

# Cone Beam Computed Tomography: Post-Imaging Documentation



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# Post-Imaging Documentation Lecture Objectives:



- UTILIZE APPROPRIATE POST-IMAGING DOCUMENTATION FOR CBCT
  - Clinical documentation
  - Interpretation/Radiographic Report
  - Radiologic Terminology
  - Radiographic Interpretation



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# Presenter Disclosure

- **Faculty Member:** Dr. Meredith Brownlee
- **Relationships with commercial interests:**
  - None to report



# Clinical Documentation



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# Clinical Documentation

- Maintenance of the CBCT exposure and retake logs:
  - must note why the retake was taken
    - e.g. patient movement, ROI not fully captured, etc.
  - retakes must be based on the referring dentist's request for a retake (RCDSO), not based on your opinion of the image, unless you are the requesting dentist
  - original image AND the retake must be interpreted and evaluated for pathology and included in the radiographic report



# Radiographic Report



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# Radiographic Report

- Predicated by a thorough knowledge of CT anatomy for the entire acquired image volume, anatomic variations and observation of abnormalities (Scarfe et. al. 2012)
- Must utilize optimal viewing conditions (Koong 2011):
  - high brightness and quality of display monitor
  - decreased ambient and extraneous light



# Radiographic Report

- Must utilize optimal viewing conditions (White and Pharoah 2014):
  - reorient the acquired volume
  - optimize the data
    - Window width and window level to desired bone level of contrast and brightness, respectively
  - view the data
    - enhancement algorithms in the software
  - format the data





# Reorient the Data

Fig. 12-2, White and Pharoah



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# Reorient the Data

Fig. 12-3, White and Pharoah



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# Format the Data

Fig. 8 Scarfe et. al. 2012



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# Radiographic Report

- Volumetric data should be reviewed in multiple appropriate planes, slices, or windows, depending on the structures involved and potential associated diseases (Koong, 2011)
  - need inherent knowledge of the viewing software
- The entire data set must be reviewed for pathology, not just the ROI
- The generation of the radiographic report is crucial in inter-office communication with regard to patient care, and distribution of treatment delivery



# Radiographic Report

- Furthermore, information gleaned from the data set may require referral to the patient's primary physician, ENT, or to another medical or dental provider
- Data collection and findings are a professional responsibility mandate (Friedland and Miles, 2014) and becomes a component of informed consent as a standard of care (Miles and Danforth, 2014)



# Radiographic Report

- Table 1 in Miles and Danforth (2014) article is a great summary of referral patterns for various findings in CBCT volumes (pg. 708 of handout)
  - e.g. Pansinusitis -> primary care provider and/or ENT
- The quality, accuracy, and use of a report are subject to medicolegal scrutiny, and knowledge of such issues determine whether or not a primary provider or a secondary radiology reader evaluates the image data and issues the final report



# RCDSO Report Contents

- RCDSO was the first province to create regulations for CBCT in Canada, and to date, are the most stringent regulations in the country
- Also the most detailed in their requirements, including the report
- Written report for all CBCTs acquired, regardless of FOV size or area captured



# RCDSO Report Contents

- Patient information:
  - name
  - address
  - date of birth
- Prescribing dentist's name
- Type of dental CT performed
- Date(s) CT was taken, dictation and transcription
- Any limitations or technical factors (QA):
  - e.g. patient movement, artifacts, etc.



# RCDSO Report Contents

- Reasons for taking additional radiographs and/or images, if deemed necessary
- Findings, using precise anatomical and radiological terminology
- Any pertinent clinical issues raised in the request for the dental CT scan
- Comparative information with previous radiographs and/or other images
- A “conclusion” section, or Impressions section



# RCDSO Report Contents

- A precise diagnosis, whenever possible
- A differential diagnosis, when appropriate
- Recommendations, when appropriate
- Follow-up and additional diagnostic radiological studies to clarify or confirm the conclusion
- SIGNATURE
- If there are immediate patient management concerns, these should be communicated to the referring dentist as soon as possible and documented



# RCDSO Report Contents

- Any discrepancy between a preliminary report and the final written report shall be directly communicated to the referring dentist or her/his representative



# Facilitating Report Writing

- Create your own template(s)
- Describe commonly identified disease or anatomical entities, and then tailor the report to the case at hand
  - e.g. right side versus left sided
  - e.g. maxillary versus mandibular
- Utilize a Dictaphone, if not as skilled at typing
- Have someone else proof-read your document for spelling and grammatical errors or omissions



# Radiologic Terminology



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Superior



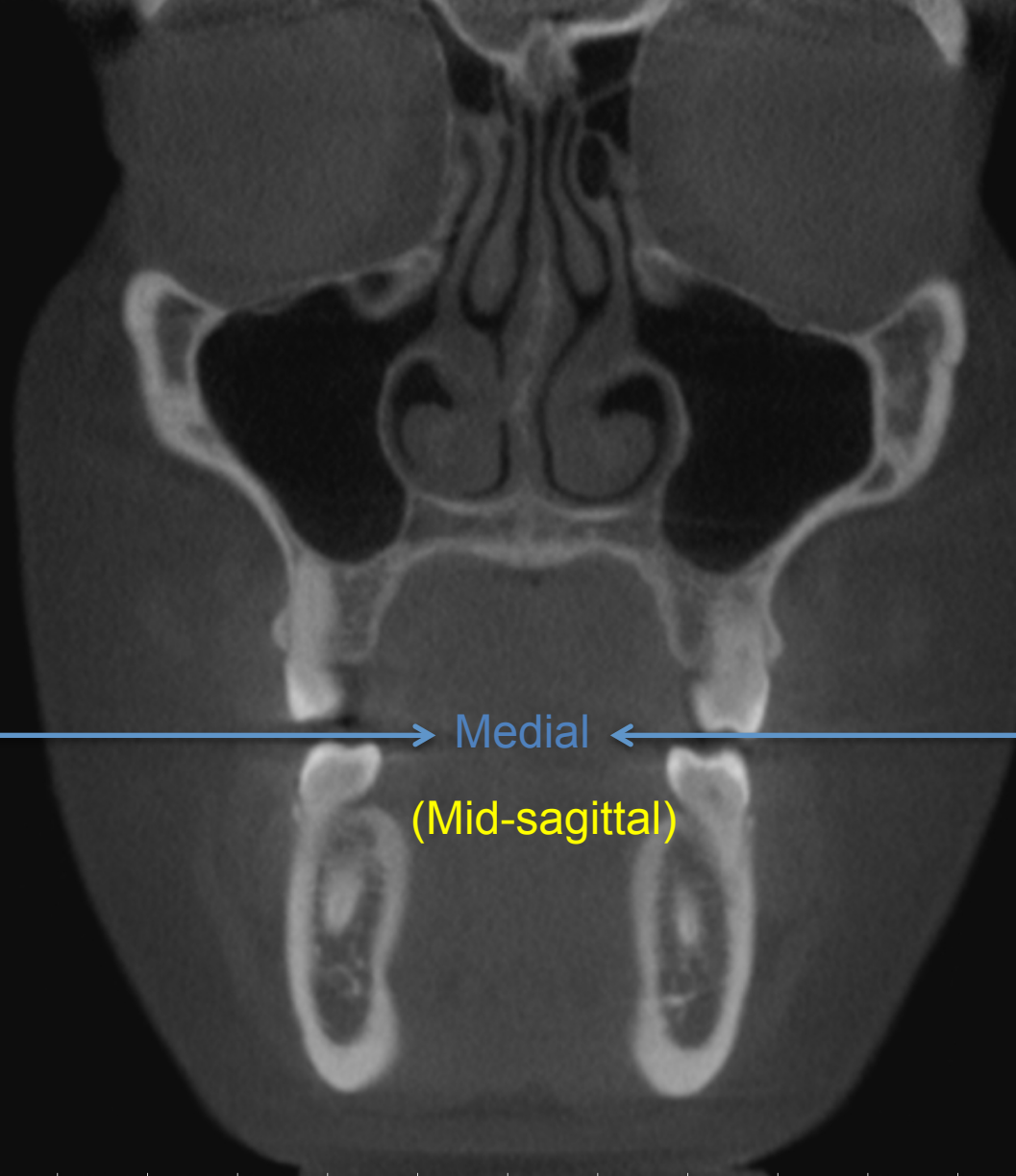
Inferior



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Lateral  
(Para-sagittal)

Medial  
(Mid-sagittal)

Lateral  
(Para-sagittal)

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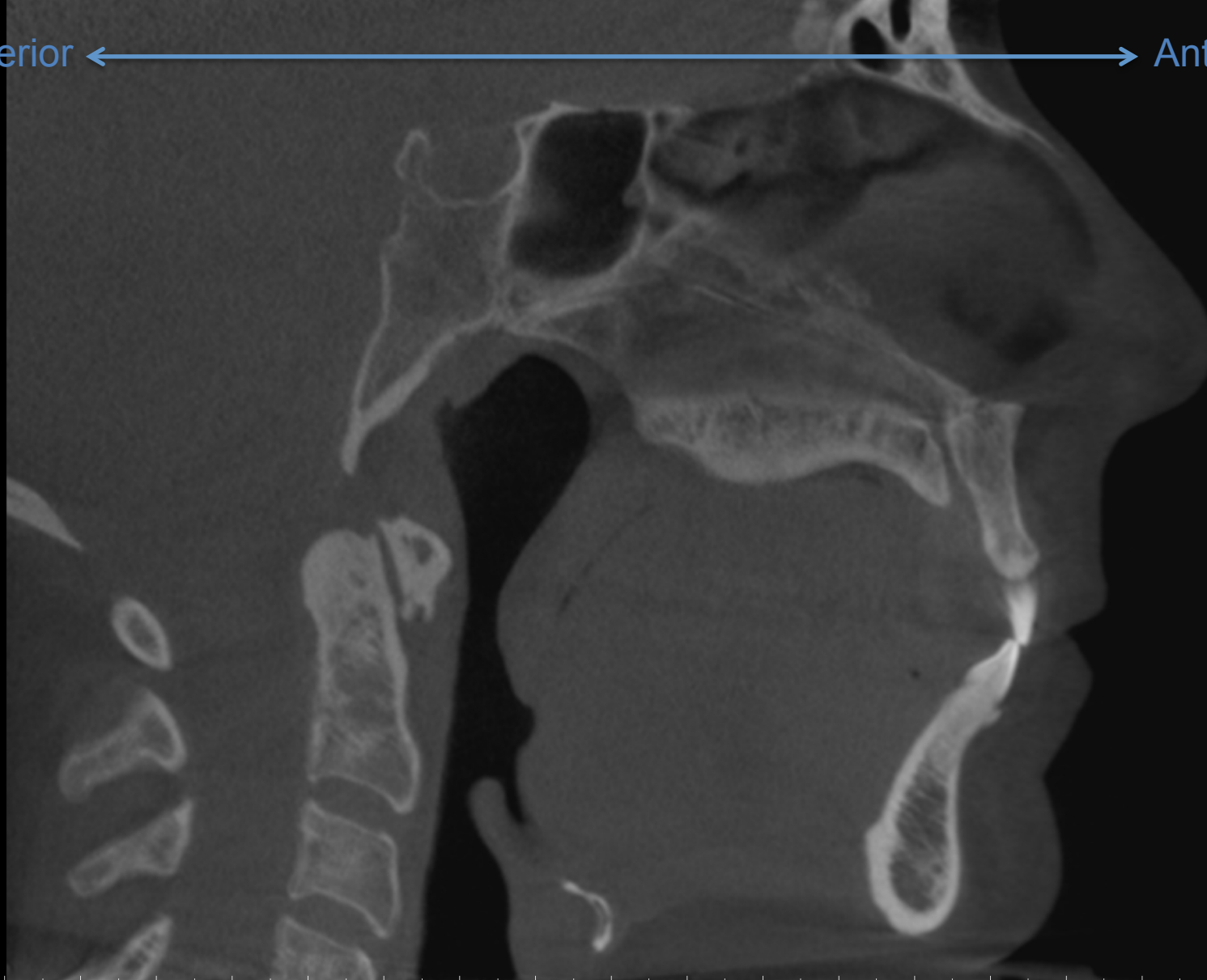


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Posterior ←

→ Anterior



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# Steps to Interpretation of Intraosseous Lesions

- Step 1: LOCALIZATION
  - Epicenter of the Lesion (epicenter)
    - can help identify tissue of origin and past growth
  - Localized or Generalized
  - Unilateral or Bilateral
  - Solitary Lesion or Multifocal Lesions
    - can be important when considering syndromes

# Steps to Interpretation of Intraosseous Lesions

- Step 2: Assess Periphery and Shape
  - Periphery:
    - Well-defined:
      - Punched out
      - Corticated
      - Sclerotic
      - Soft tissue capsule
    - Ill-defined:
      - Blending
      - Invasive
  - Shape:
    - Round
    - Scalloped
    - Irregular

# Steps to Interpretation of Intraosseous Lesions

- Step 3: Analyze Internal Structure
  - Radiolucent (low attenuation)
  - Radiopaque (high attenuation)
    - homogeneous
    - heterogeneous
  - Mixed density
  - Septation (partial septae or multilocular)
  - Dystrophic calcifications

# Steps to Interpretation of Intraosseous Lesions

- Step 4: Analyze Effects of Lesion on Surrounding Anatomical Structures
  - Teeth, lamina dura, PDL spaces
  - Neurovascular bundles (IAC, foramina)
  - Sinonasal complex
  - Surrounding bone density and trabecular pattern of cancellous bone
  - Cortical bone and periosteal bone reactions

# Steps to Interpretation of Intraosseous Lesions

- Step 5: Formulate an Interpretation
  - Are the findings normal or abnormal?
  - Are the findings indicative of acquired disease or developmental disease?
  - If acquired disease, which disease category?



# Acquired Disease Categories

- Cyst
- Inflammatory lesion
- Benign neoplasm
- Malignant neoplasm
- Bone dysplasia
- Trauma
- Systemic/Metabolic disease
- Vascular



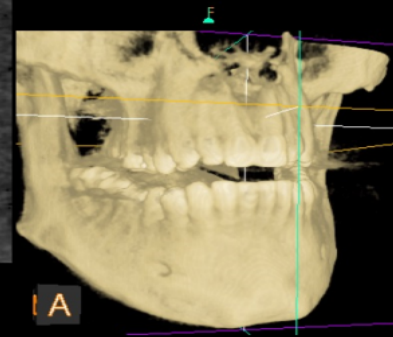
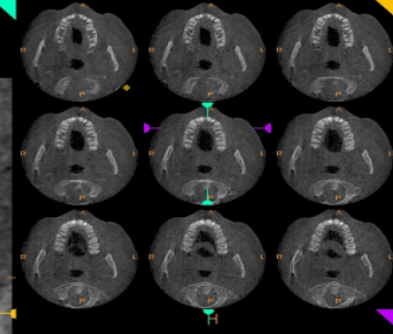
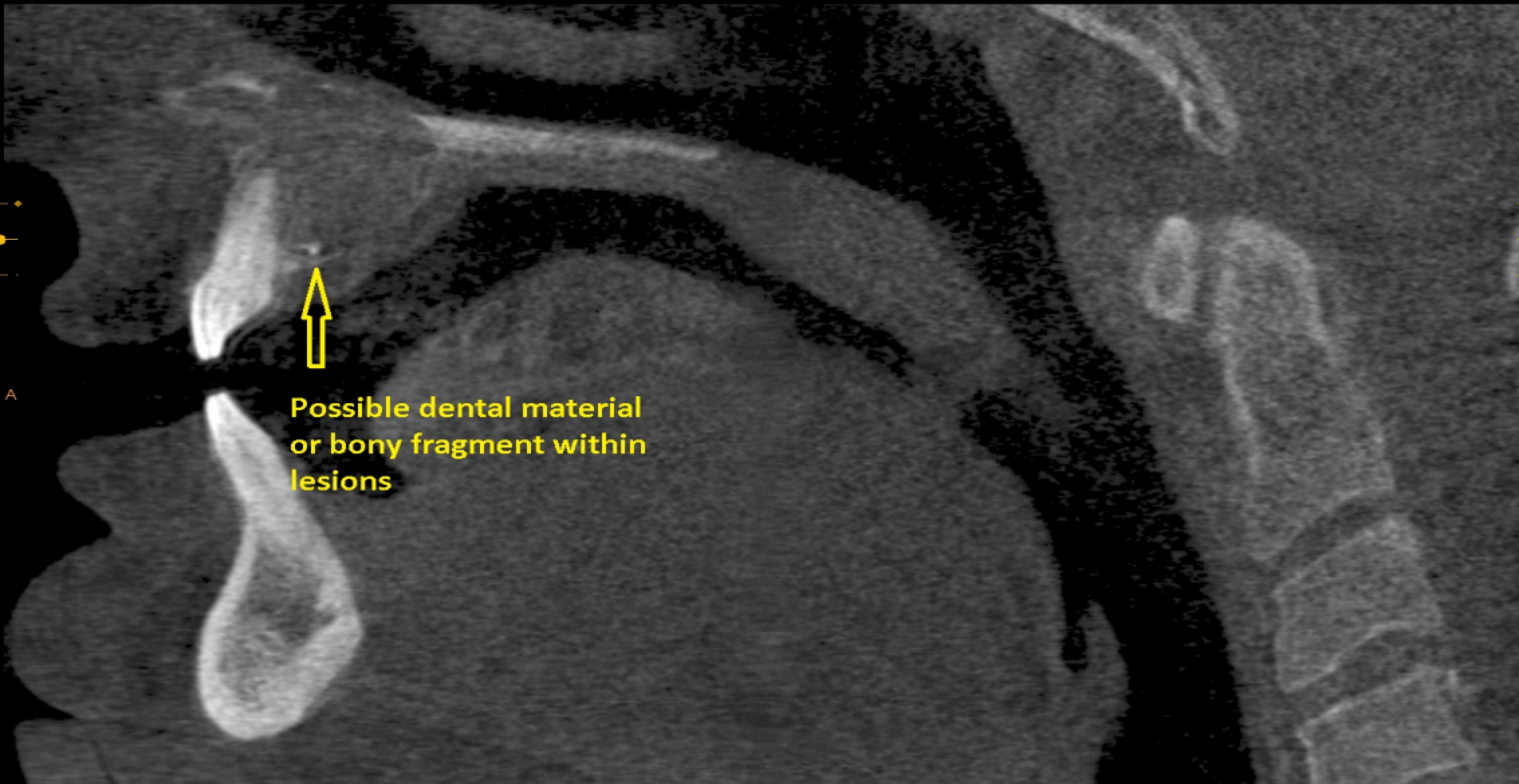
# Cysts

- Tend to be round in shape and entirely radiolucent
  - dystrophic calcifications in long-standing cysts
- Well-defined borders, usually corticated
- Intraosseous
- Mass effects:
  - displace or resorb teeth
  - expand cortices of bone
  - displace the inferior alveolar canal
  - invaginate into the maxillary sinus
- If superimposed infection or chronic process, can lose corticated border, have increased symptoms



# Nasopalatine Duct Cyst

Sagittal Section



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# Inflammatory Lesions

- Odontogenic inflammatory lesions are some of the most common pathologies noted in CBCTs
- Located at the apex or adjacent to lateral pulpal canals of non-vital teeth, periodontal lesions are typically at the alveolar crest, and osteomyelitis occurs most frequently in the posterior mandible
- Borders are blending or ill-defined
- Shade of lesion can vary from rarefaction (radiolucent) to sclerotic (radiopaque), or a combination of them both

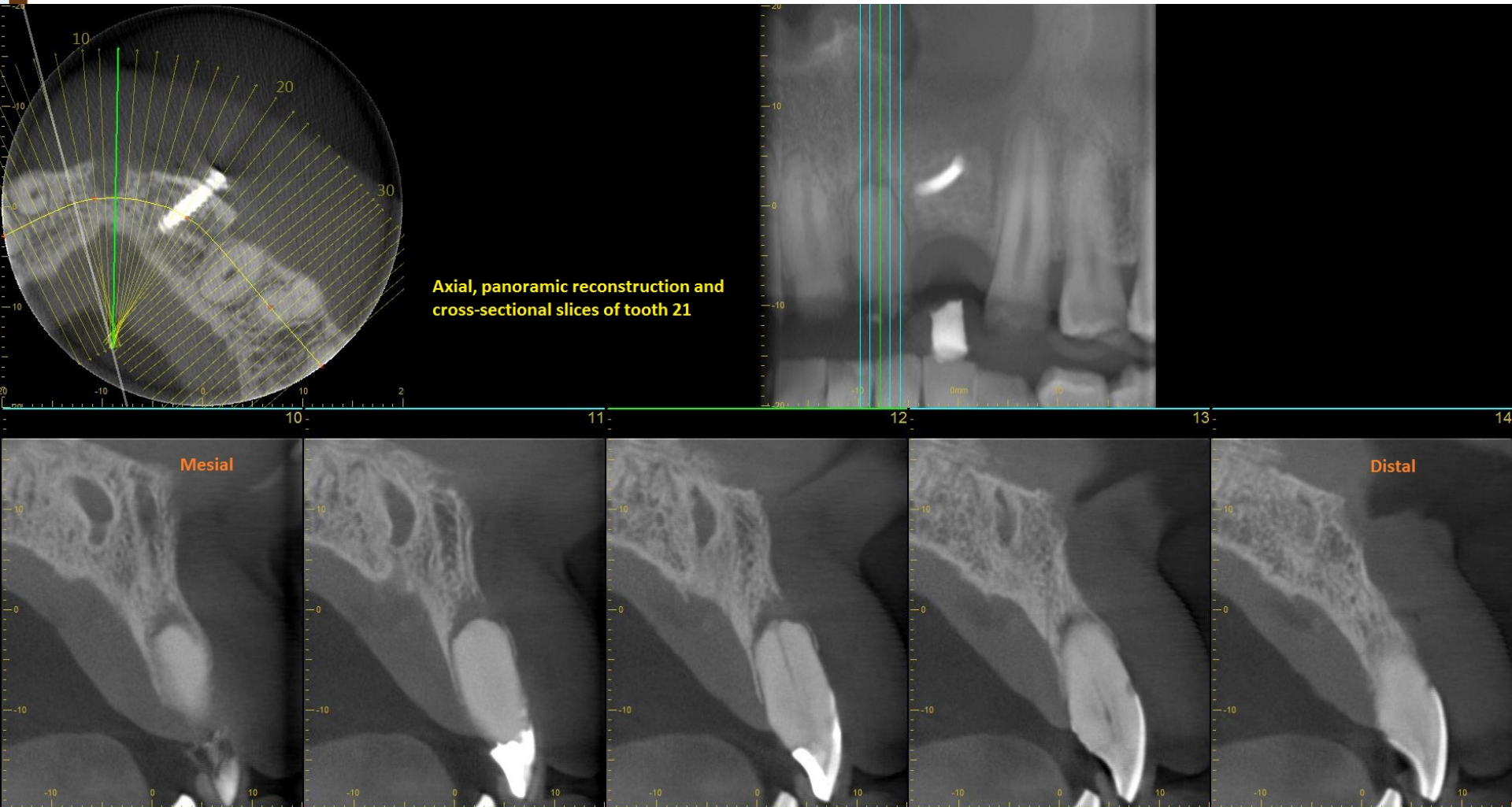


# Inflammatory Lesions

- Osteomyelitis will show bony sequestration
- Acute mass effects:
  - loss of lamina dura
  - widened PDL spaces
  - rarefaction of bone
- Chronic mass effects:
  - sclerosis of bone blending into normal trabecular pattern
  - parulis formation
  - periosteal new bone formation



# Periapical Inflammatory Lesion



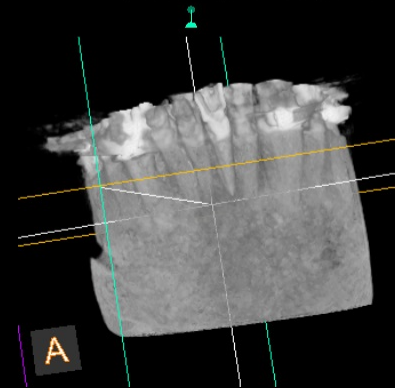
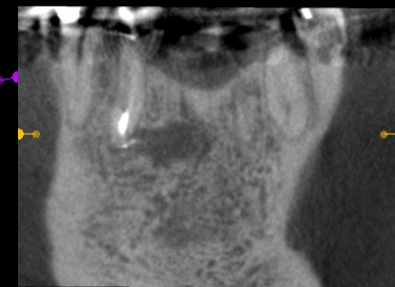
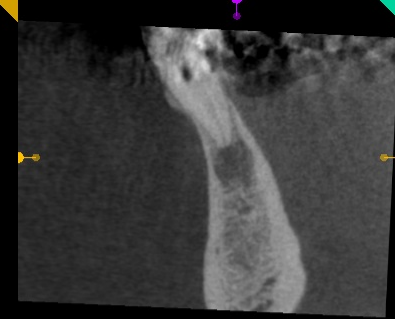
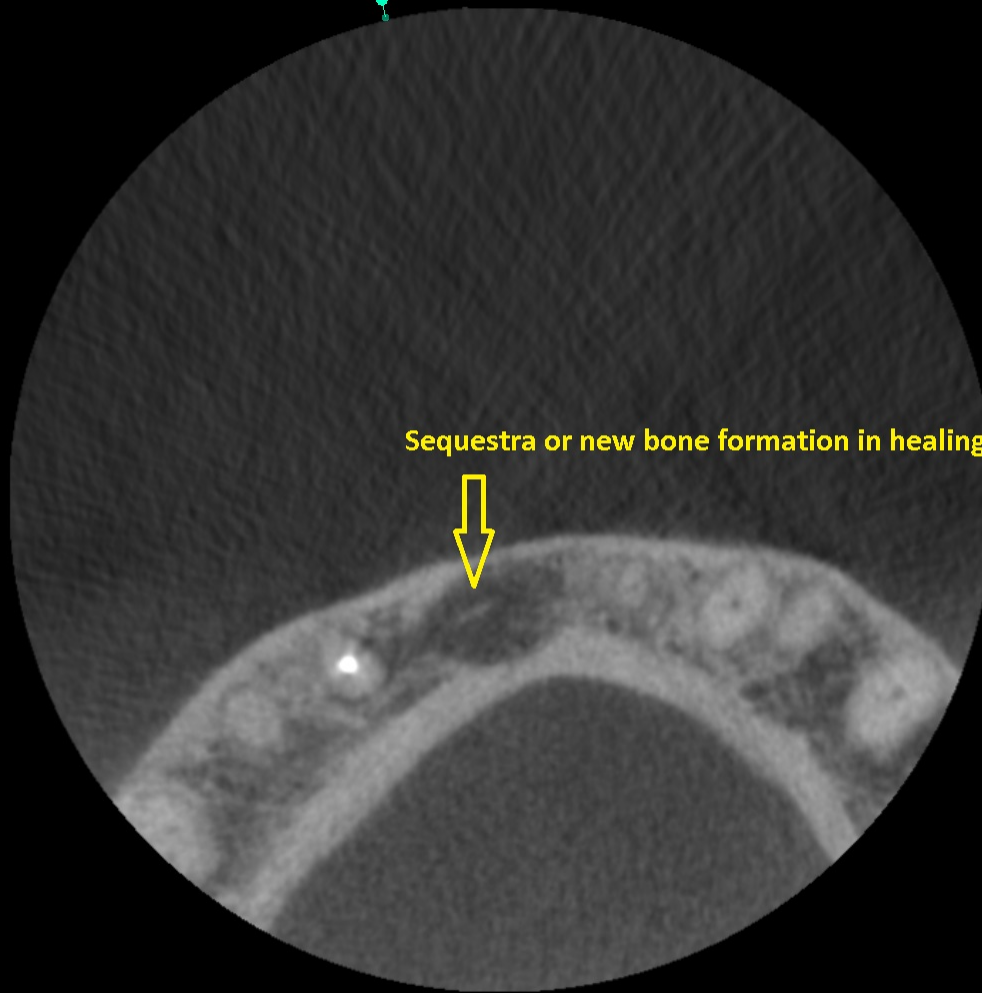
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# Osteomyelitis Sequestrum



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# Benign Neoplasms

- Epicenter and location of the lesion play a key role in determination of the tissue of origin
  - alveolar process => odontogenic in origin
  - mandibular canal => neurovascular in origin
  - below mandibular canal => non-odontogenic
  - condylar head => cartilagenous in origin
- Typical borders are smooth, well-defined, corticated, and can show scalloping
- Shade can be radiolucent, mixed or radiopaque

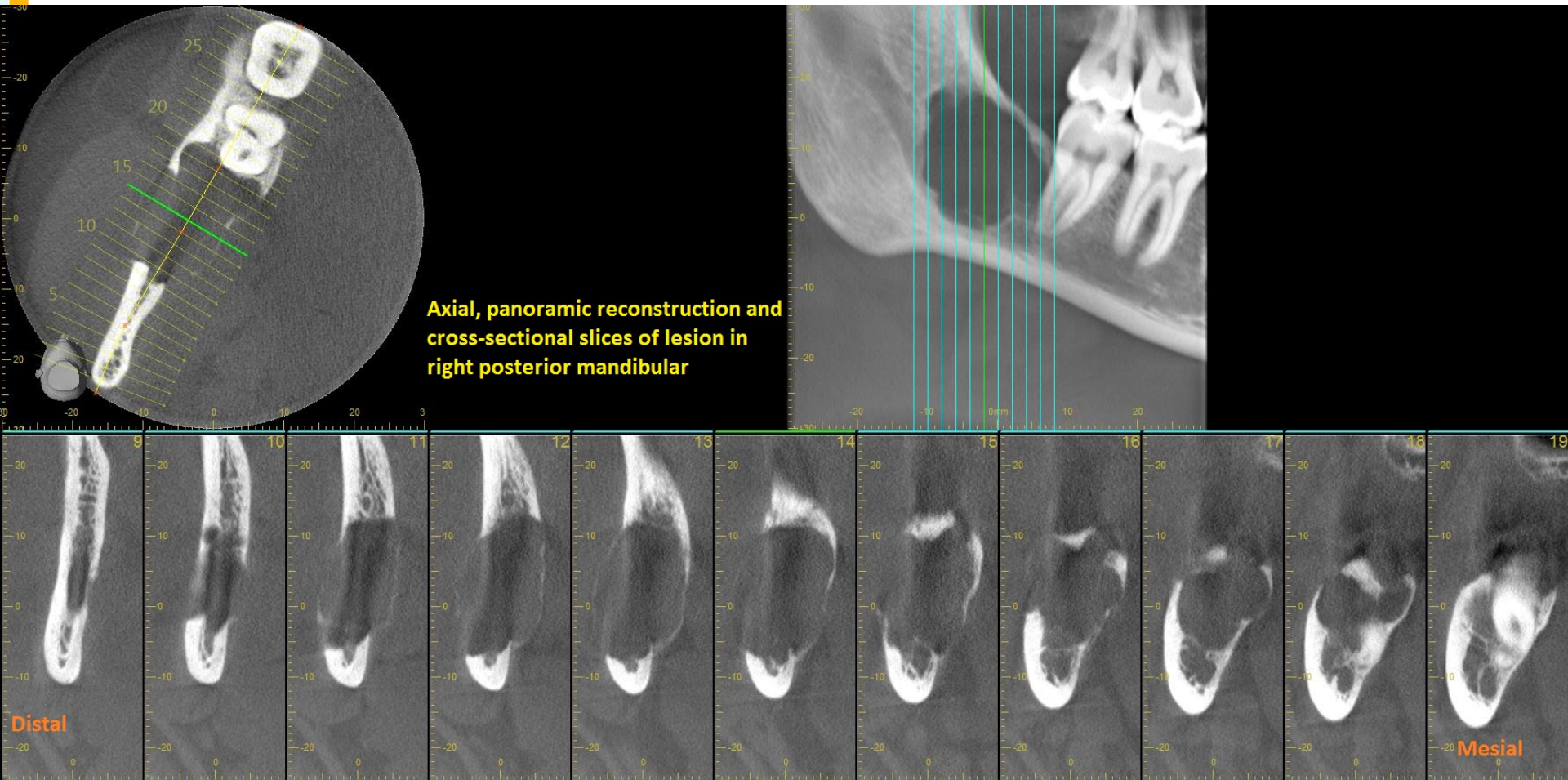


# Benign Neoplasms

- Internal structures may include:
  - reactive bone
  - residual bone
  - calcified material produced by the tumour
  - septations
- Mass effects may include:
  - expansion of cortices
  - displacement and resorption of teeth



# Benign Neoplasms



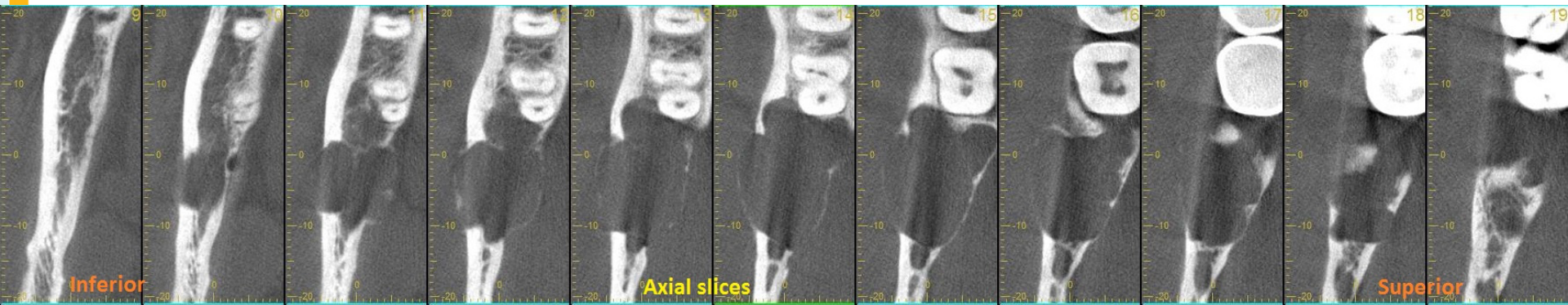
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# Benign Neoplasms



Same Case as previous slide

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# Malignant Neoplasms

- Primary and metastatic malignancies can occur anywhere in the gnathic region, but tend to:
  - primary carcinomas tend to occur in the tongue, lip, floor of the mouth, gingiva, tonsillar pillars, and soft palate, then invade the bone
  - sarcomas tend to occur in the mandible or in the posterior segments of the jaws
  - metastases tend to occur in the posterior segments of the jaws
  - some metastases go to the root apices and the dental follicle



# Malignancies

- A. Ill-defined invasive borders
- B. Soft tissue mass and cortical destruction
- C. Irregular widening of the PDL space
- D. Multifocal metastases at the root apices and in the dental papilla
- E. Cortical bone destruction, laminated PNB, Codman's triangles, and spiculated PNB
- F. Teeth floating in air

Fig. 24-1, White and Pharoah

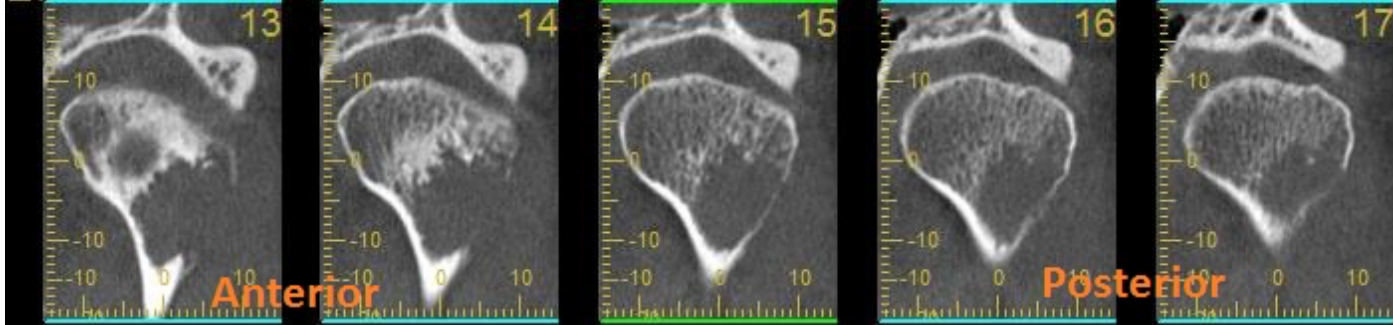
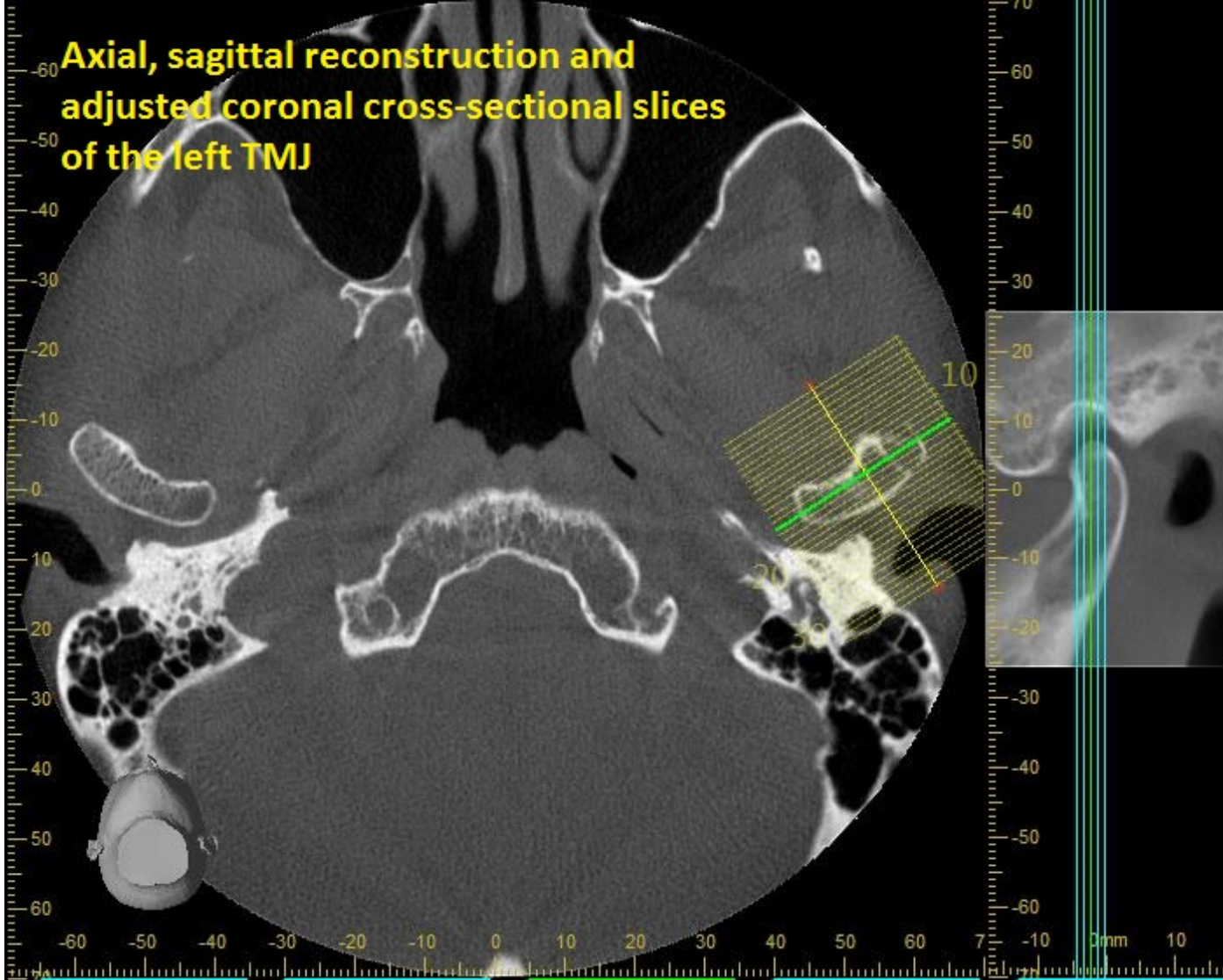


# Malignant Neoplasms

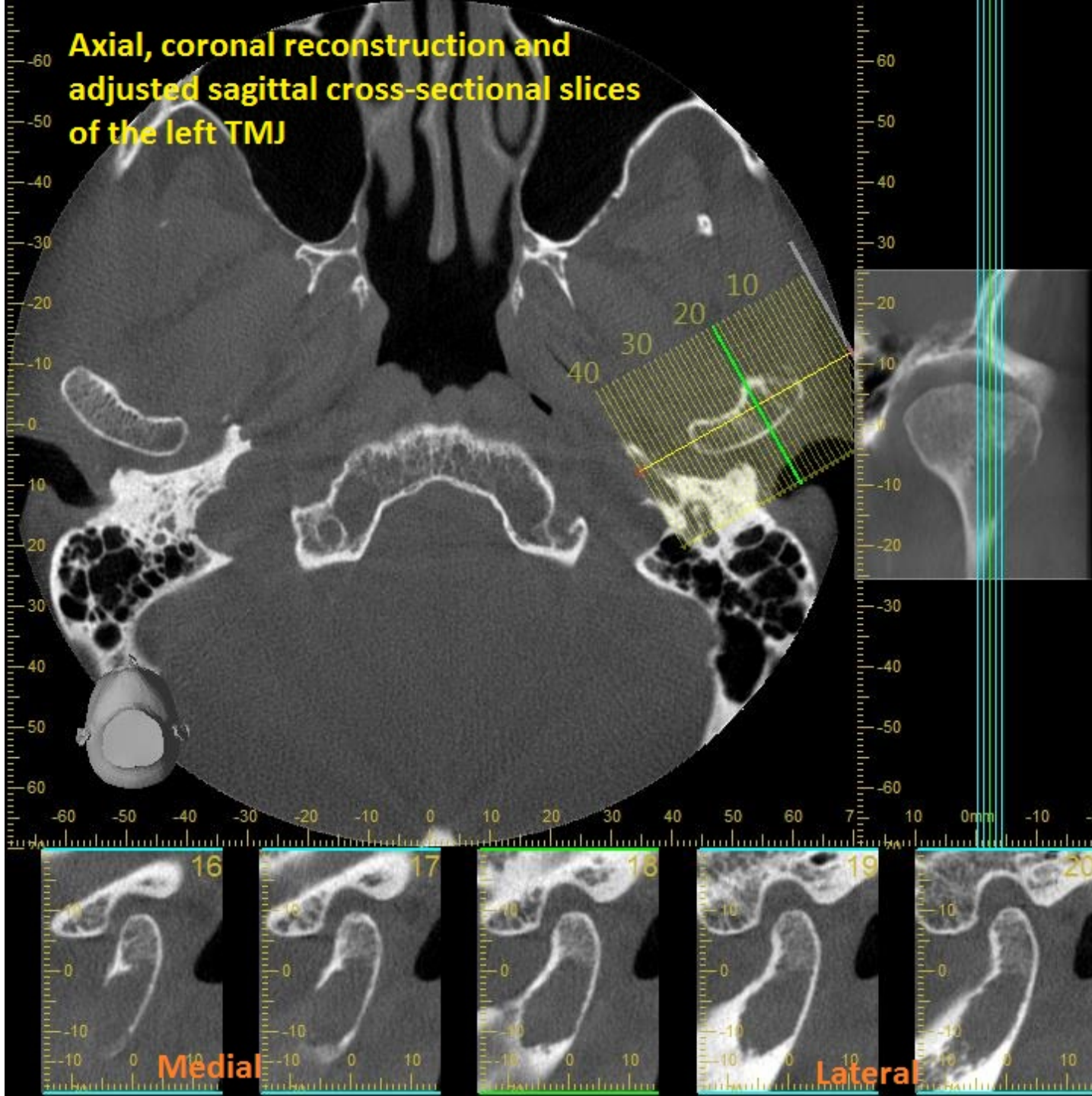
- Mostly are radiolucent
- Breast and prostate metastases can induce bone formation
- Sarcomas can produce bone, thus sclerotic appearance
- Mass effects on surrounding structures:
  - destruction of anatomic structures
  - little expansion
  - spiky root resorption
  - widened PDL space
  - perineural spread
- Paraesthesia is not uncommon



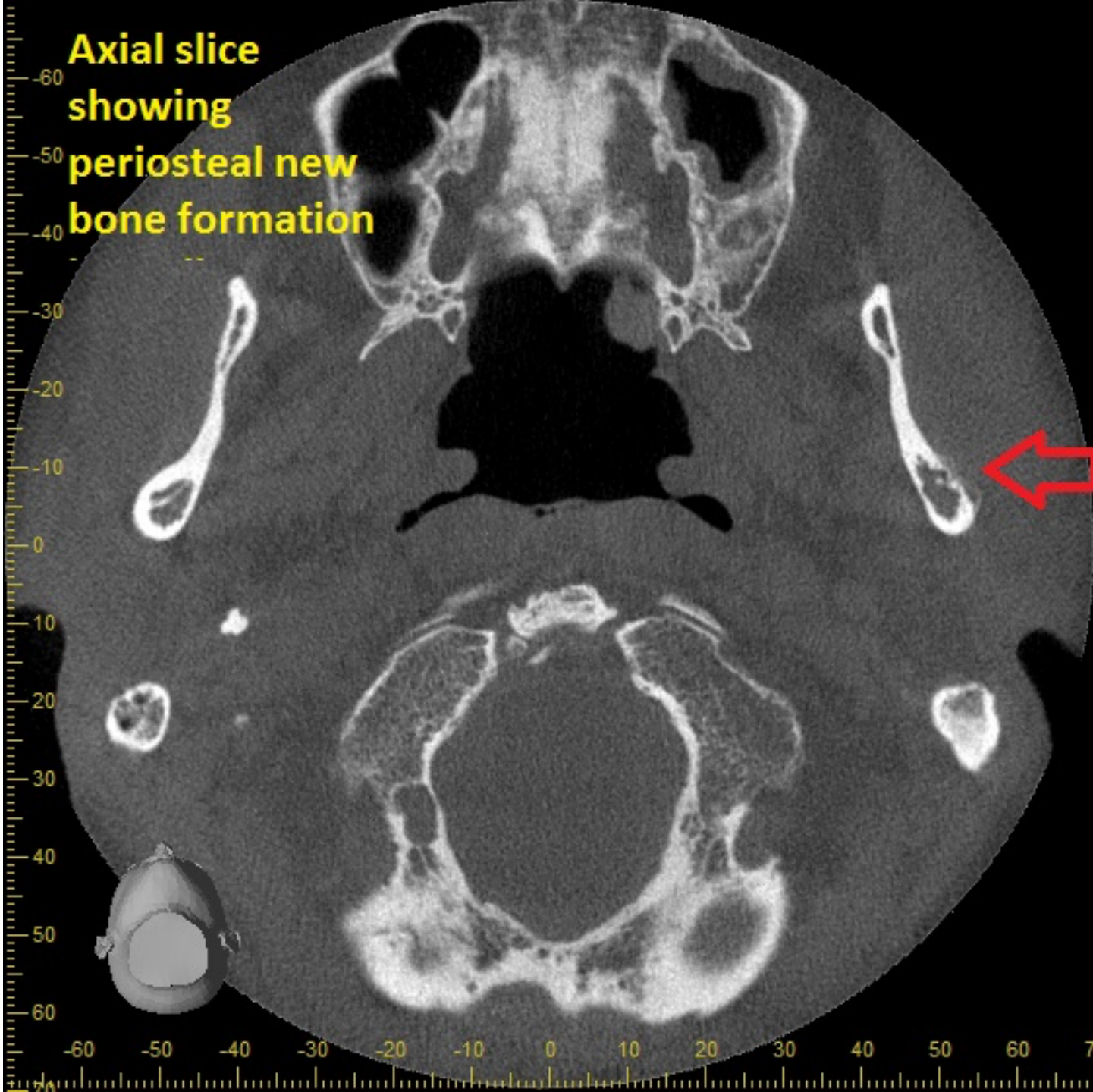
**Axial, sagittal reconstruction and  
adjusted coronal cross-sectional slices  
of the left TMJ**



**Axial, coronal reconstruction and adjusted sagittal cross-sectional slices of the left TMJ**



**Axial slice showing periosteal new bone formation**



# Bone Dysplasias

- Fibrous dysplasia affects Maxilla 2:1 Mandible, and posterior segments more than anterior
- Borders can be well-defined to ill-defined, blending into normal trabecular and cortical patterns
- Internal contents can be quite variable:
  - maxilla lesions tend to be more homogeneous
  - mandibular lesions more varied in appearance
  - lesions change over time from RL to RO



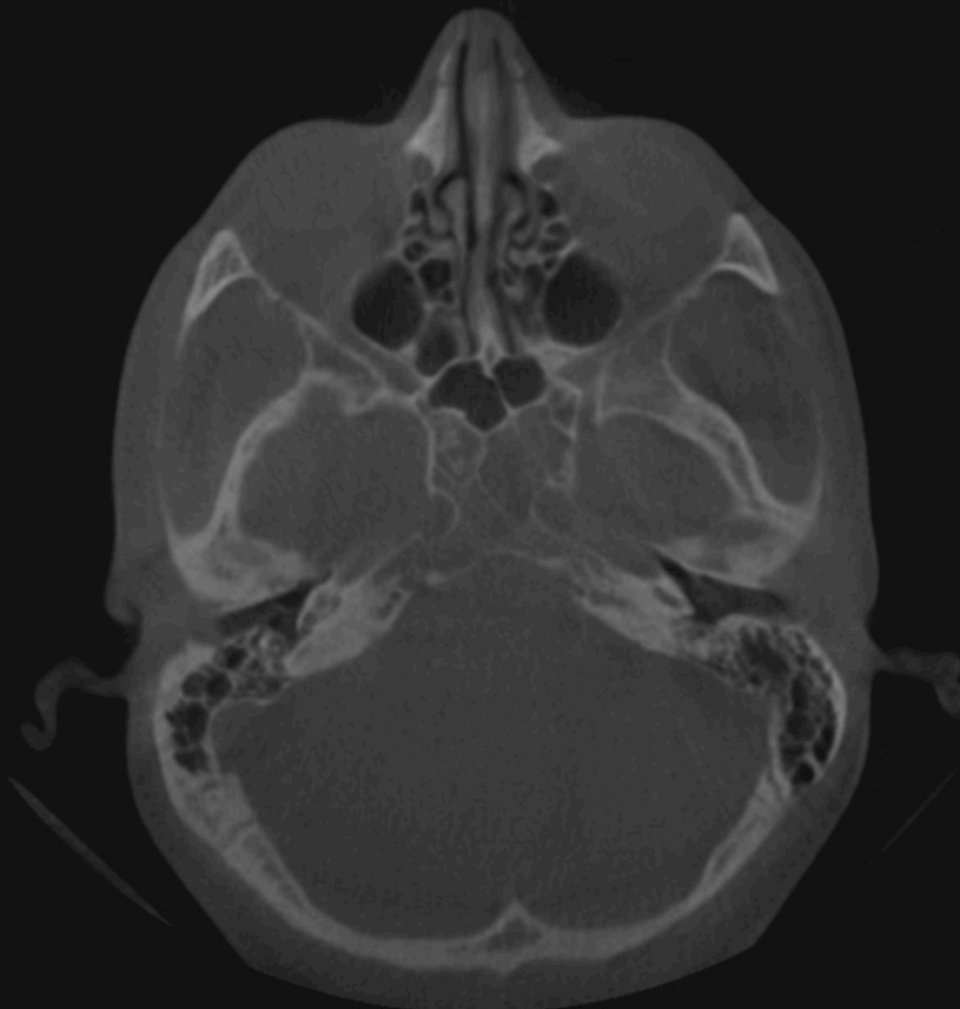
# Bone Dysplasias

- Mass effects include:
  - expansion of the bone, usually following the anatomic shape of the bone
  - invagination into the maxillary sinuses
  - lamina dura can disappear adjacent to teeth
  - displace teeth
  - prevent eruption of teeth
  - narrow-appearing PDL space
  - superior displacement of the mandibular canal
  - rarely, causes external root resorption





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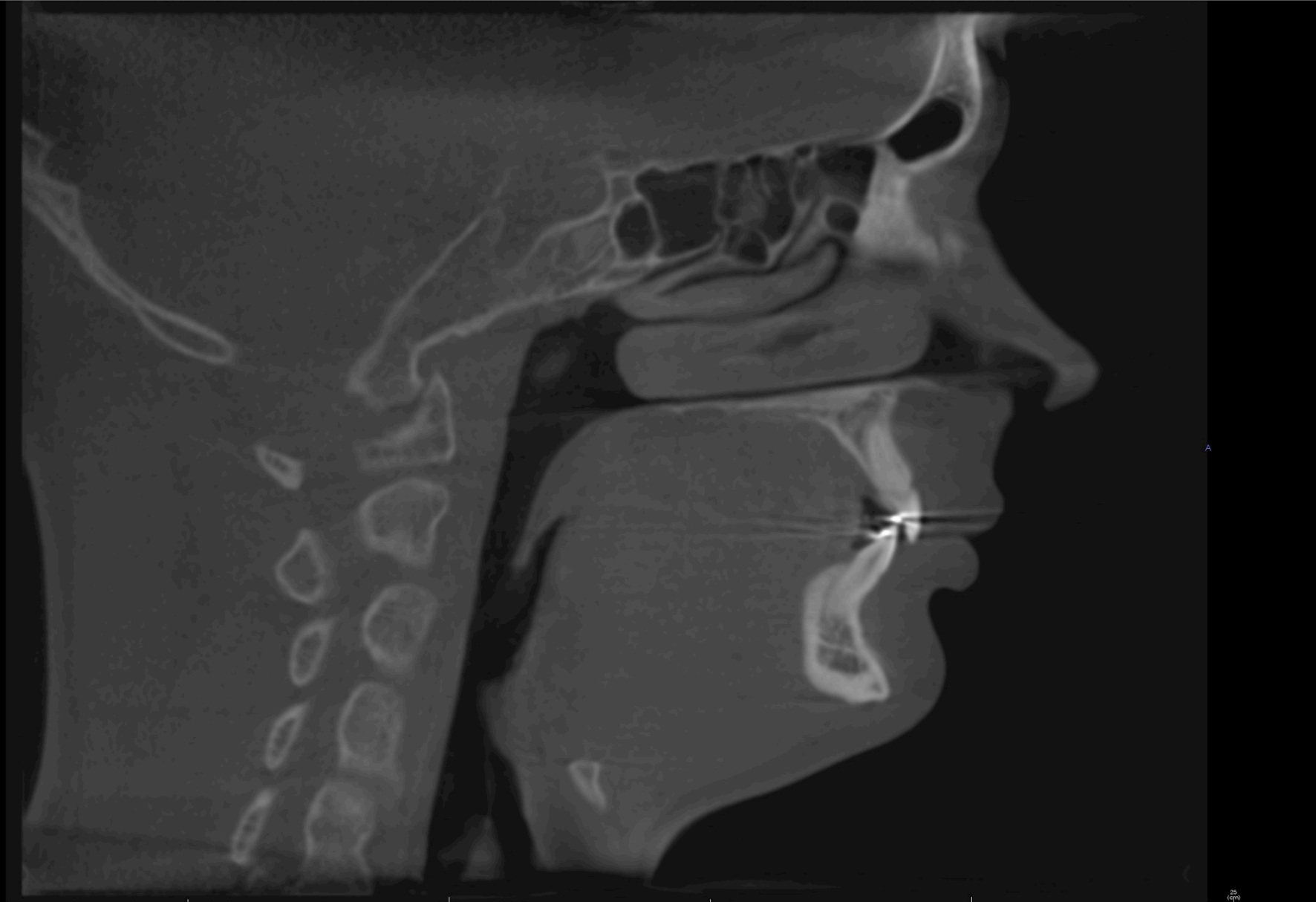


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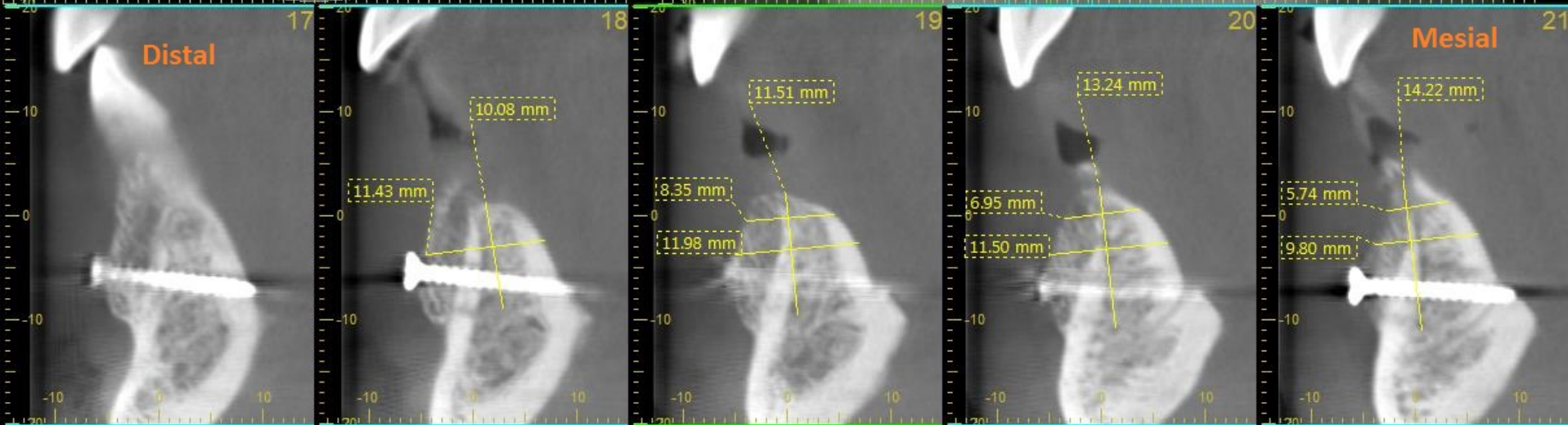
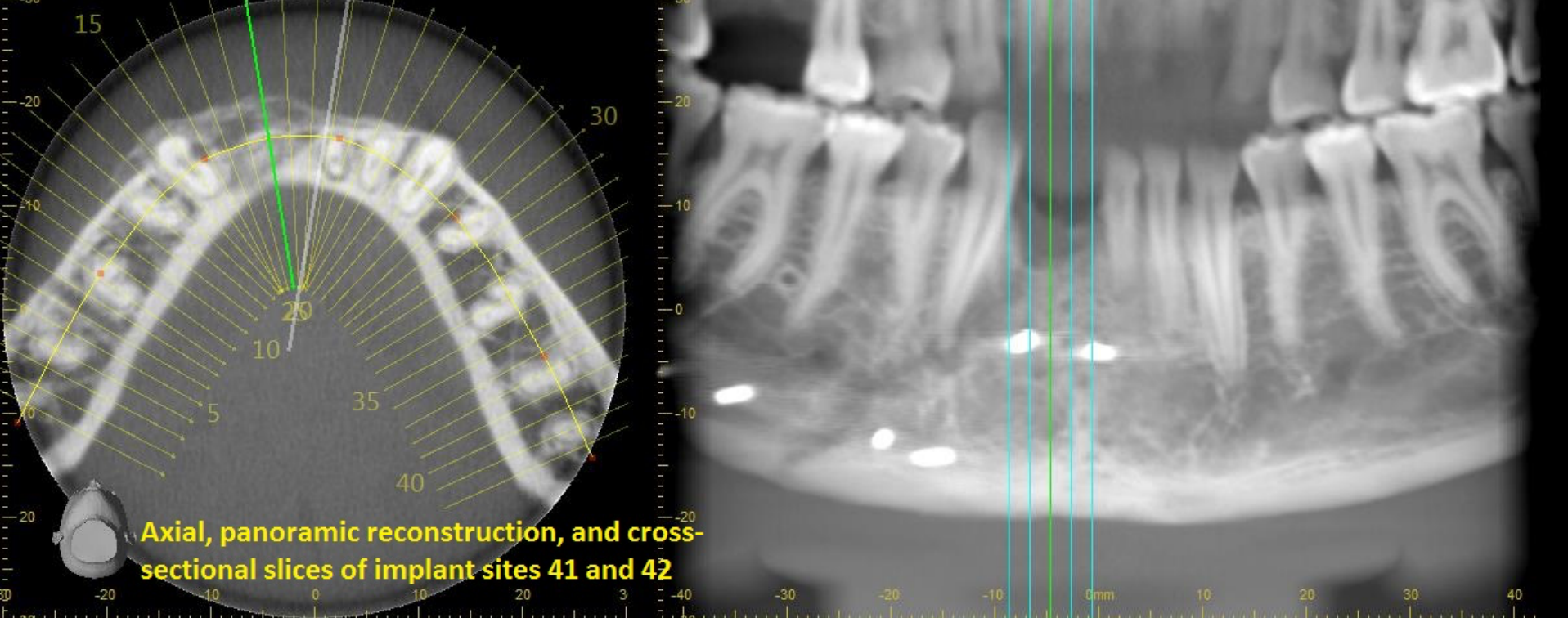
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# Trauma

- Can range from dentoalveolar fractures, to mandibular fractures to facial complex fractures
- Usually a distinct radiolucent line is noted
- Change in anatomic shape or contour
  - asymmetry
- Loss of continuity of a border
- in 2D images, can superimpose two pieces, appearing more radiopaque
- Most common CBCT trauma findings are tooth fractures, internal and external root resorption
- OMFS utilize CBCT for some larger cases, but if patient presents at ER, usually a MSCT is obtained



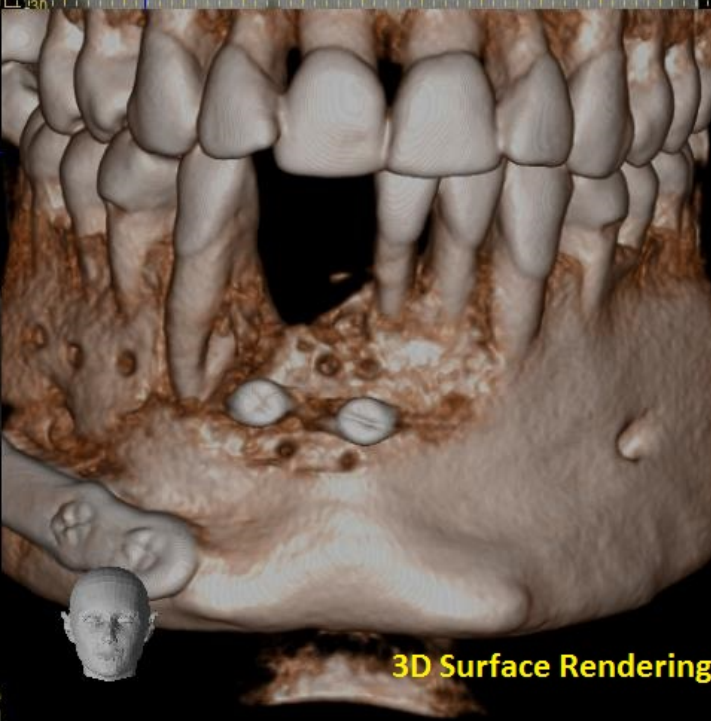
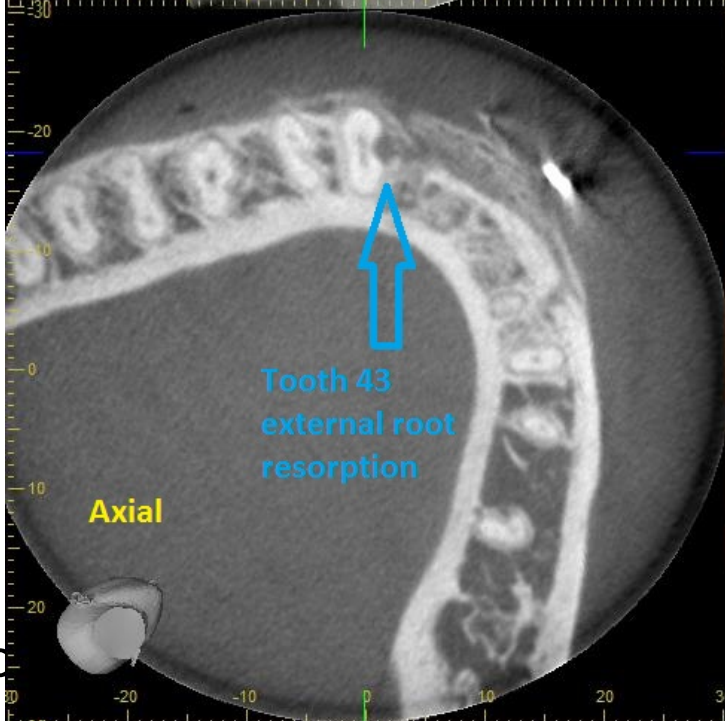
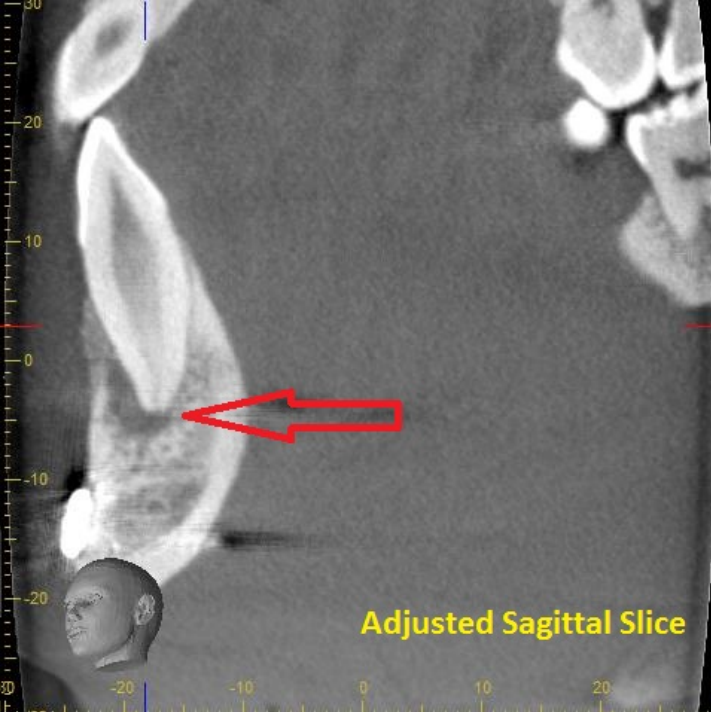
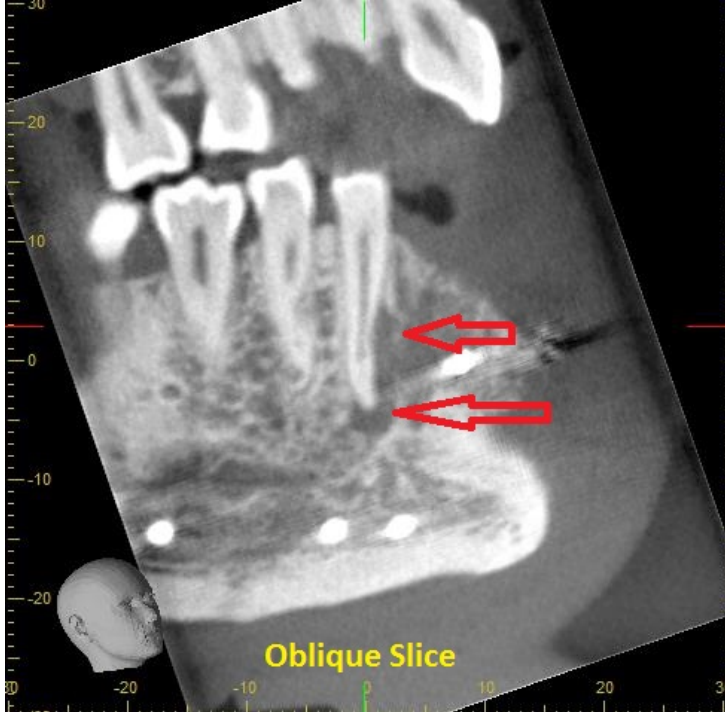


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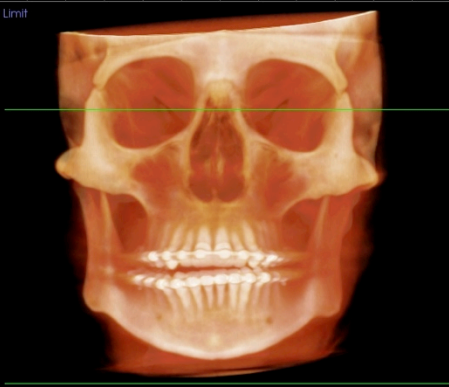
# Systemic/Metabolic Disease

- Show generalized bony changes:
  - change in the size and shape of bone
  - change in the number, size and orientation of trabeculae
  - altered thickness and density of cortical structures
  - increase or decrease in overall bone density
- Dental findings may include:
  - accelerated or delayed eruption of teeth
  - hypoplasia
  - hypocalcification
  - loss of distinct lamina dura
- Most common is post-menopausal osteoporosis

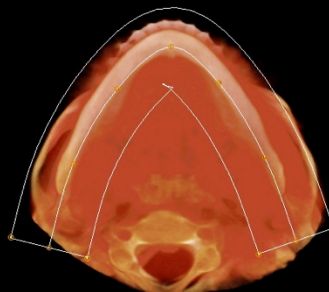




Upper-Lower Limit



Focal Trough



Preview



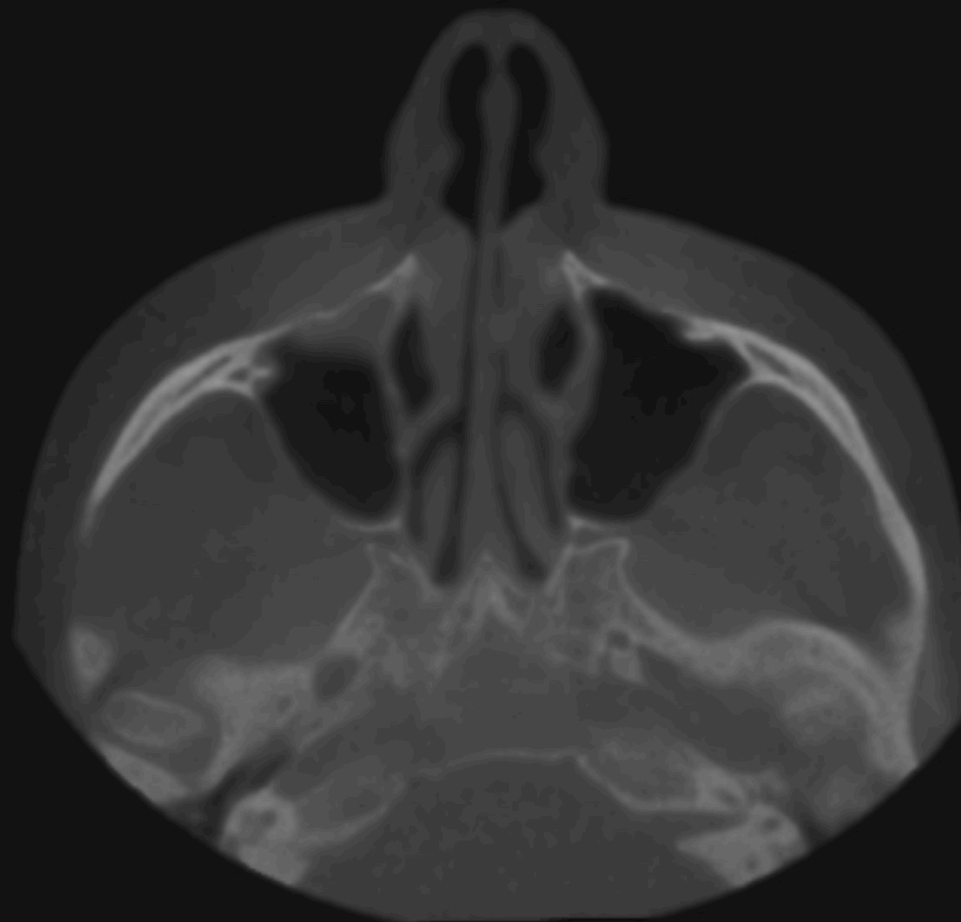
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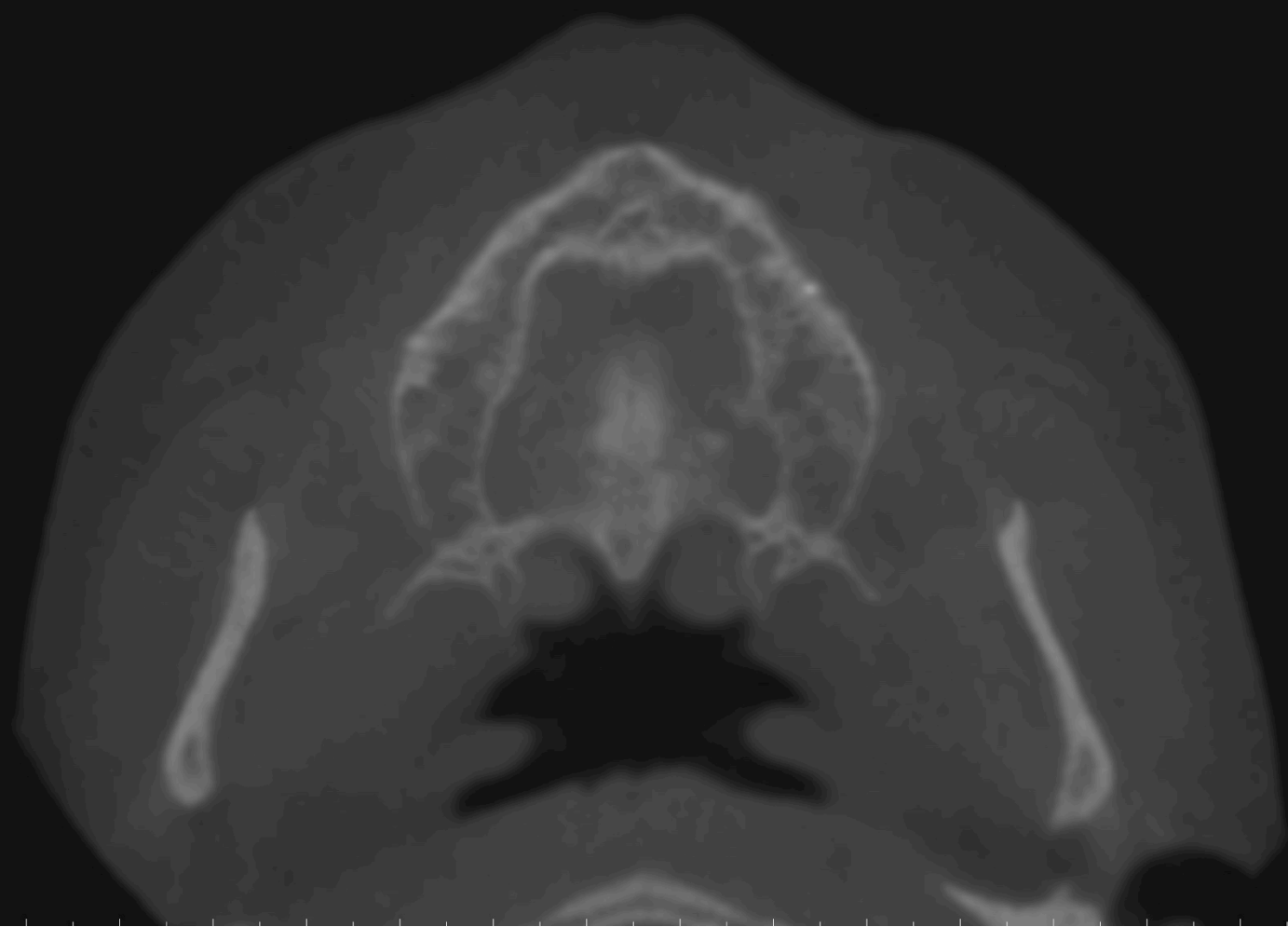
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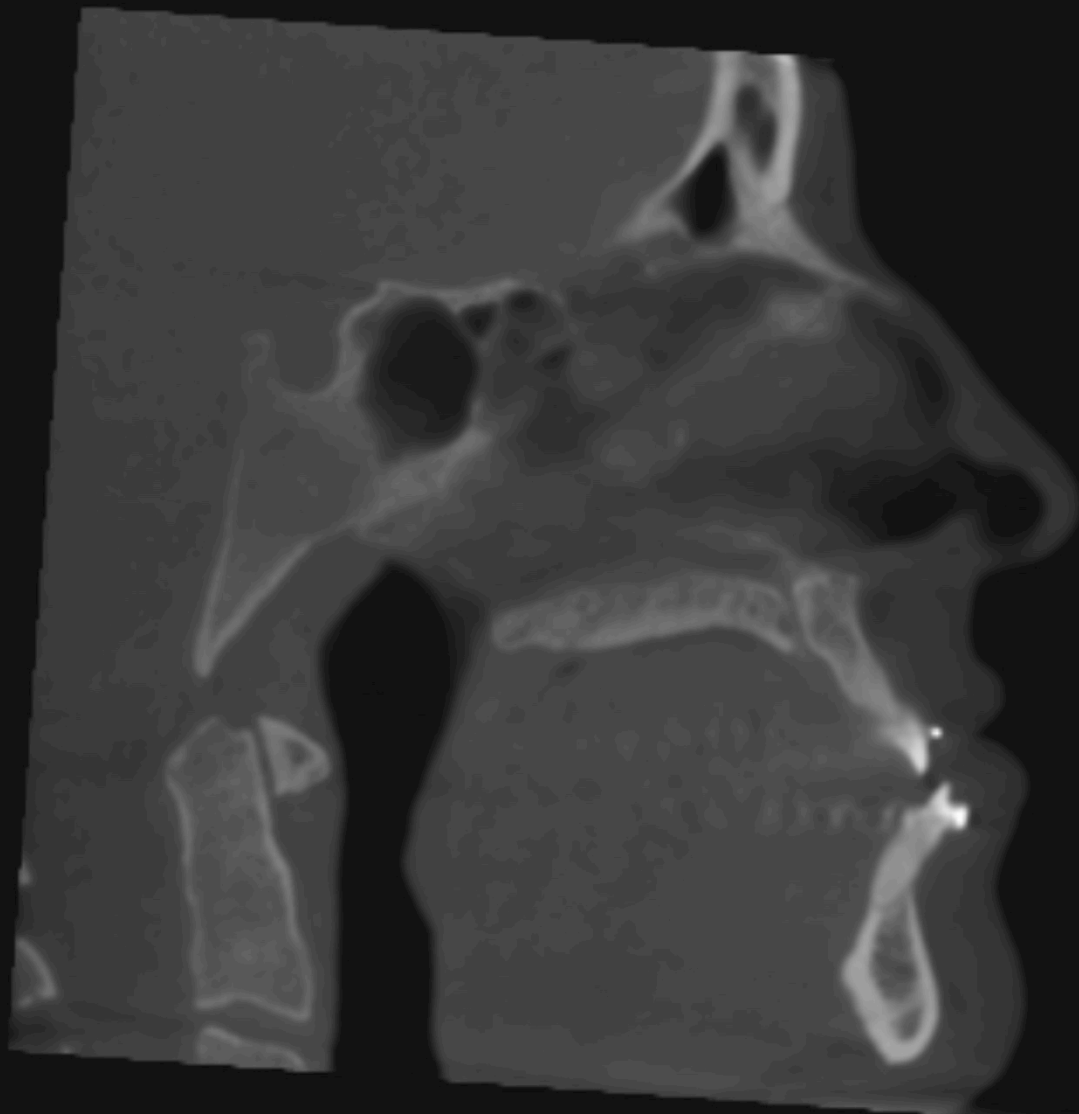


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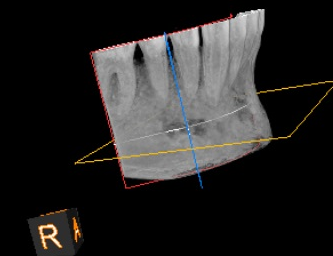
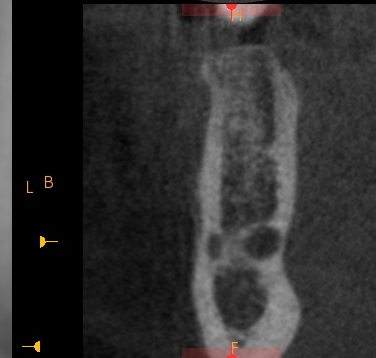
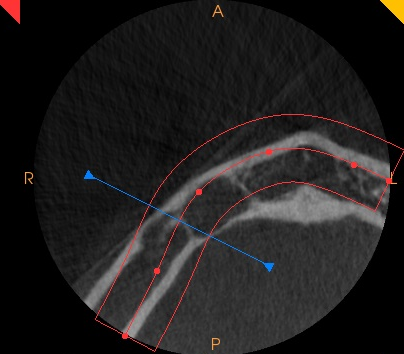
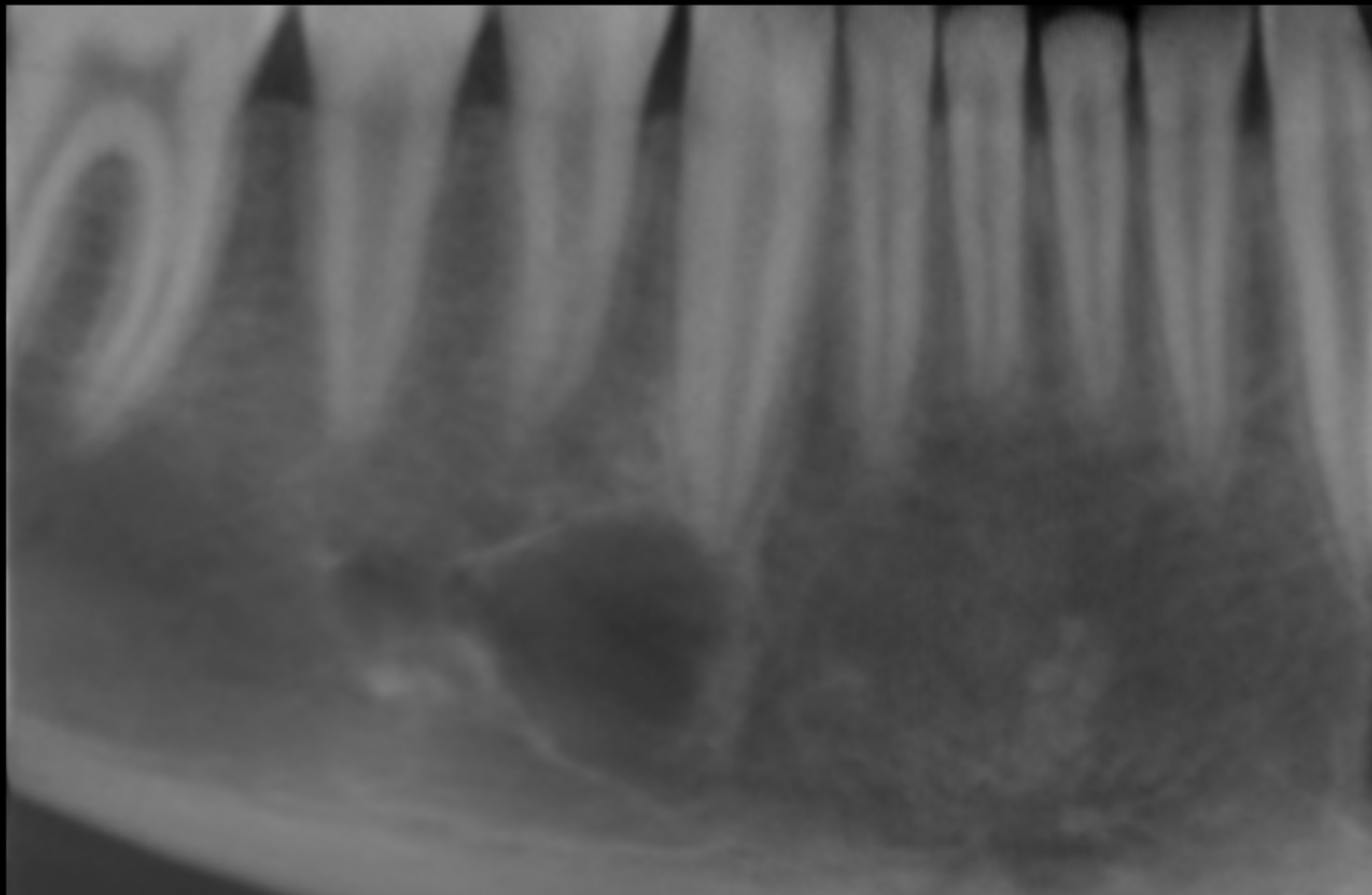
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# Vascular Lesions

- Typically 2 Mandible:1 Maxilla, posterior regions, and along the mandibular canal
- Periphery can be well-defined and corticated and ranging to ill-defined and malignant in appearance
- Can cause spiculated PNBFB
- Typically entirely radiolucent, but may be multilocular or contain phleboliths
- Dense trabecular struts may be coarser, and denser
- Marrow spaces may be enlarged
- “honeycombing”
- Mass effects:
  - displaced or resorbed tooth roots
  - may alter the path and enlarge the mandibular canal



# Panoramic Reconstruction

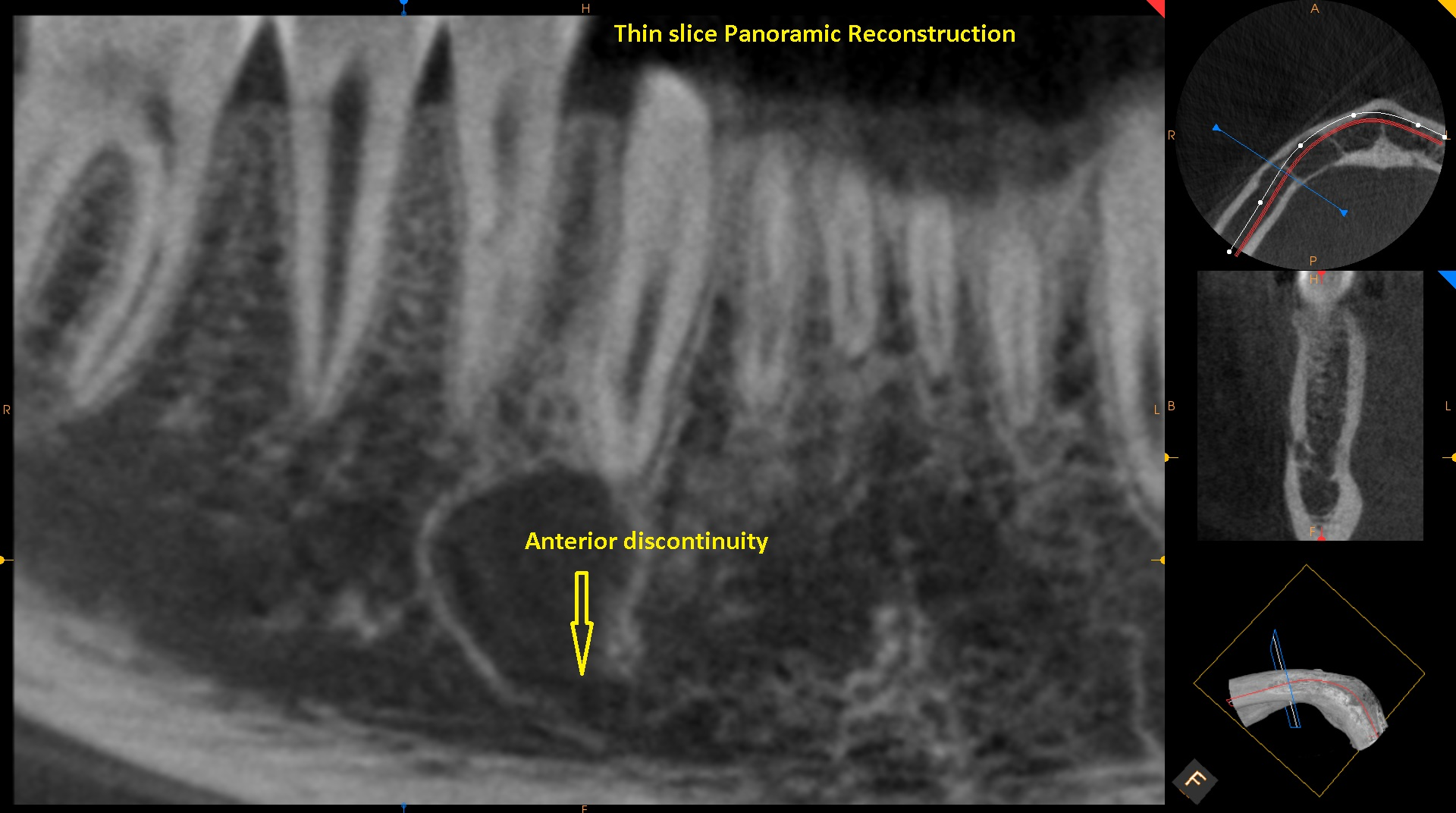


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Thin slice Panoramic Reconstruction



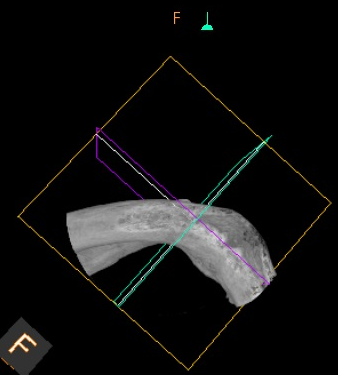
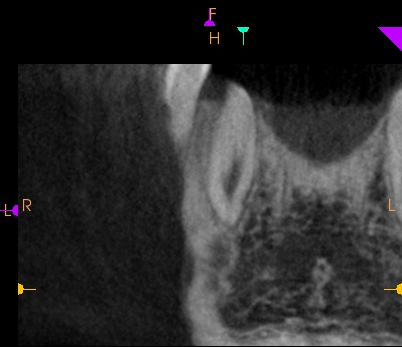
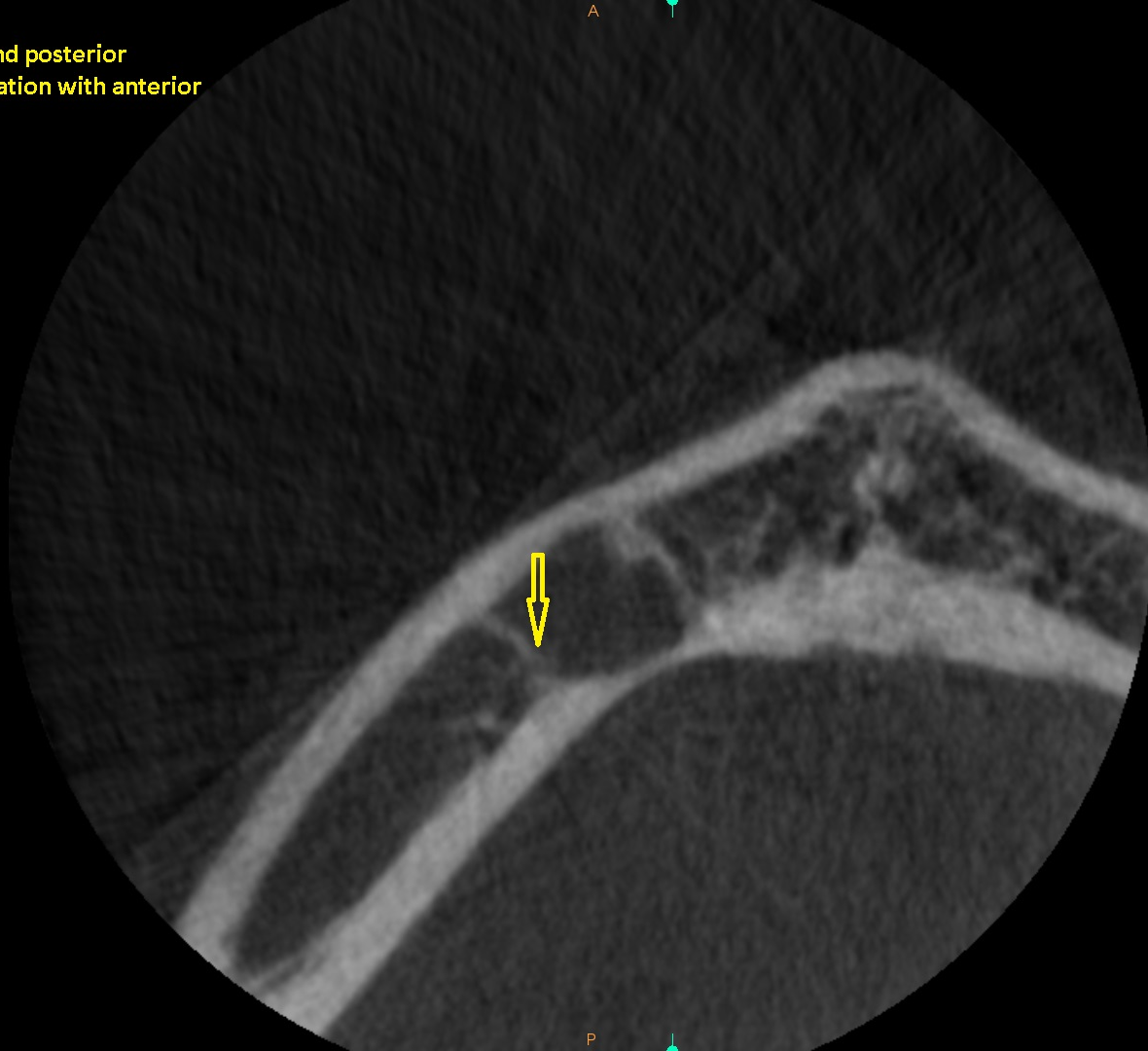
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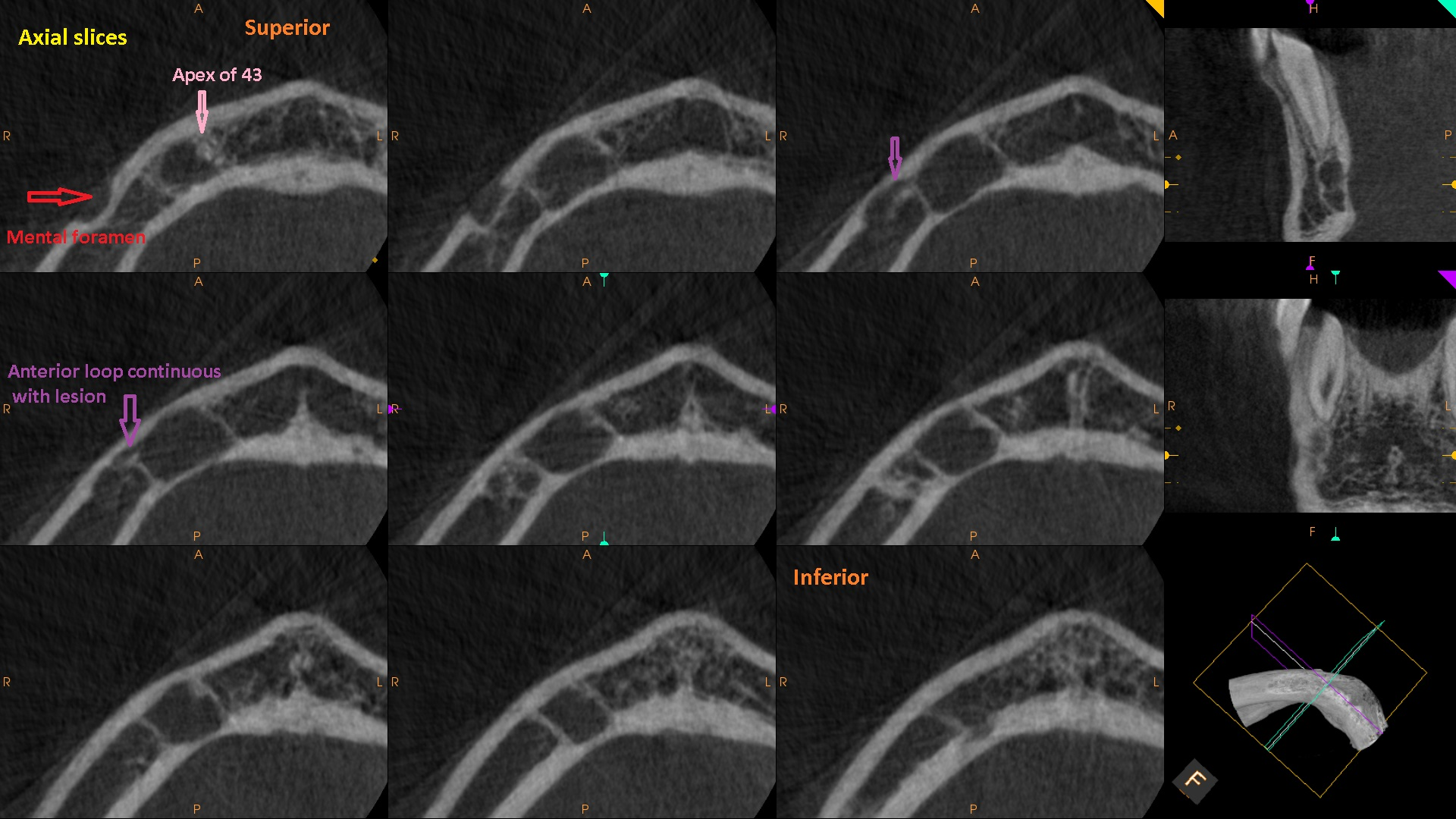
Axial of 2nd posterior  
communication with anterior  
loop



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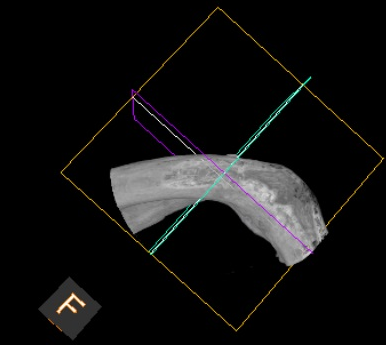
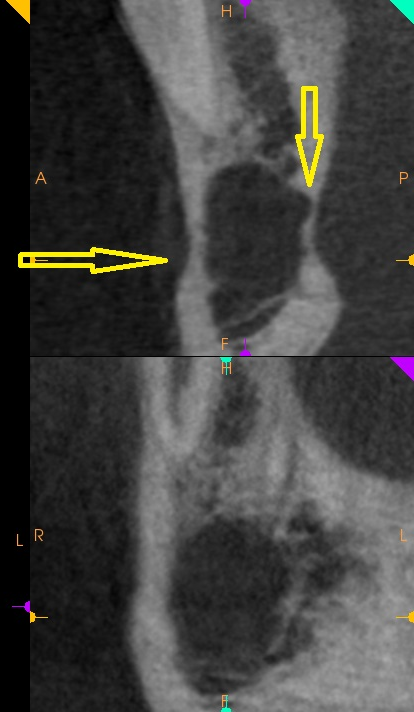
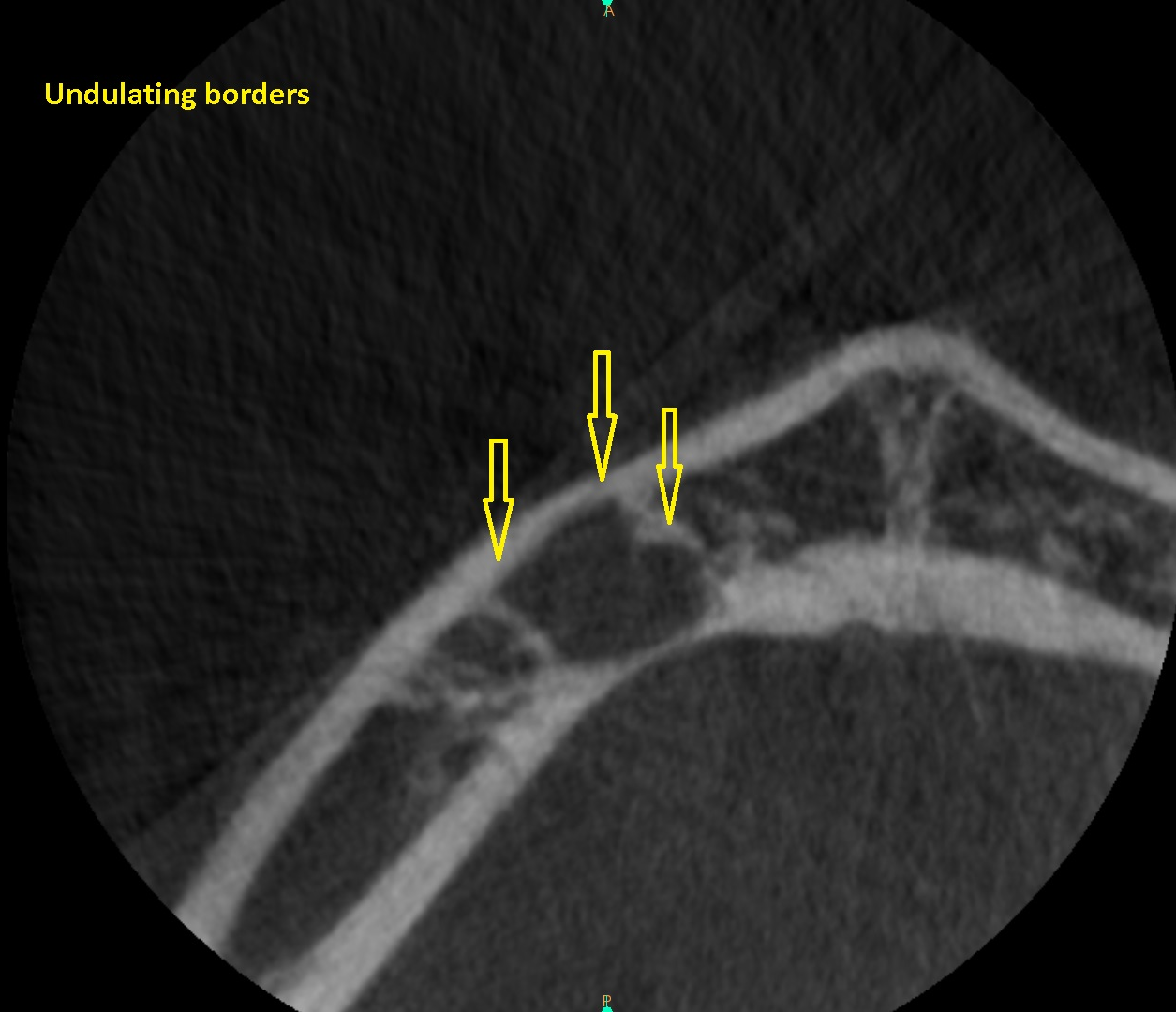


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Undulating borders



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# Analytical Algorithm

- Is your lesion completely imaged?
- What features are most important in your diagnosis?
- What features lead you to which disease categories?
- Is there contributing health information in the patient chart that may guide you to your diagnosis?
- Are you missing anything?
- Do you require further diagnostic tests?



# References

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