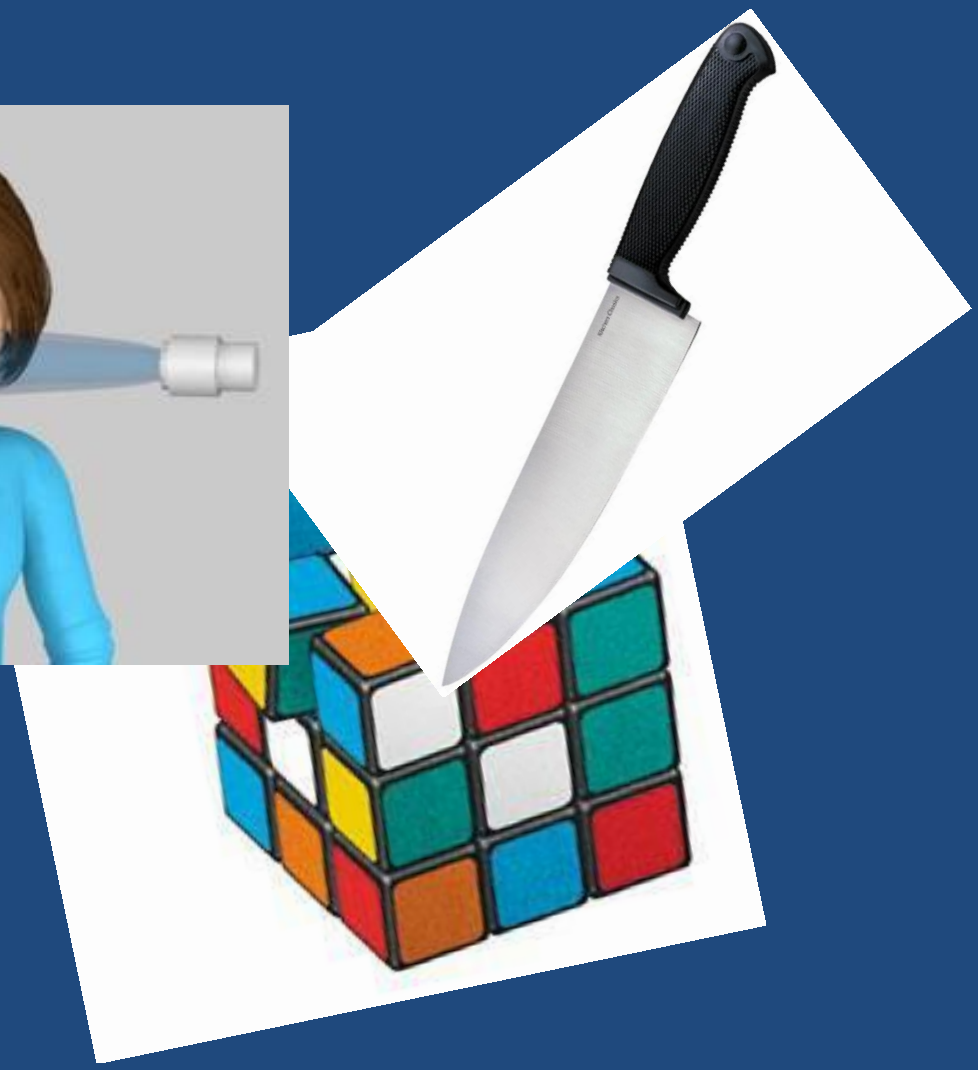


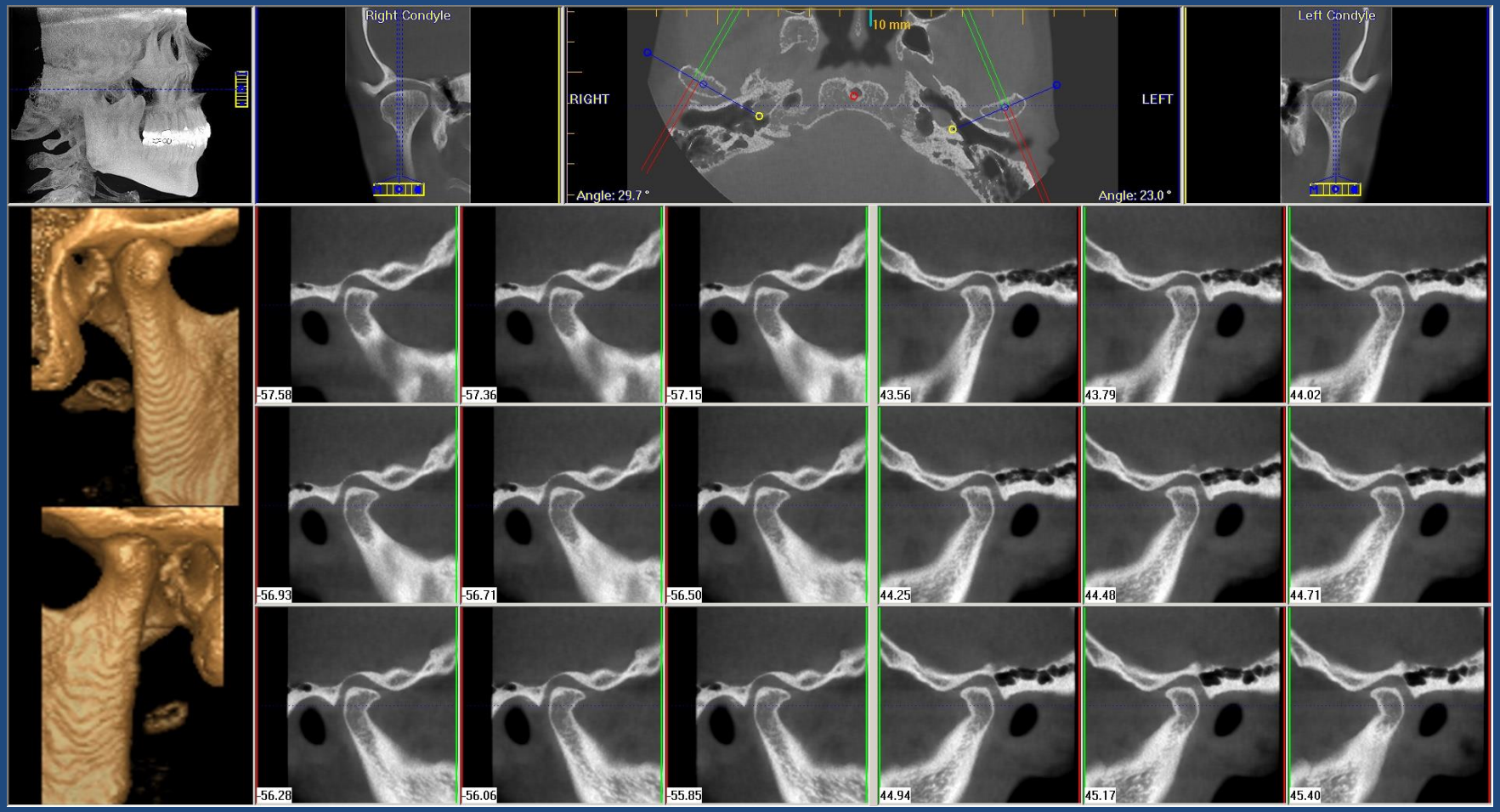


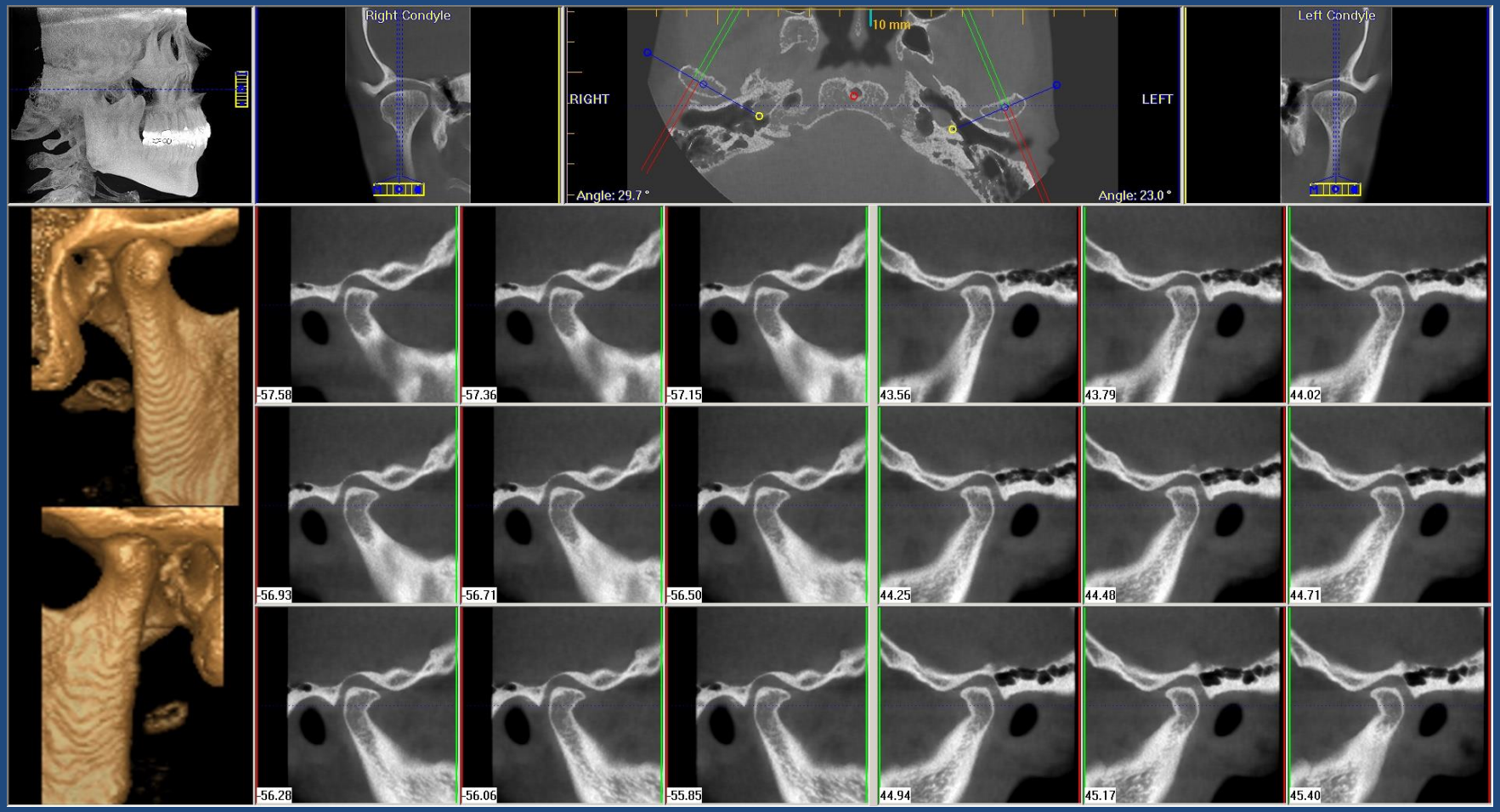

•Glenoid Fossa
•Articular Eminence
•External Auditory Meatus
Pterygoid

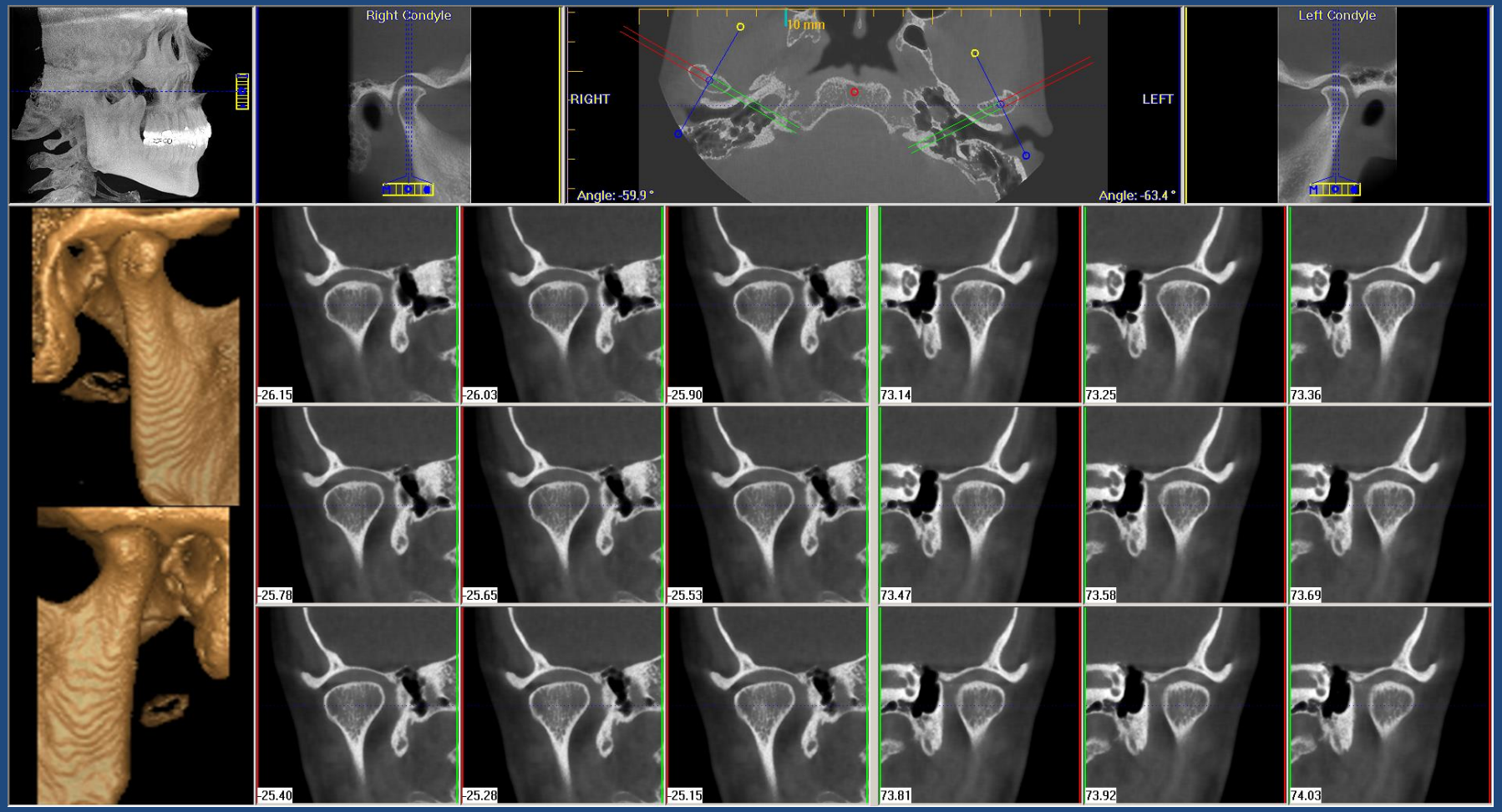


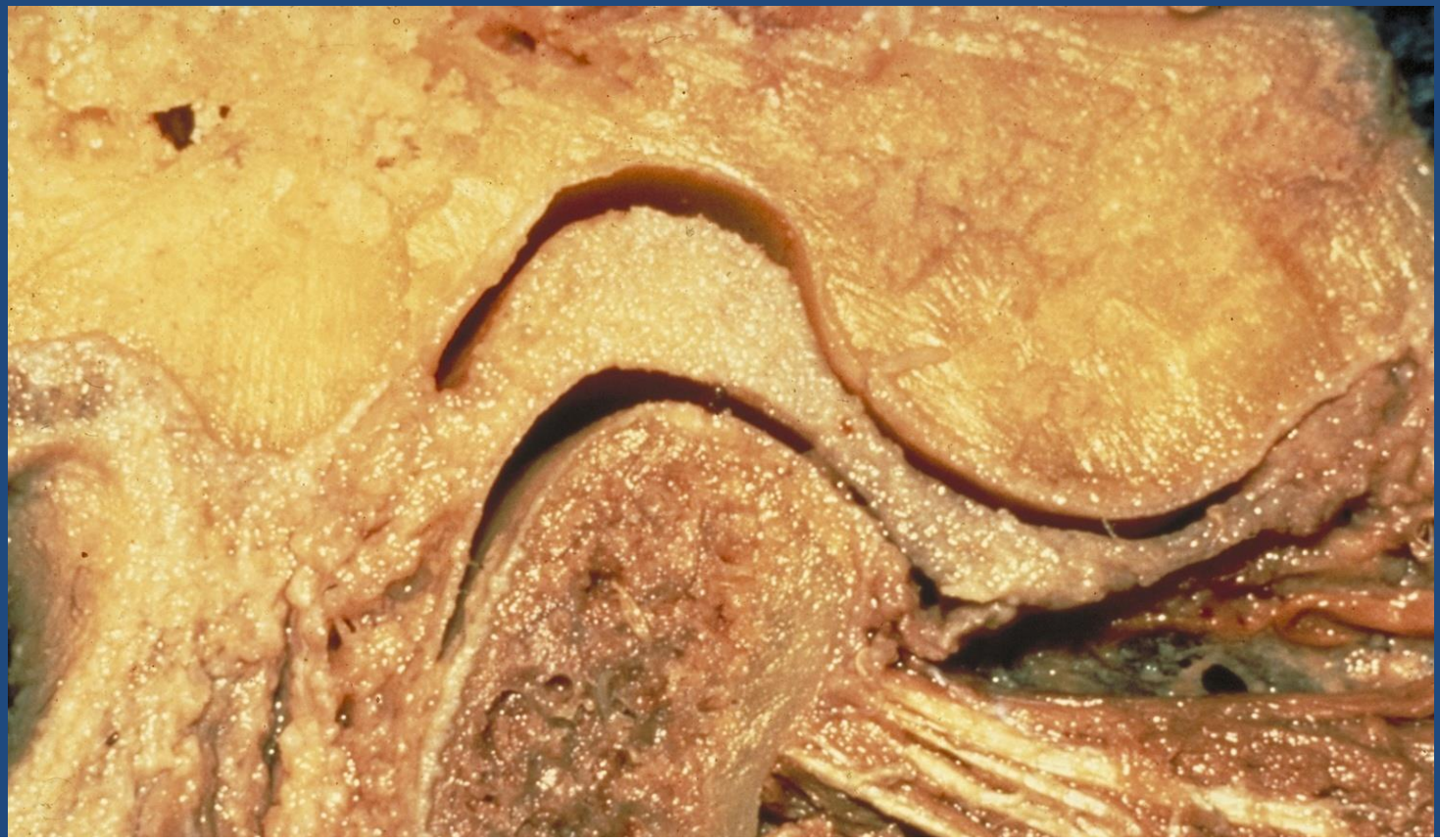
ConeBeam CT



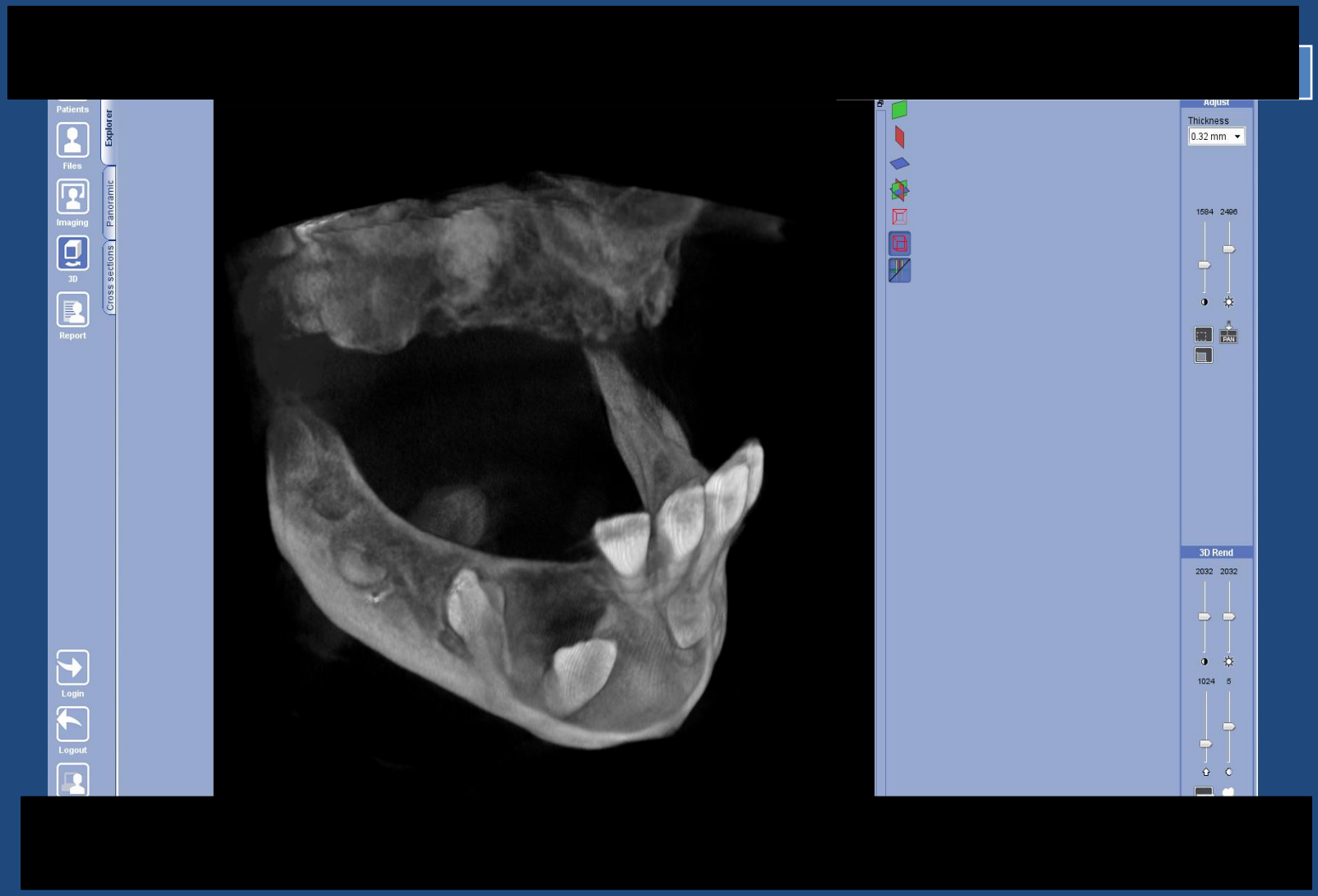

Right Condyle
10 mm
RIGHT
LEFT
Angle: 29.7 °
Angle: 23.0 °
Left Condyle
-57.58
-57.36
-57.15
43.56
43.79
44.02
-56.93
-56.71
-56.50
44.25
44.48
44.71
-56.28
-56.06
-55.85
44.94
45.17
45.40

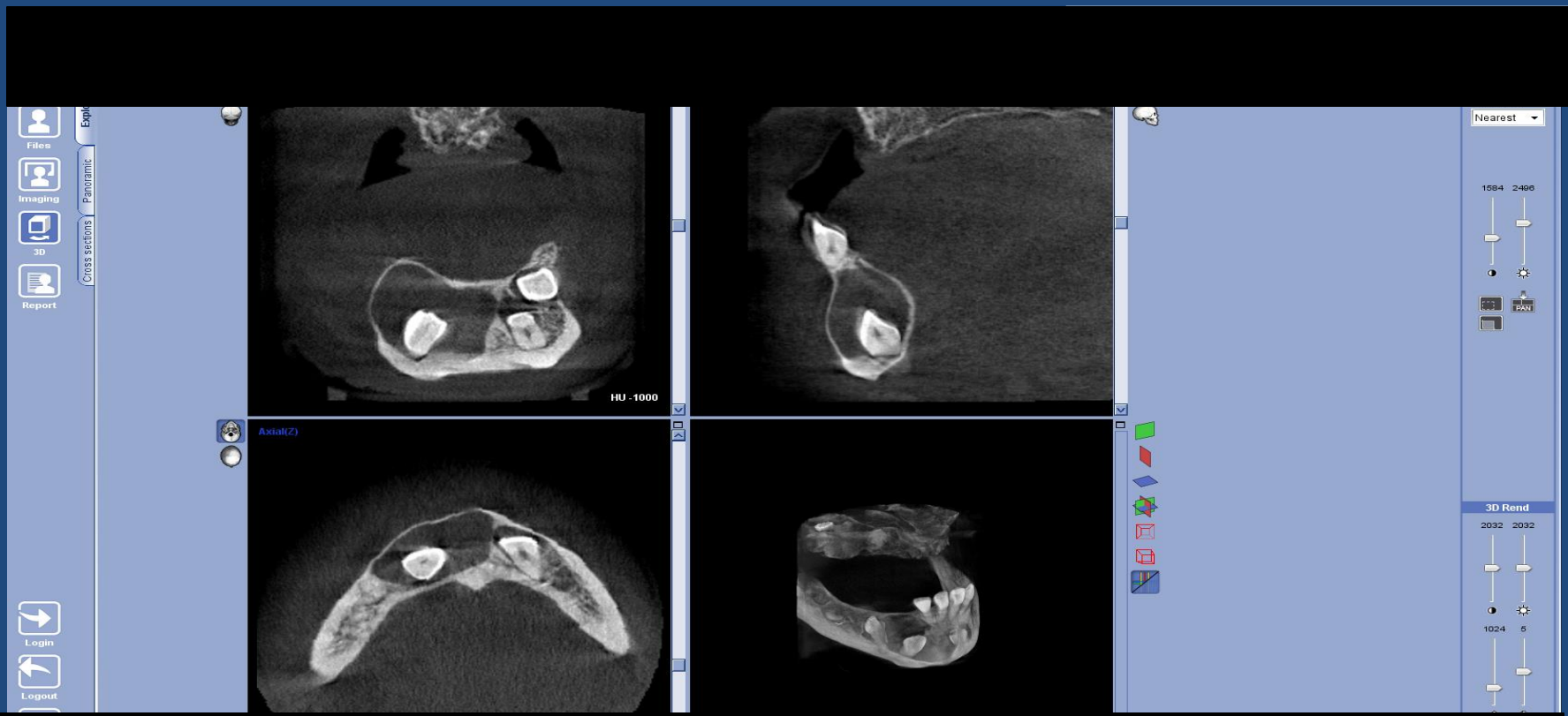

Right Condyle
10 mm
RIGHT
LEFT
Angle: 29.7 °
Angle: 23.0 °
Left Condyle
-57.58
-57.36
-57.15
43.56
43.79
44.02
-56.93
-56.71
-56.50
44.25
44.48
44.71
-56.28
-56.06
-55.85
44.94
45.17
45.40

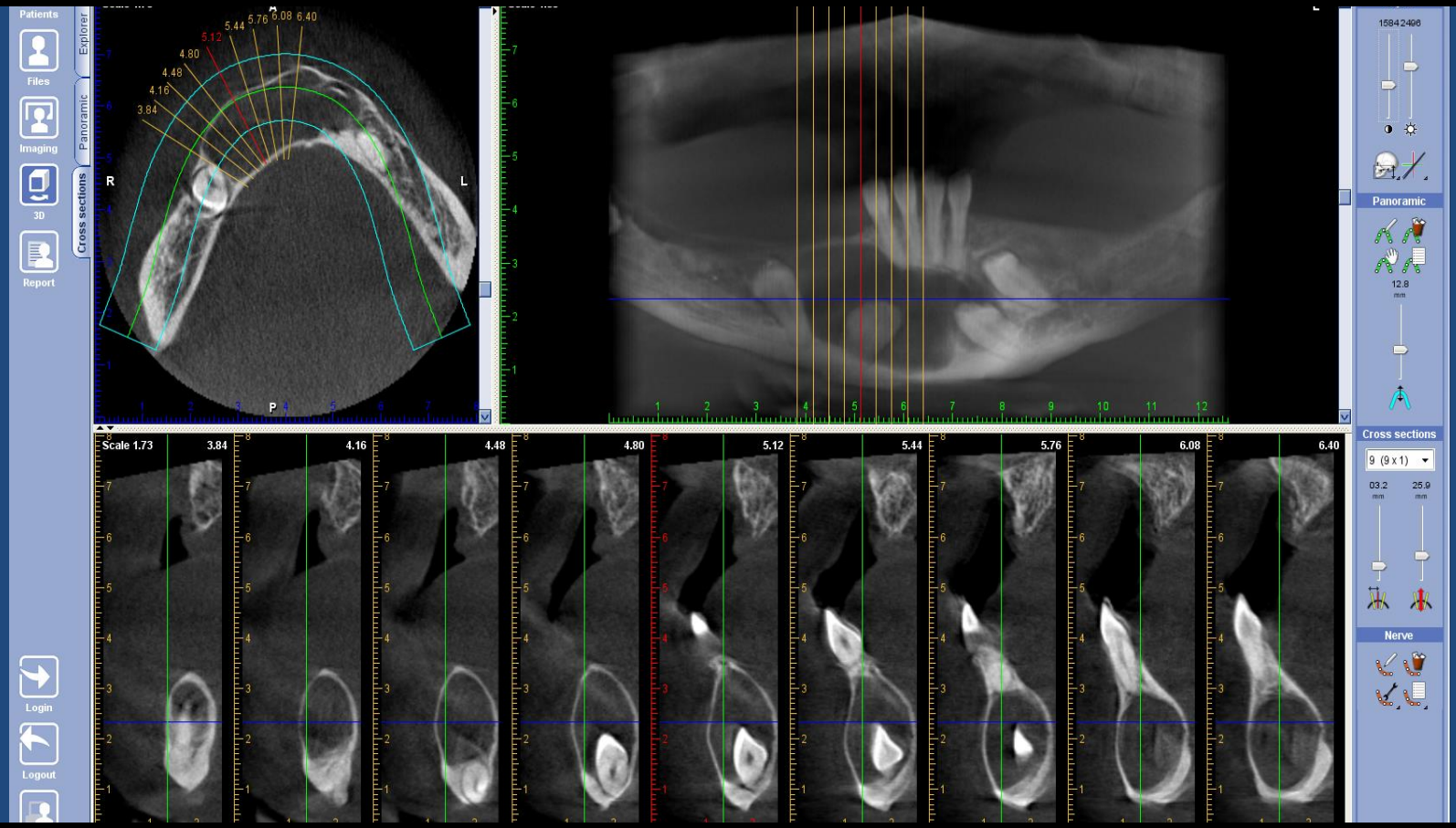

Right Condyle
10 mm
RIGHT
LEFT
Angle: -59.9 °
Angle: -63.4 °
Left Condyle
-26.15
-26.03
-25.90
73.14
73.25
73.36
-25.78
-25.65
-25.53
73.47
73.58
73.69
-25.40
-25.28
-25.15
73.81
73.92
74.03



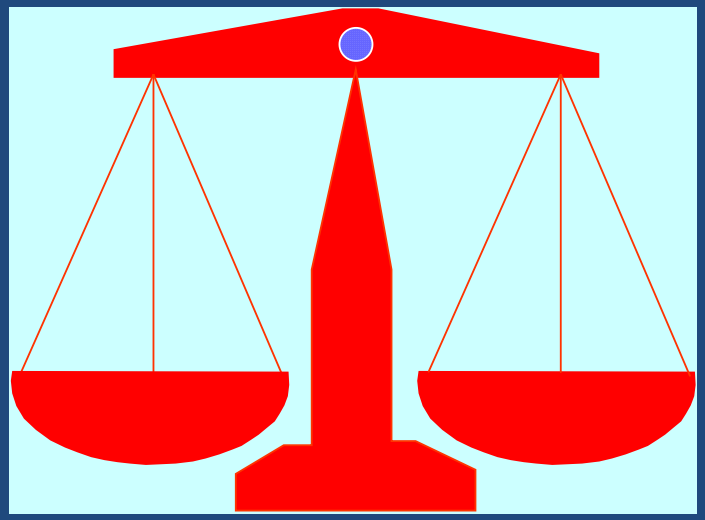
Diagnostic Yield




Files
Imaging
3D
Report
Login
Logout
Panoramic
Cross sections
HU -1000
Axial(Z)
Nearest
1584
2496
PAN
3D Rend
2032
2032
1024
5


Patients
Files
Imaging
3D
Report
Explorer
Panoramic
Cross sections
Login
Logout
3.84
4.16
4.48
4.80
5.12
5.44
5.76
6.08
6.40
R
L
P
Scale 1.73
Panoramic
Cross sections
9 (9 x 1)
Nerve

ALARA



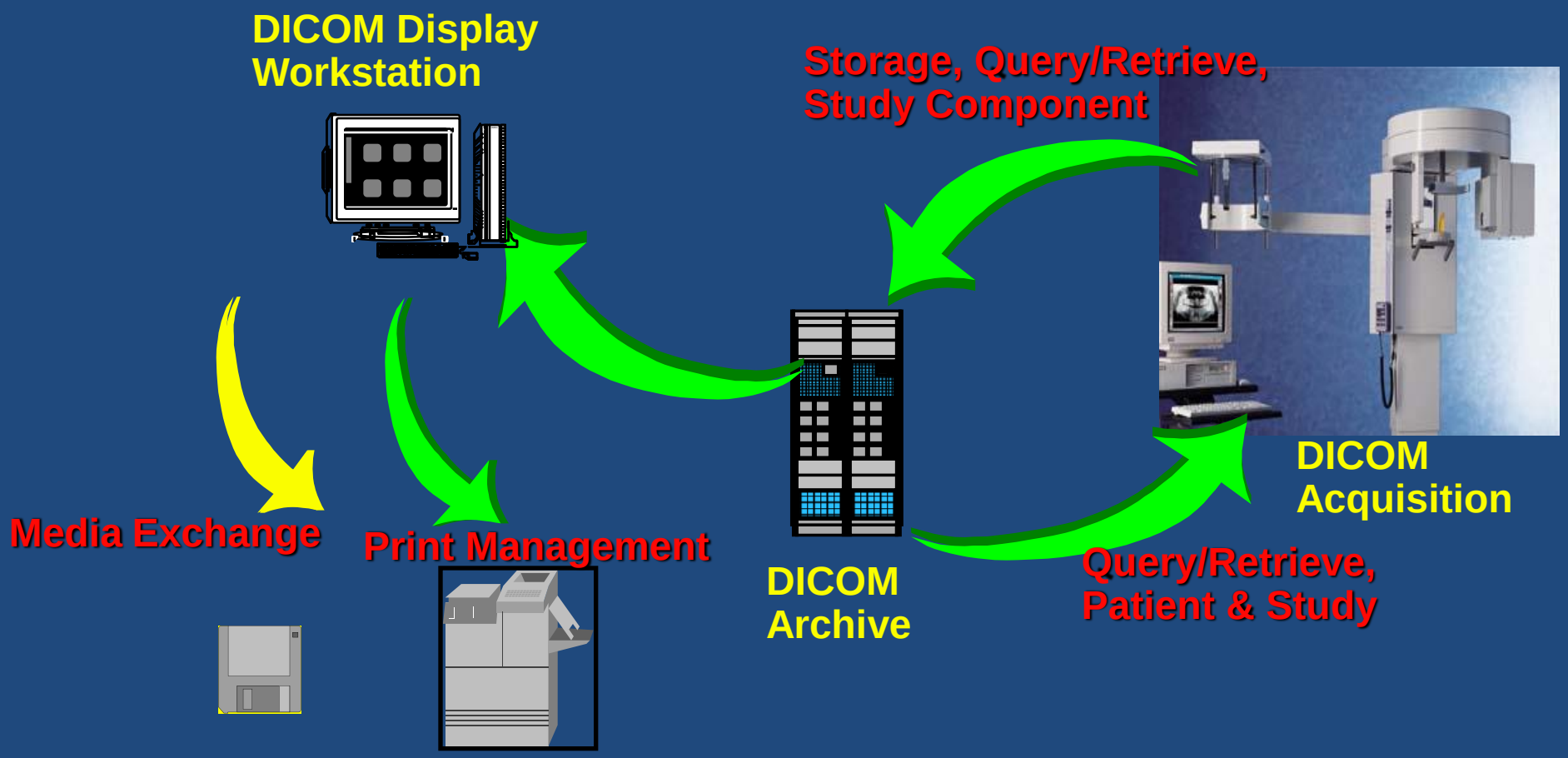
-90%

The DICOM Standard

Digital Imaging & Communications in Medicine

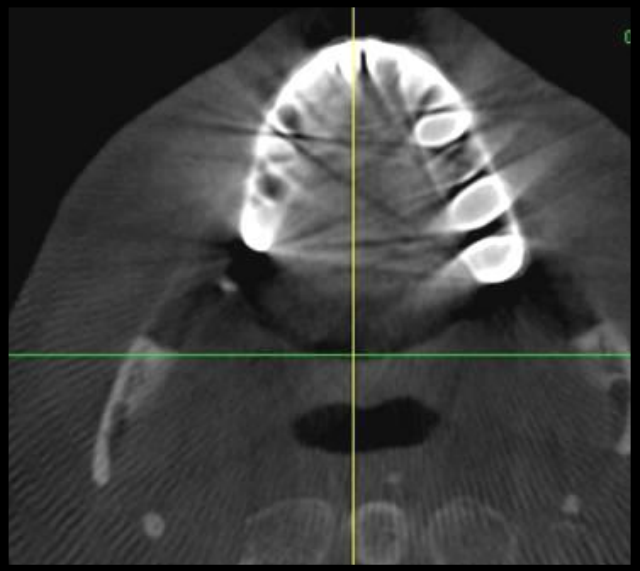
Detailed specification that describes a means of formatting and exchanging data in and out of an imaging device.

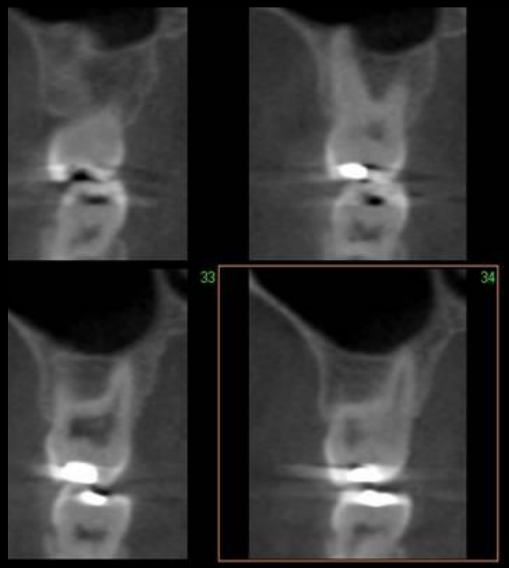
DICOM Workflow



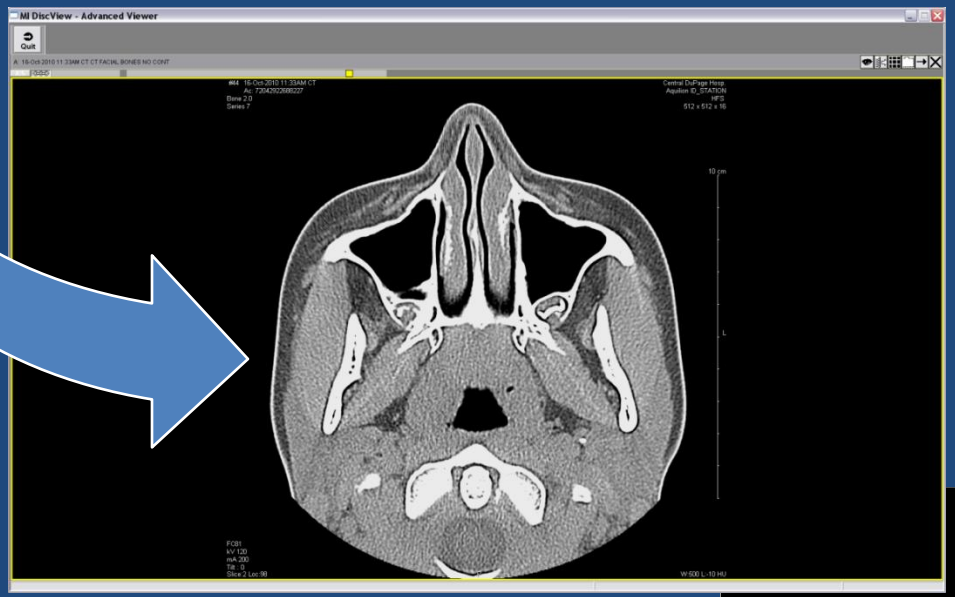
Public Domain images

Artifact

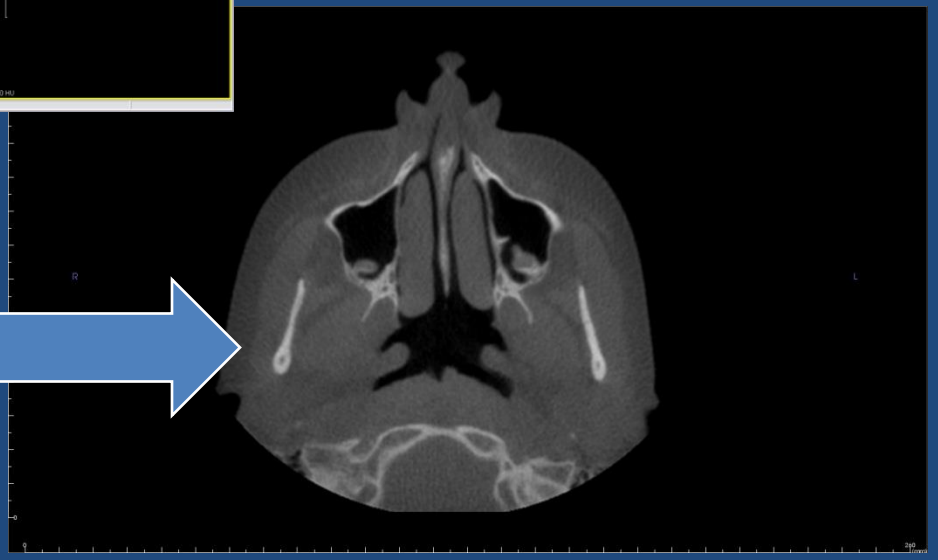




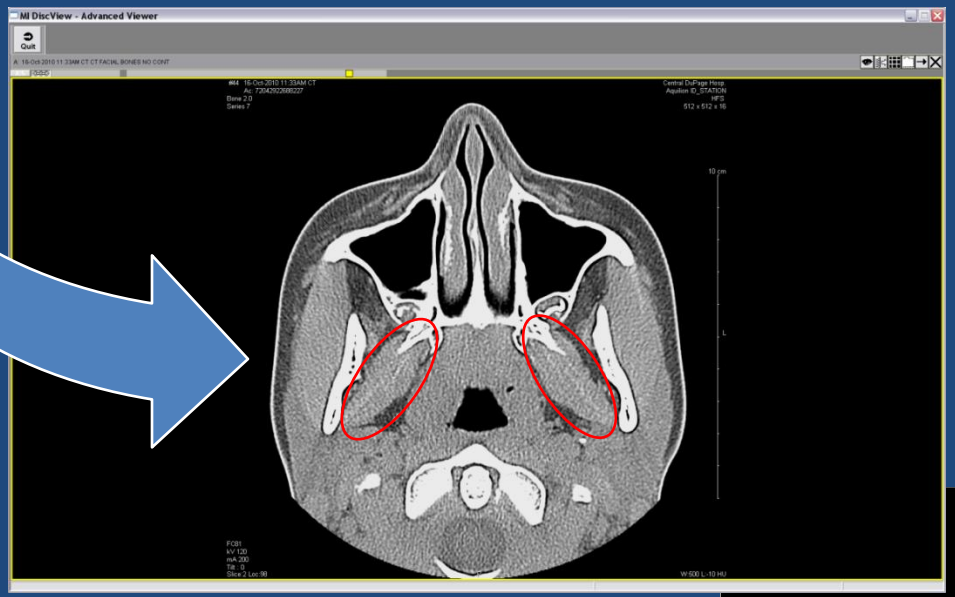
Traditional CT gives you hard tissue as well as soft tissue "window"



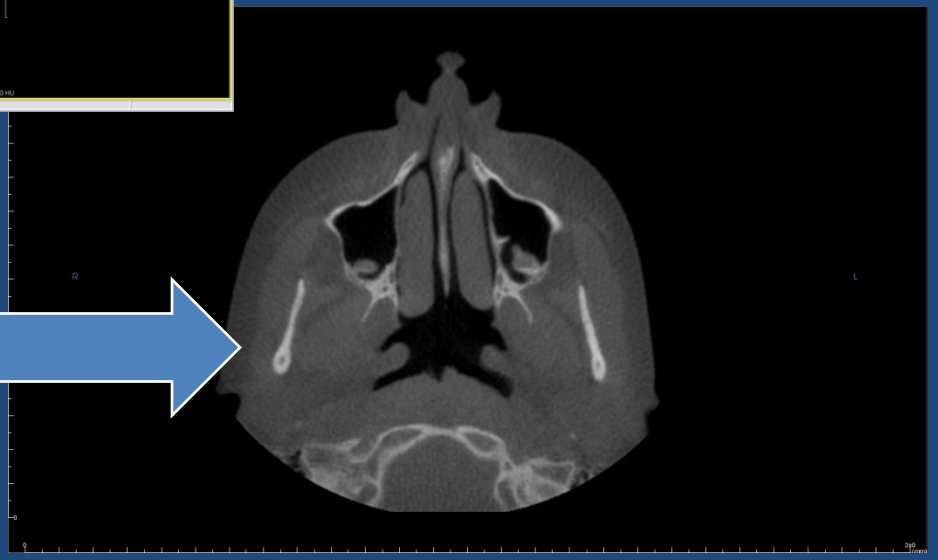
CBCT gives you hard tissue only



Traditional CT gives you hard tissue as well as soft tissue "window"



CBCT gives you hard tissue only



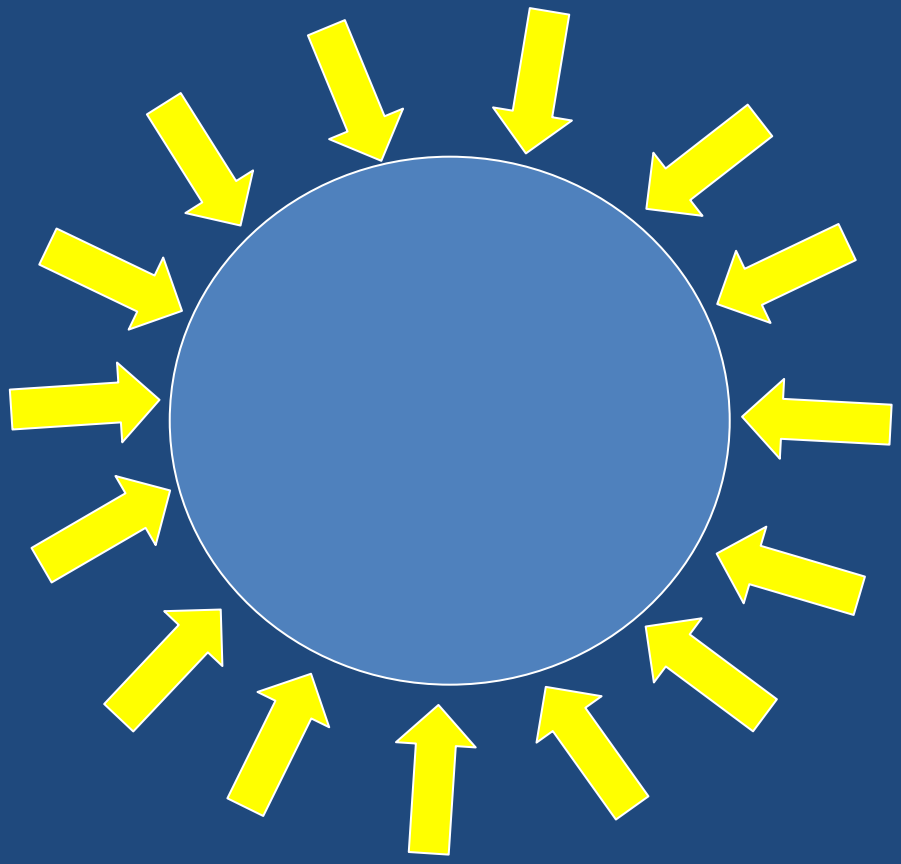
More than a Panoramic
Less then a Panacea

We will now review 24 CBCT scans for normal anatomy, variations of normal and indications of pathology.

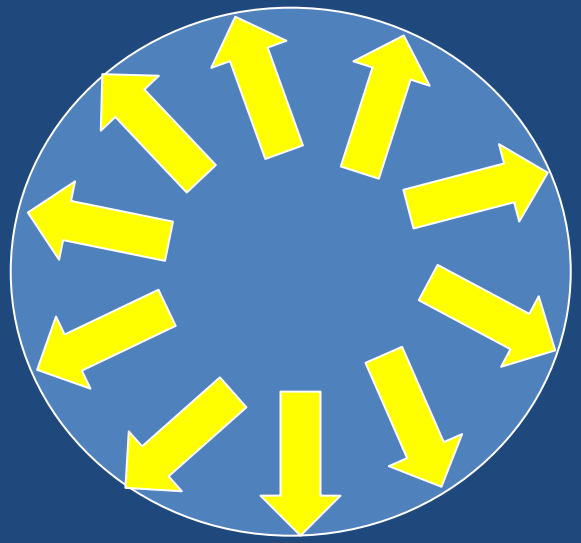
Percent of population with Anatomic Variations

- 50% Nasal septal deviation
- 40% Concha bullosa
- 30% Sphenoid sinus pneumatize pterygoid plates
- 25% Ethmoids pneumatize sphenoid
- 20% Ethmoids pneumatize sinus roof
- 10% pneumatize of frontal bone
- 10% of time pneumatized crista galli
- 15% CBCT scans show benign mucus retention cysts
- 15% show idiopathic osteosclerosis
- 33% show a partially calcified second septa in the sphenoid sinus
- 20% show a partially calcified second septa in the maxillary sinus

Imploding



Exploding



Documentation that you have reviewed a scan is a two-step process

1) report on the findings related to the reason the scan was taken

2) evaluate the entire volume of the scan for indications of pathology that require treatment/referral

In the common situation where no referral is necessary a statement is still needed in order to document the entire scan was reviewed. One way to fulfill this requirement is to state:

“The remainder of the scan is essentially unremarkable.”

By _____ consensus the following are not considered essential to report in the asymptomatic patient:

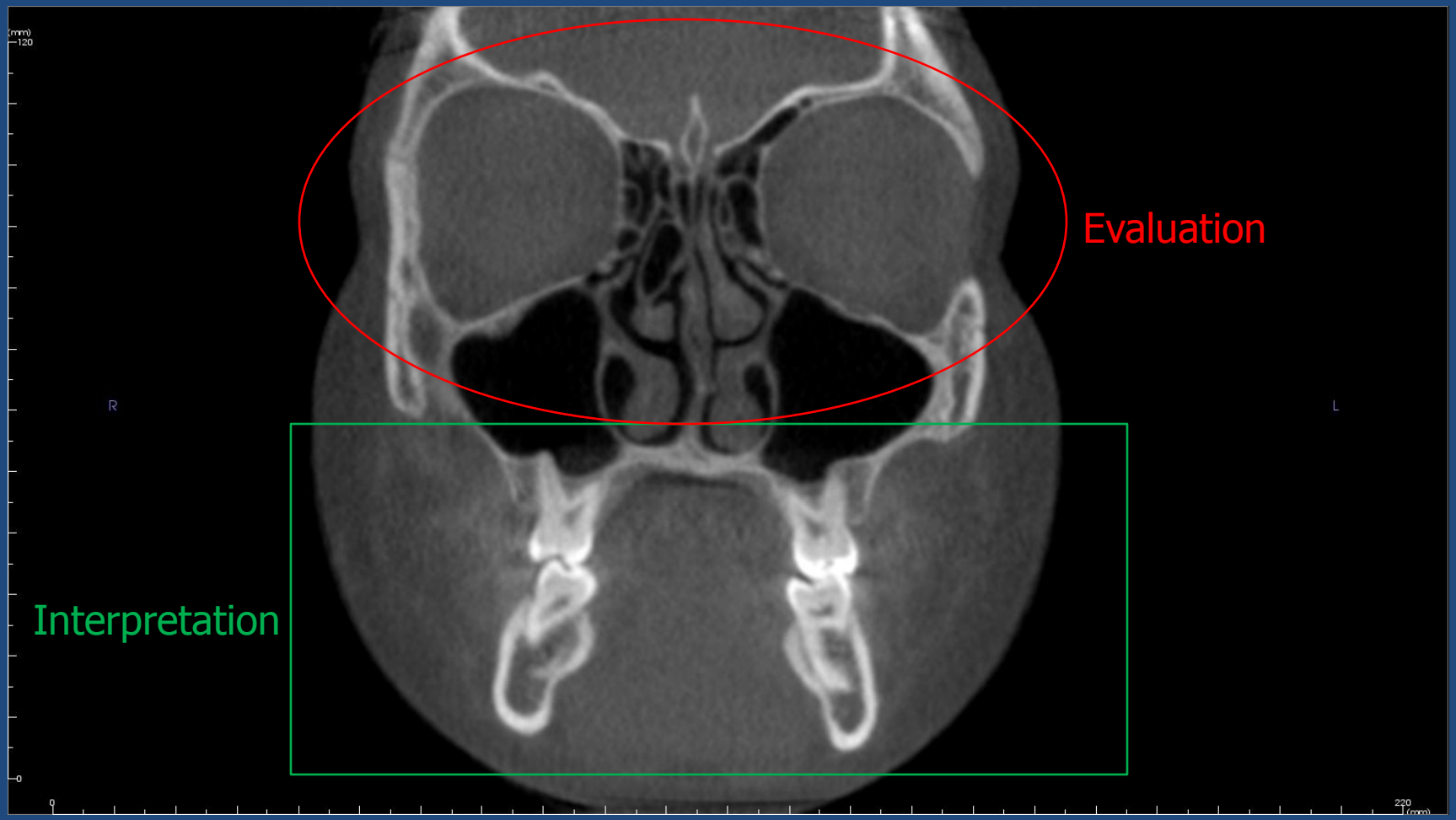
- deviated nasal septum – concha bullosa
- pneumatization caused by extension of a paranasal sinus
- mucus retention cysts
- idiopathic osteosclerosis – tori – exostosis – enostosis
- septa within a paranasal sinus
- calcified stylohyoid ligament
- mild asymptomatic mucosal thickening in a paranasal sinus

(next slide: see comment on sphenoid sinus)

Due to the proximity of the optic nerve the sphenoid sinus mandates the following special considerations

- A mucus retention cyst and/or mild mucosal thickening are not considered essential to report

- Any other presentation that demonstrates an opacification/alteration within the sphenoid sinus should be considered a reportable finding and evaluated accordingly.


Evaluation
Interpretation
R
L

This must be true:

U  

or know someone who does.

An Atlas of Imaging of the Paranasal Sinuses

Lalitha Shankar and Kate Evans

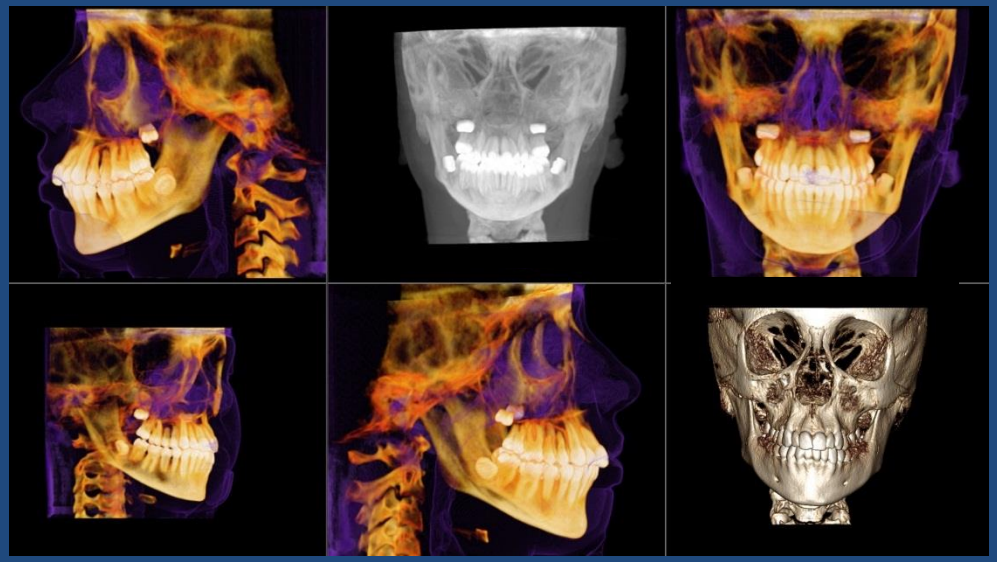
Informa Healthcare

Diseases of the Sinuses: diagnosis & management

David Kennedy and William Bolger

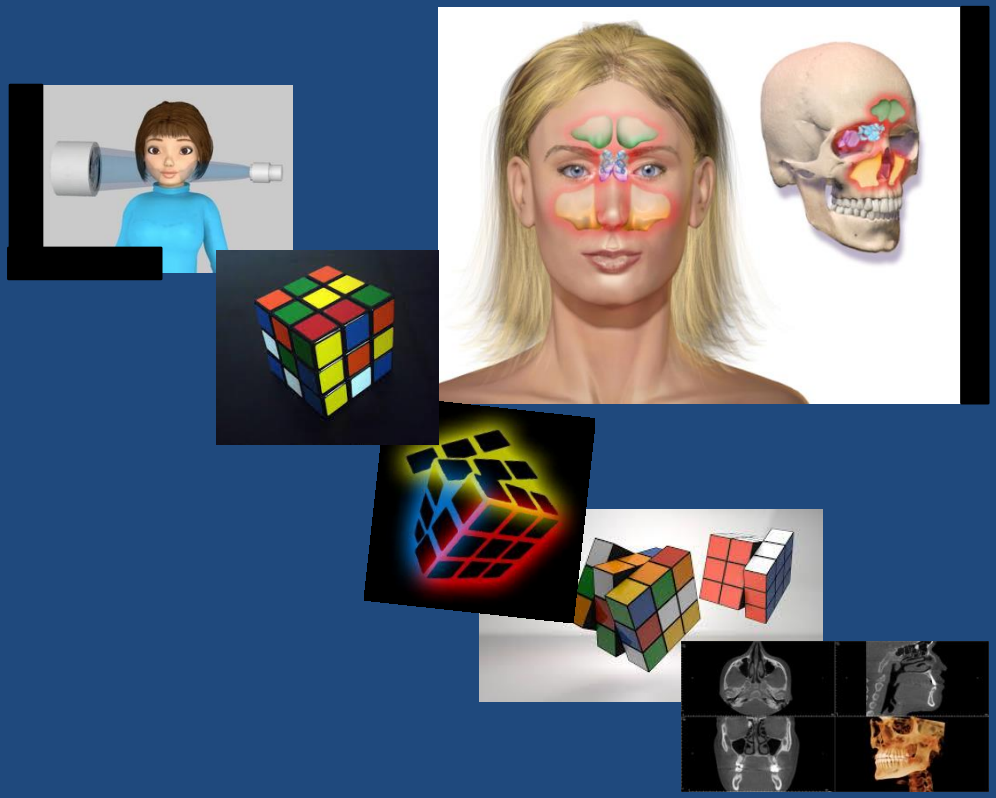
Decker, Inc.

ALARA ALWAYS APPLIES



CBCT: Essential or *Essentially Overkill*

Y 3D ?



AGD 2015 SAN FRANCISCO

a golden opportunity

June 18 to 21, 2015 Moscone West Convention Center *www.agd2015.org*

Academy of General Dentistry™