ORBITAL TRAUMA : WHAT CAN THE RADIOLOGIST OFFER?

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Outline

- Introduction
- Anatomy - Imaging modalities & protocols
- Mechanism of orbital trauma
- What should we read for orbital trauma?
- Cases
- Take Home Messages

Introduction

Orbital Trauma → permanent visual loss

↑

Clinical assessment

Visual acuity

Extraocular muscle motility

Limited by : edema & concomitant injuries

mechanism & timing of injury

↓

Imaging

- trauma pattern
- extent of injury

↓

Indications :

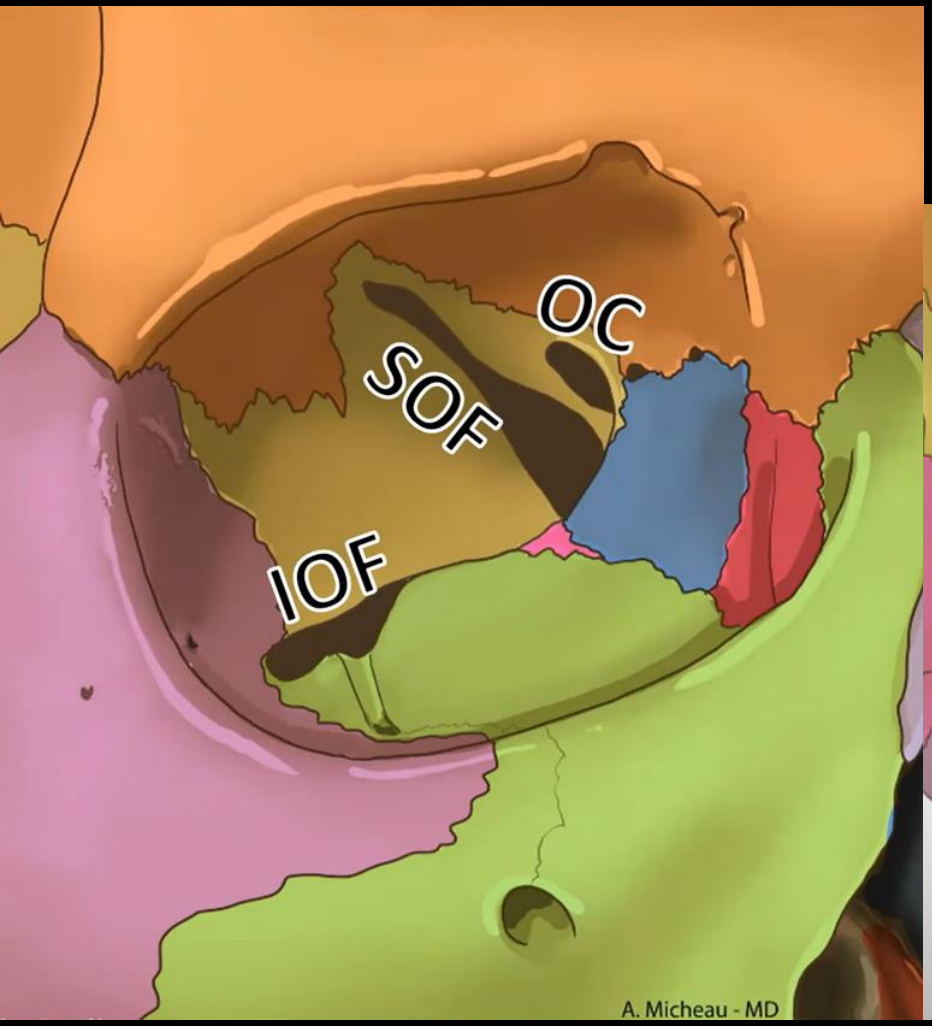
- if the posterior chamber not visualized
- susp orbital fractures
- intraocular foreign body
- occult globe rupture

Isolated injury

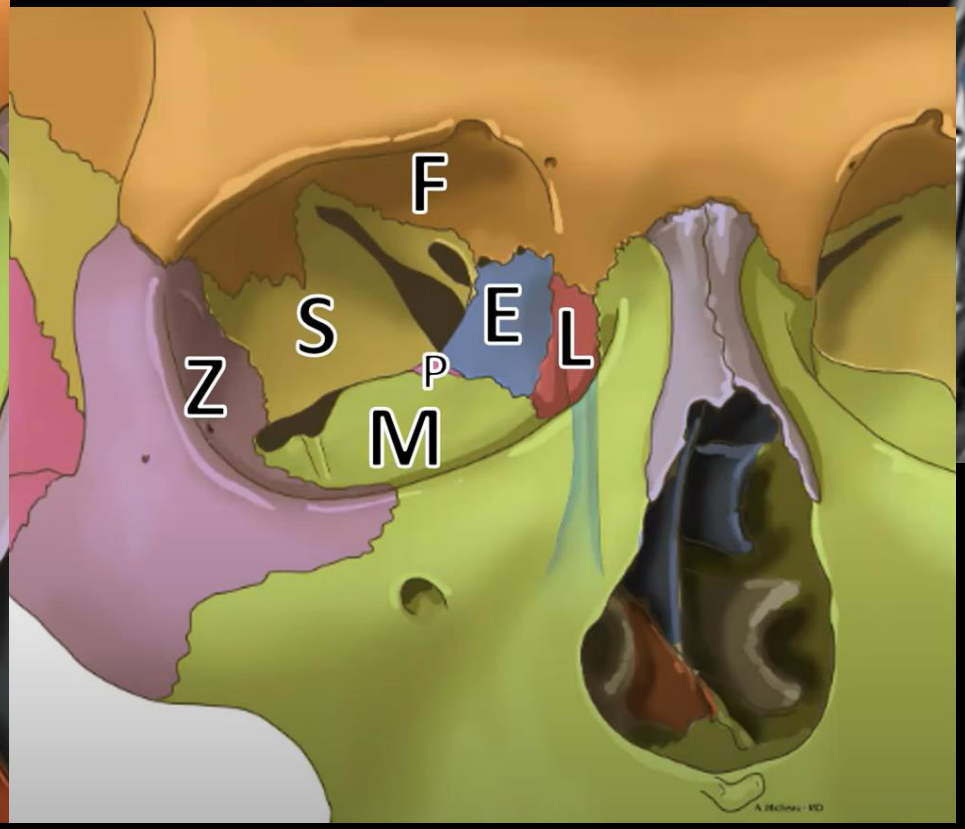
Effect of severe craniofacial injury-

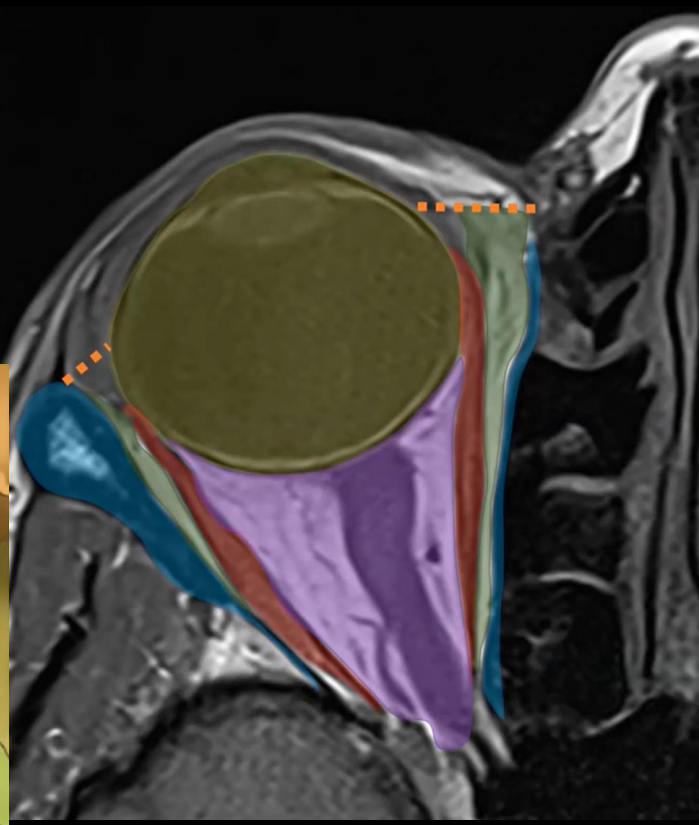
Anatomy – Imaging Modalities - Protocols

3 openings



7 bones






Infra-orbital
canal

Imaging Modalities : CT

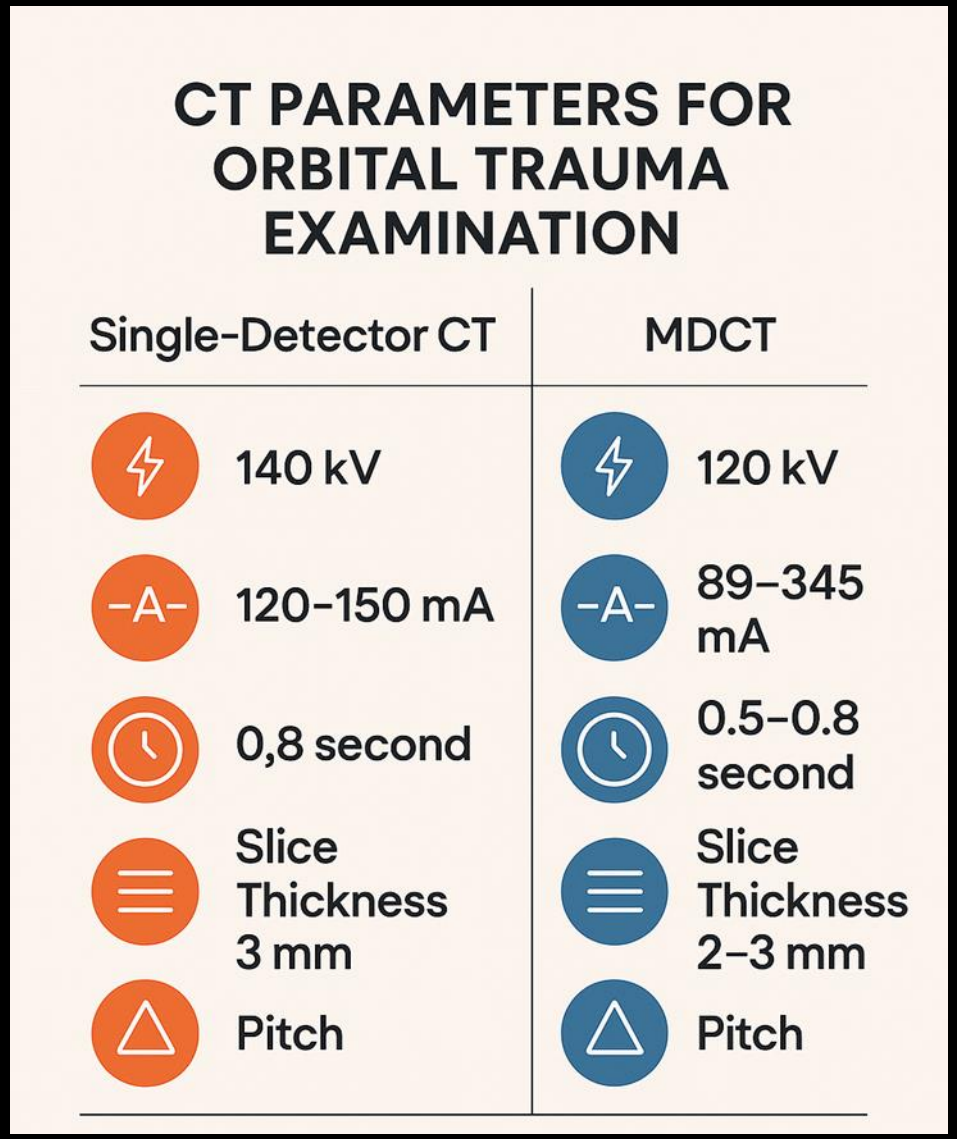
(+)
Images in various fields
Detection of fat herniation into the paranasal sinuses
The picture of distortion, avulsion, herniation of extraocular muscles is well depicted
For evaluation of orbital soft tissue trauma and chronic bleeding

(-)
Poor detection of acute focal hemorrhage in the orbit bone details are unclear

Protocols CT

No iv contrast
CT bones & soft tissue reconstructions
Axial & coronal planes : coronal perpendicular to orbit axis
Preferably : 1-2mm reconstructions for the bone setting, 1,5-3mm for the soft tissue imaging
3D reconstructions for surgical planning

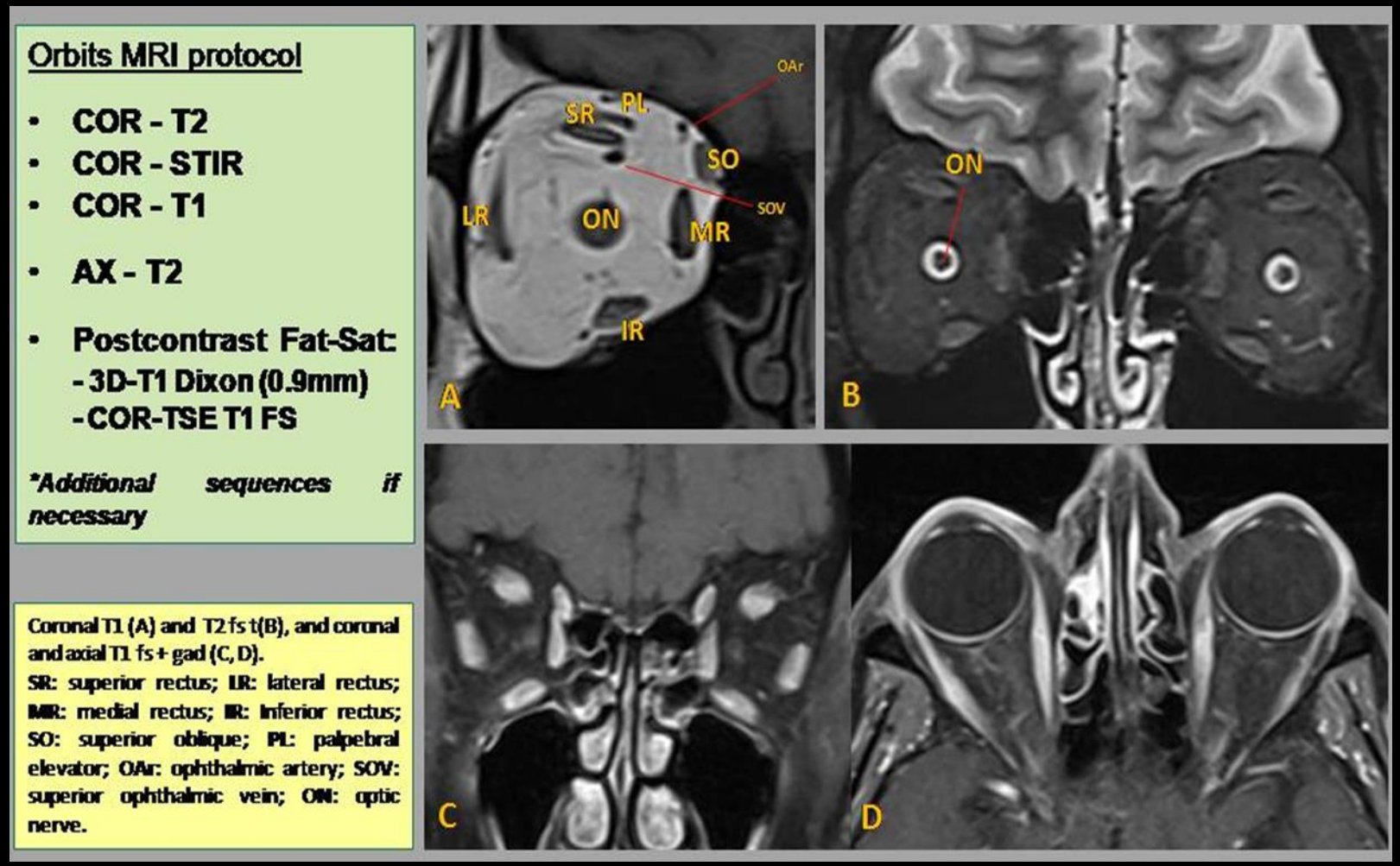
CT Imaging of Orbital Trauma



CT Scan - BALPINE Mnemonic

- B : Bones
- A : Anterior Chamber
- L : Lens
- P : Posterior Globe Structures
- I : Intraconal Orbit
- N : Neurovascular Structures
- E : Extraocular Muscles / Extraconal Orbit

MR Imaging of Orbital

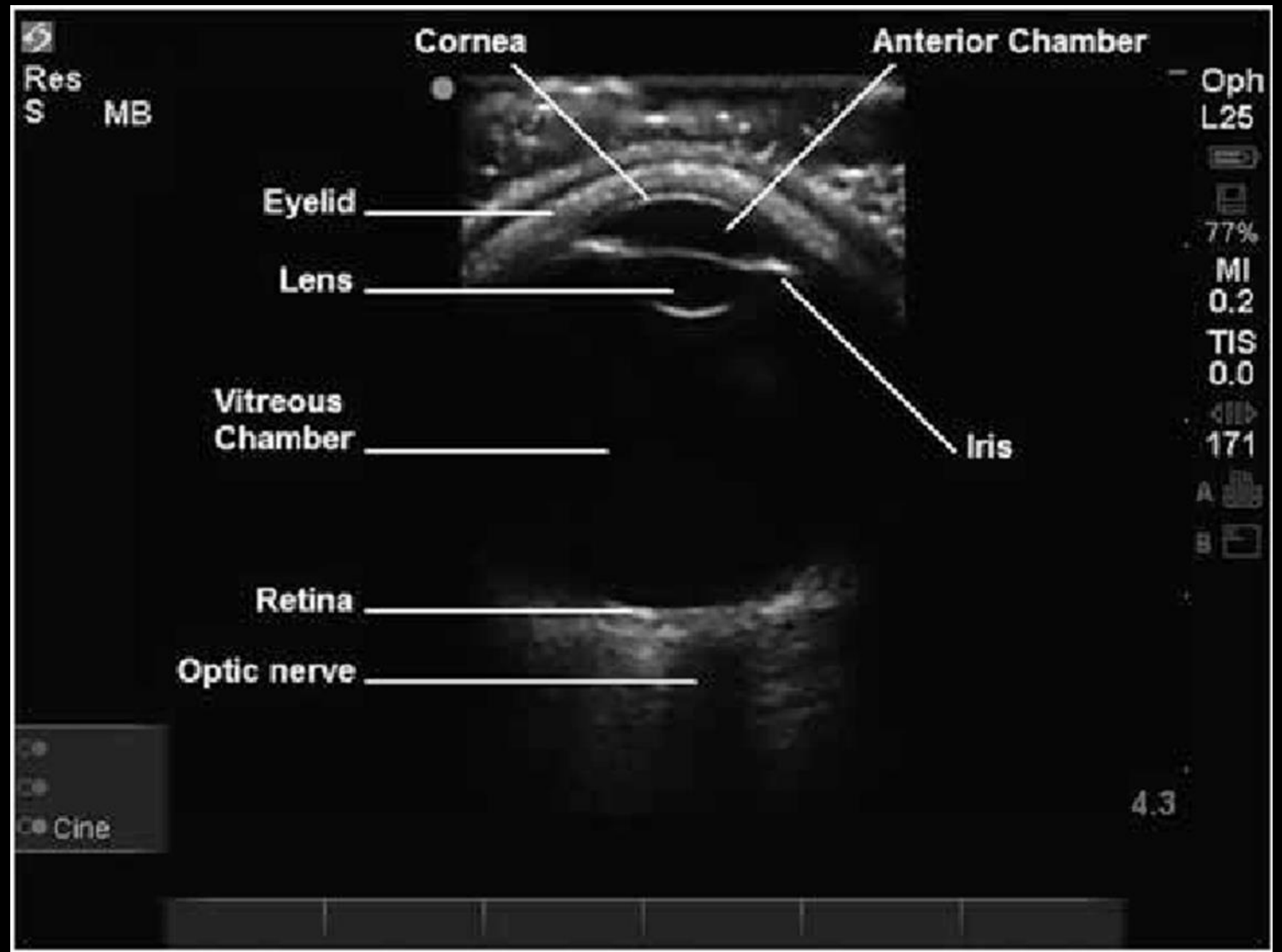


(-)
Longer acquisition time
↙ sensitivity of fracture
Cons : metallic ocular foreign bodies

(+)
Retinal & choroidal detachment : well detected
Non radioopaque foreign bodies

Additional imaging for complicated cases
Not in acute trauma

Orbital Ultrasound



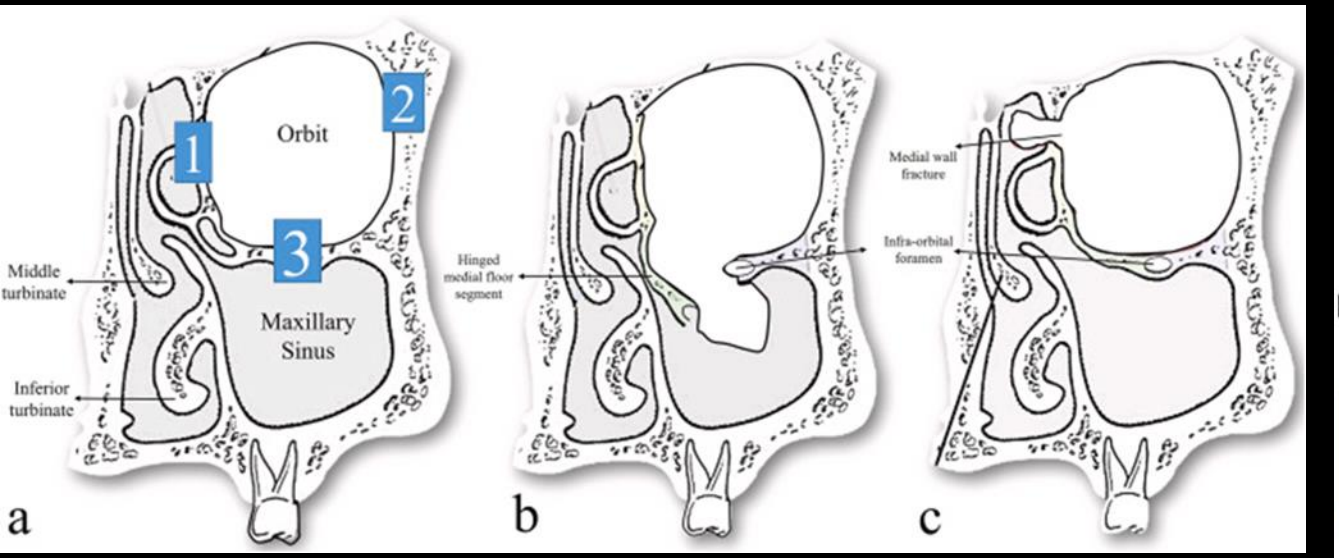
Can be performed rapidly at the bedside

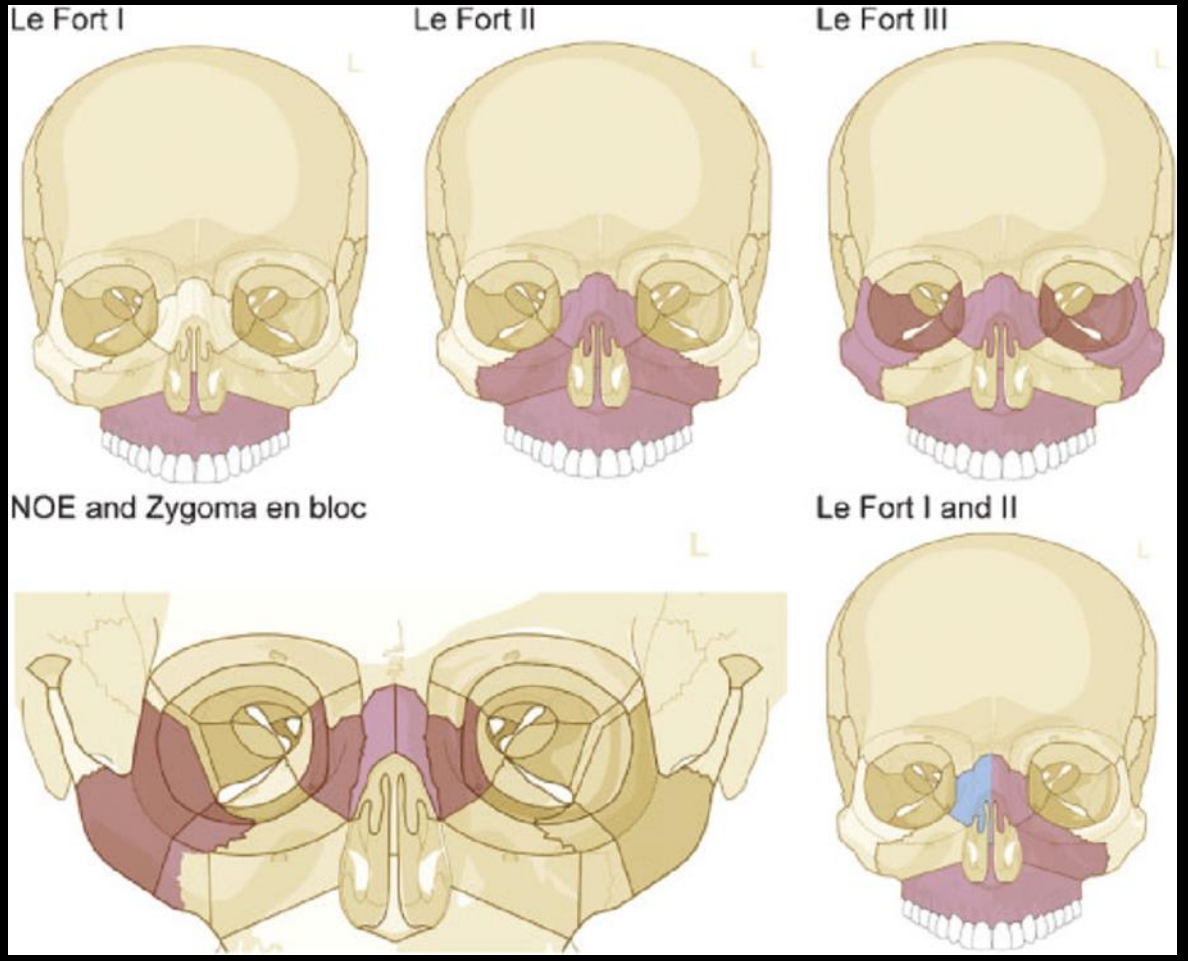
Accurate detection of :
Retrobulbar haemorrhage
Foreign body
Lens dislocation
Retinal detachment

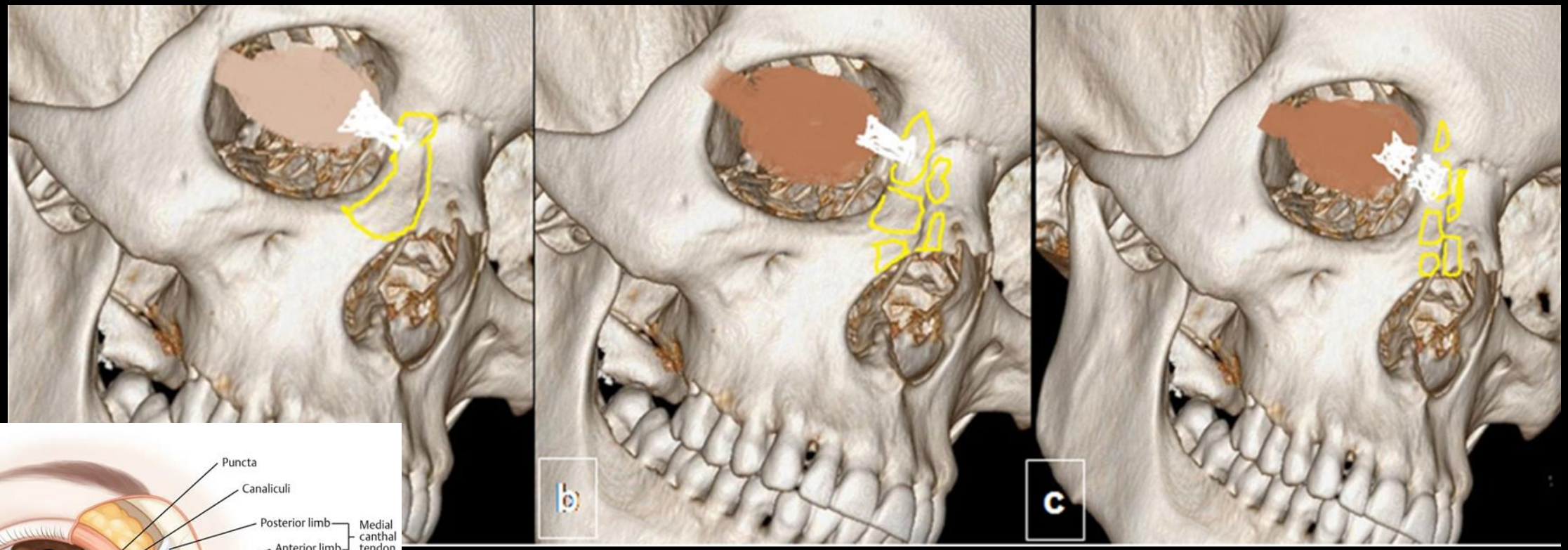
Cons : globe rupture

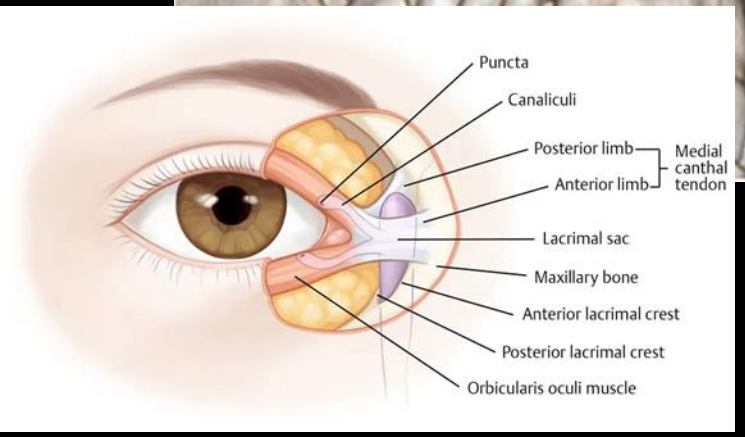
Mechanism of orbital trauma :

- Hydraulic theory : where pressure builds up after a blow to the eye
- Buckling theory : where a blow to the face transmits pressure, causing the orbital floor to buckle









Medial canthal tendon

Gomez Rosello et al., Insight into Imaging, 2020

Classification of naso-orbito-ethmoidal fractures (Markovitz and Manson classification)

(a) Type I : single large fragment with attached medial tendon

(b) Type II : with bone comminution without extension to the medial canthal tendon

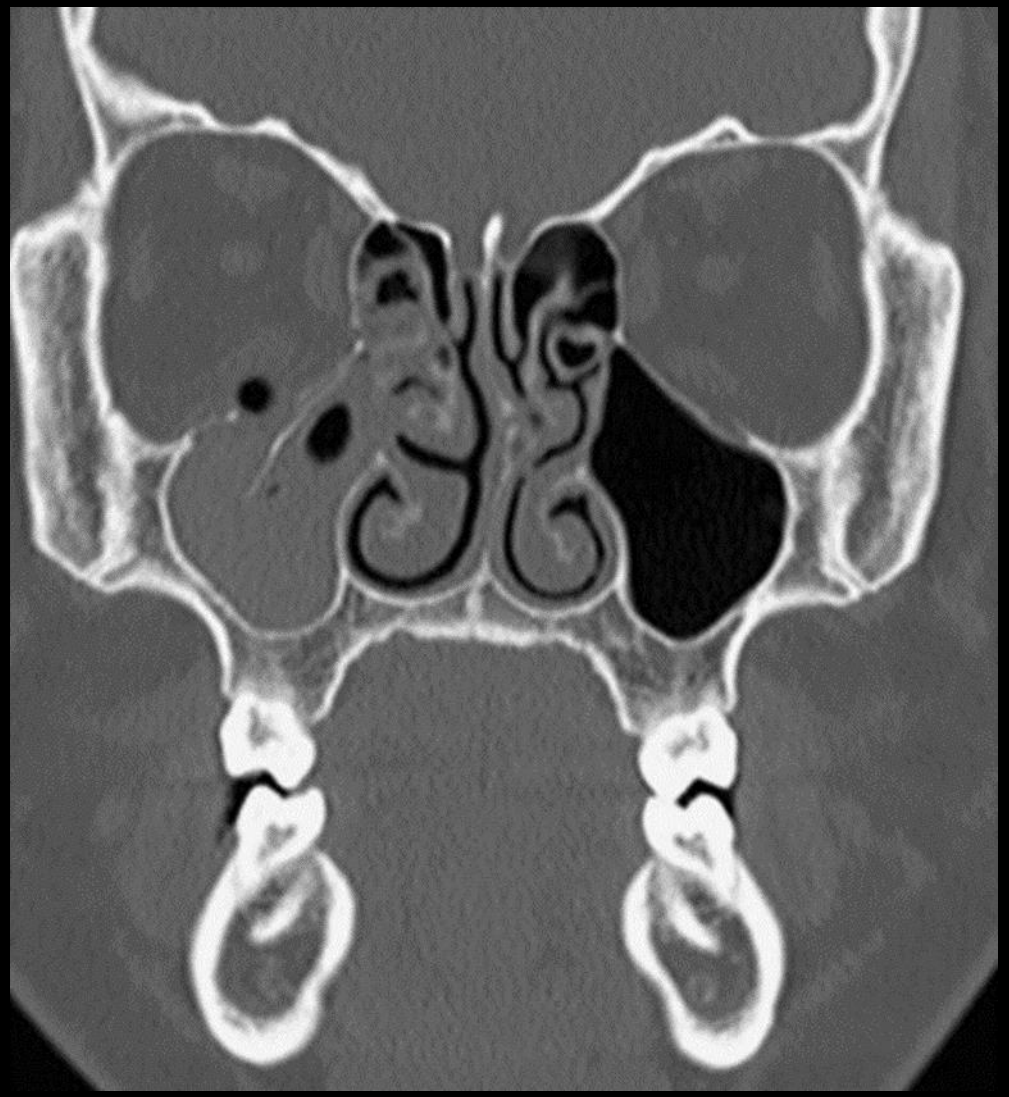
(c) Type III : where comminution affects the medial canthal tendon

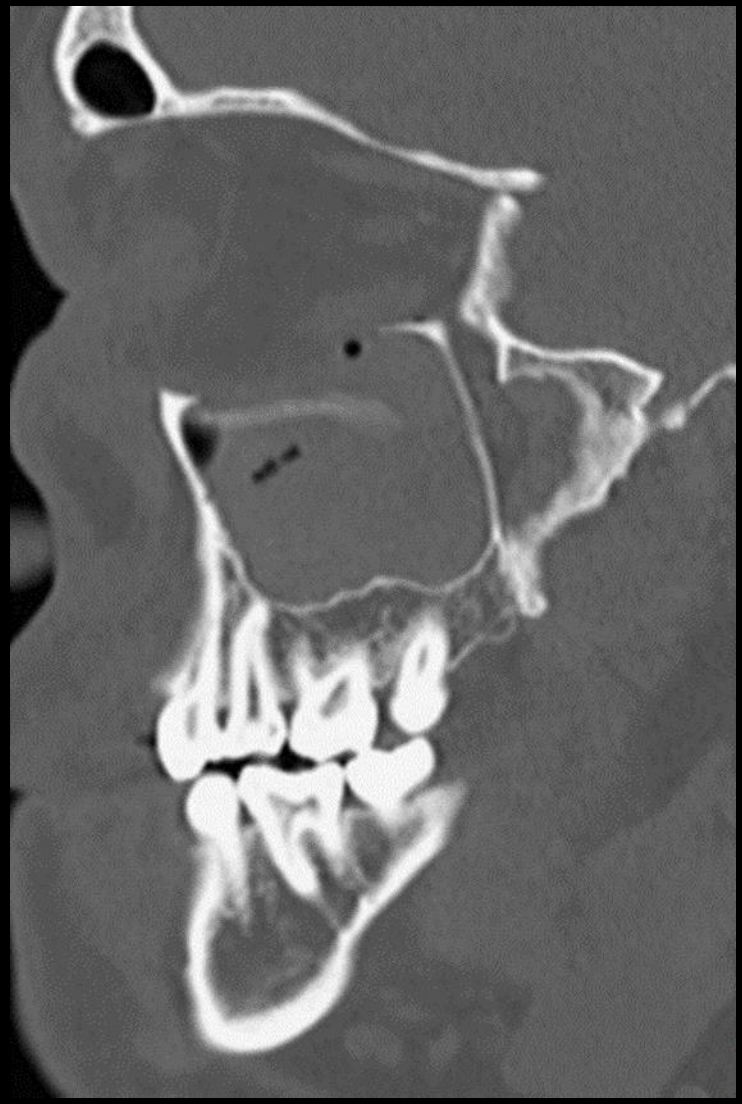
What should we read for orbital trauma?

BALPINE mnemonic

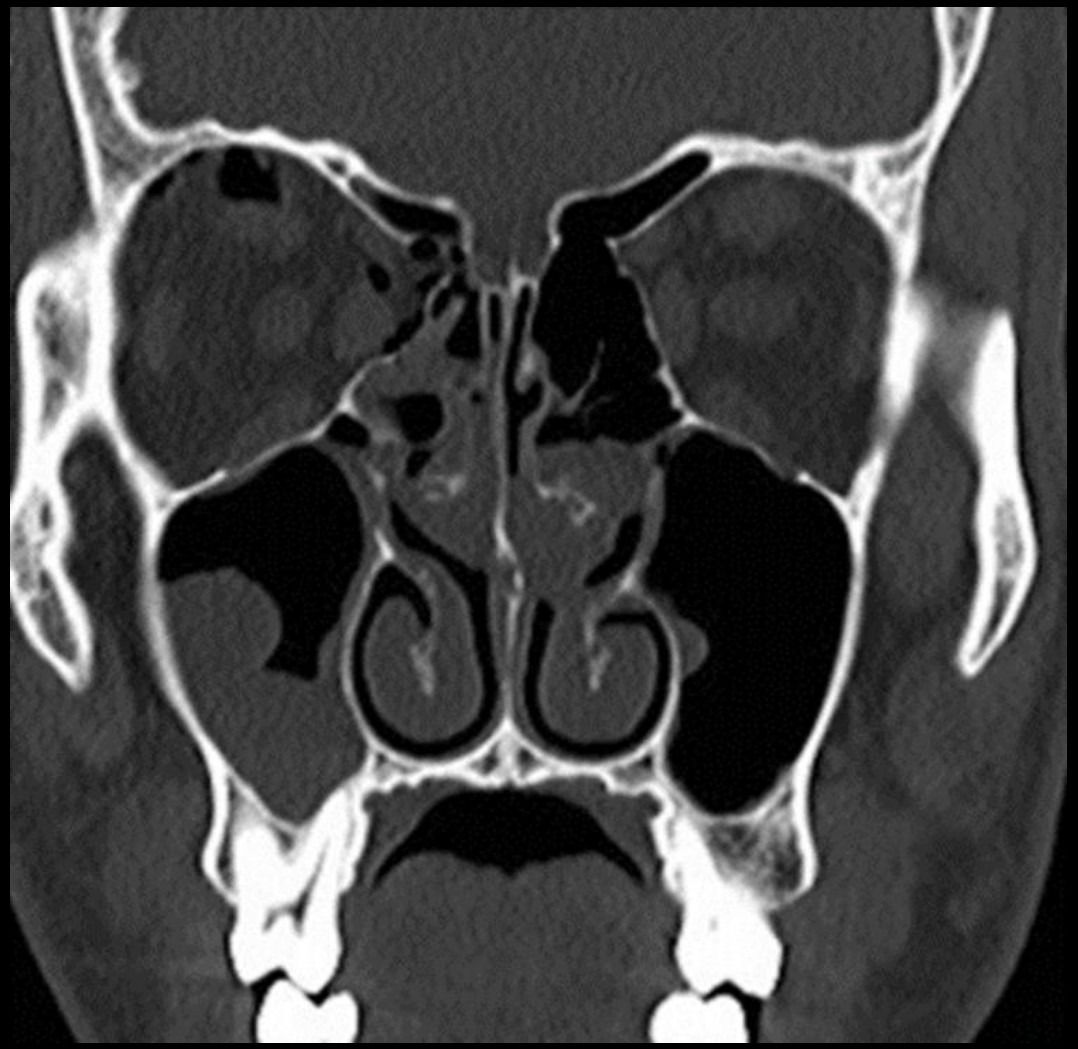
- B : bones
- A : anterior chamber
- L : lens
- P : posterior globe structures
- I : intraconal orbit
- N : neurovascular structures
- E : extraocular muscles/ extraconal orbit

Cases 1



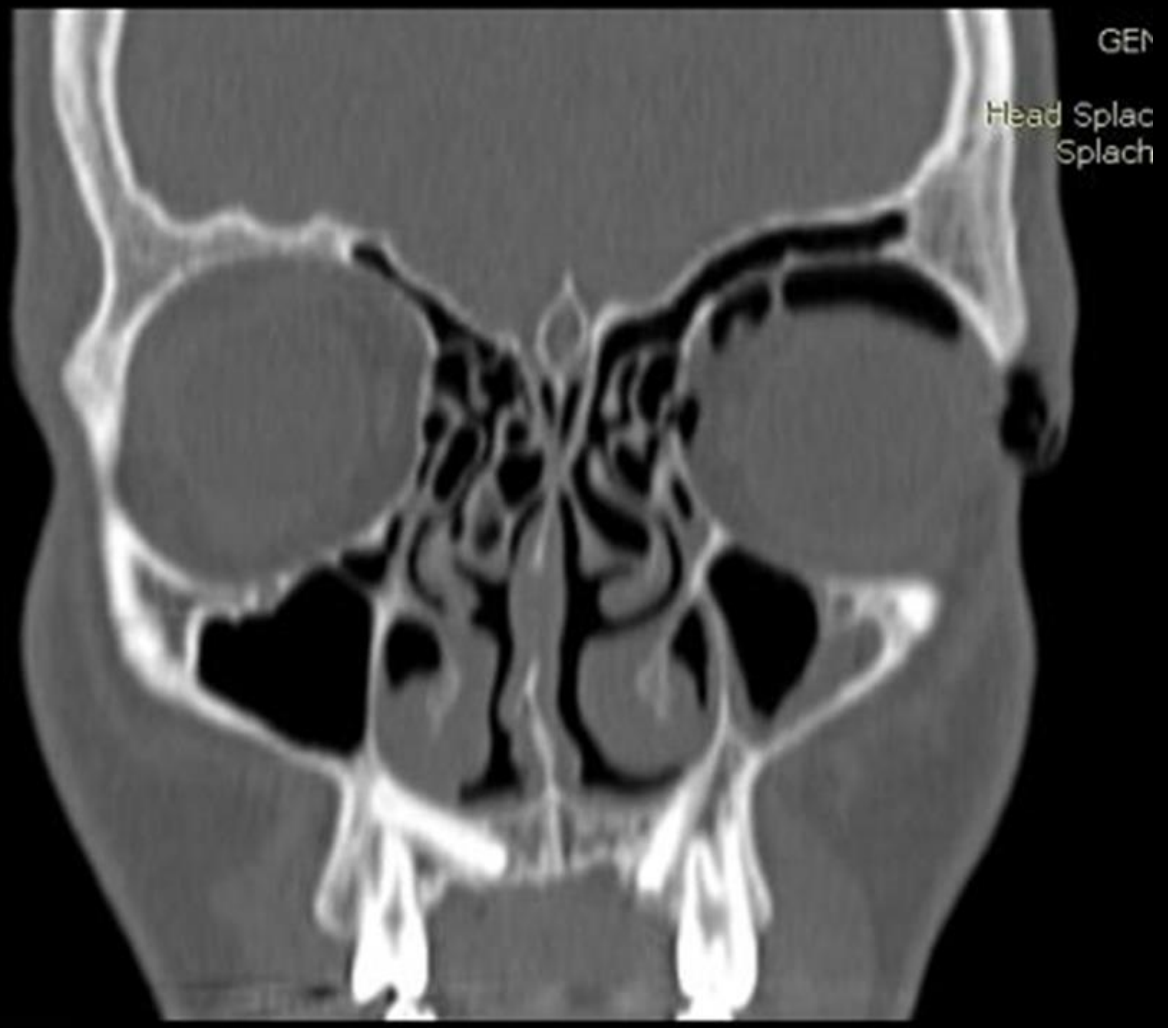


Cases 2

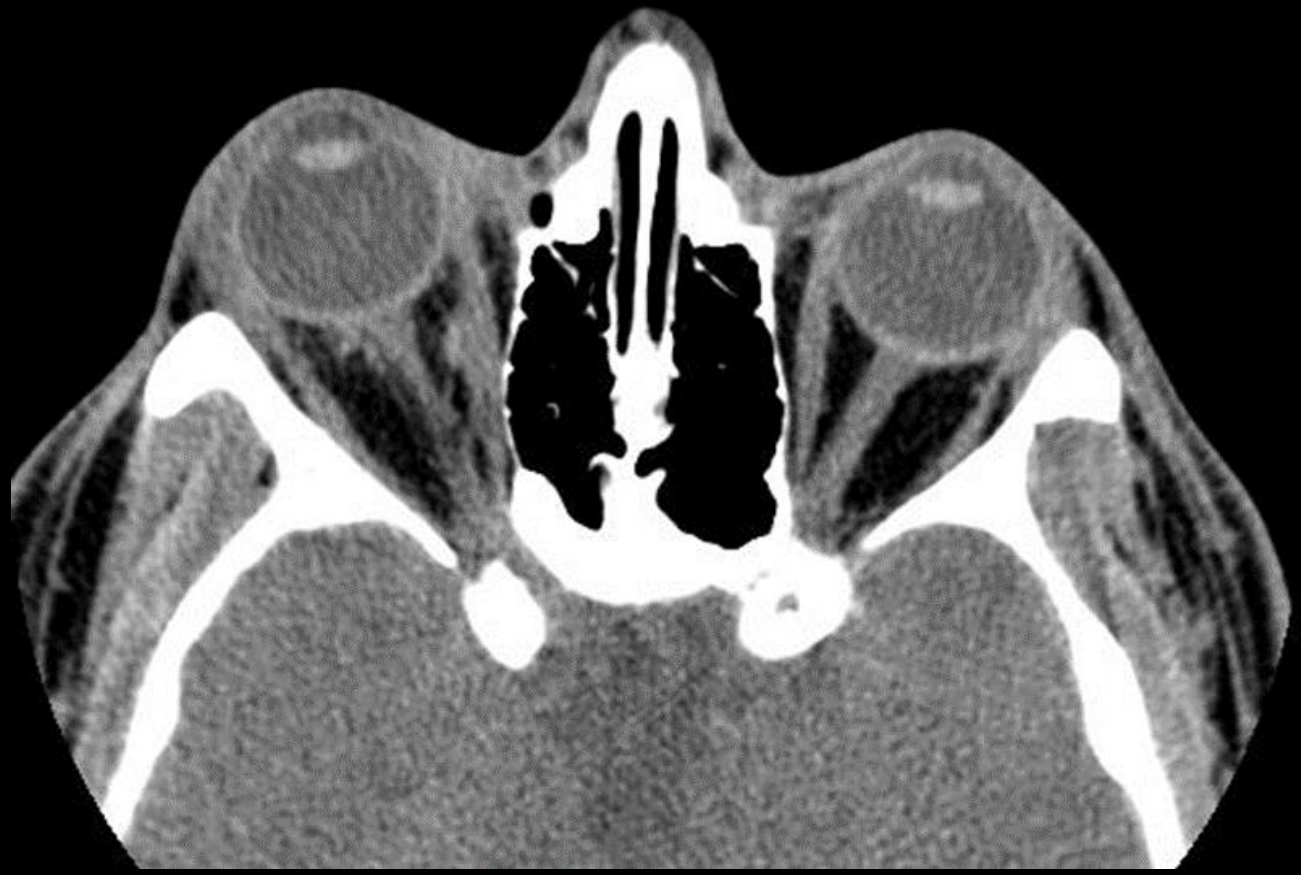


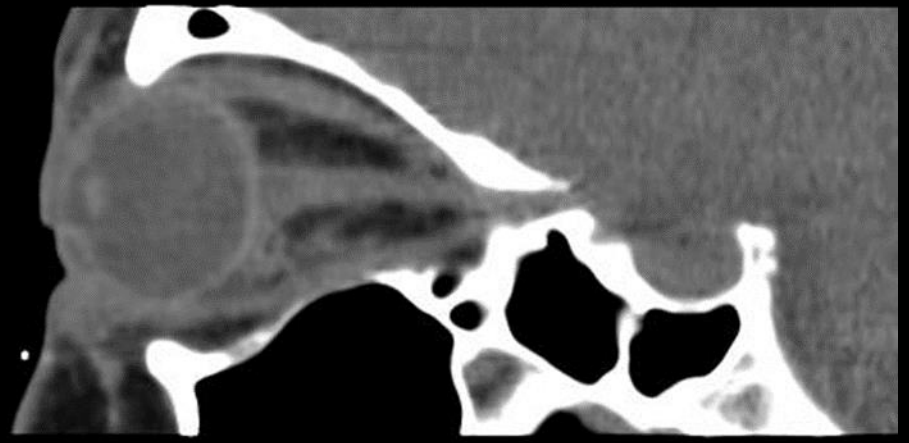
Case 3

Cases 4

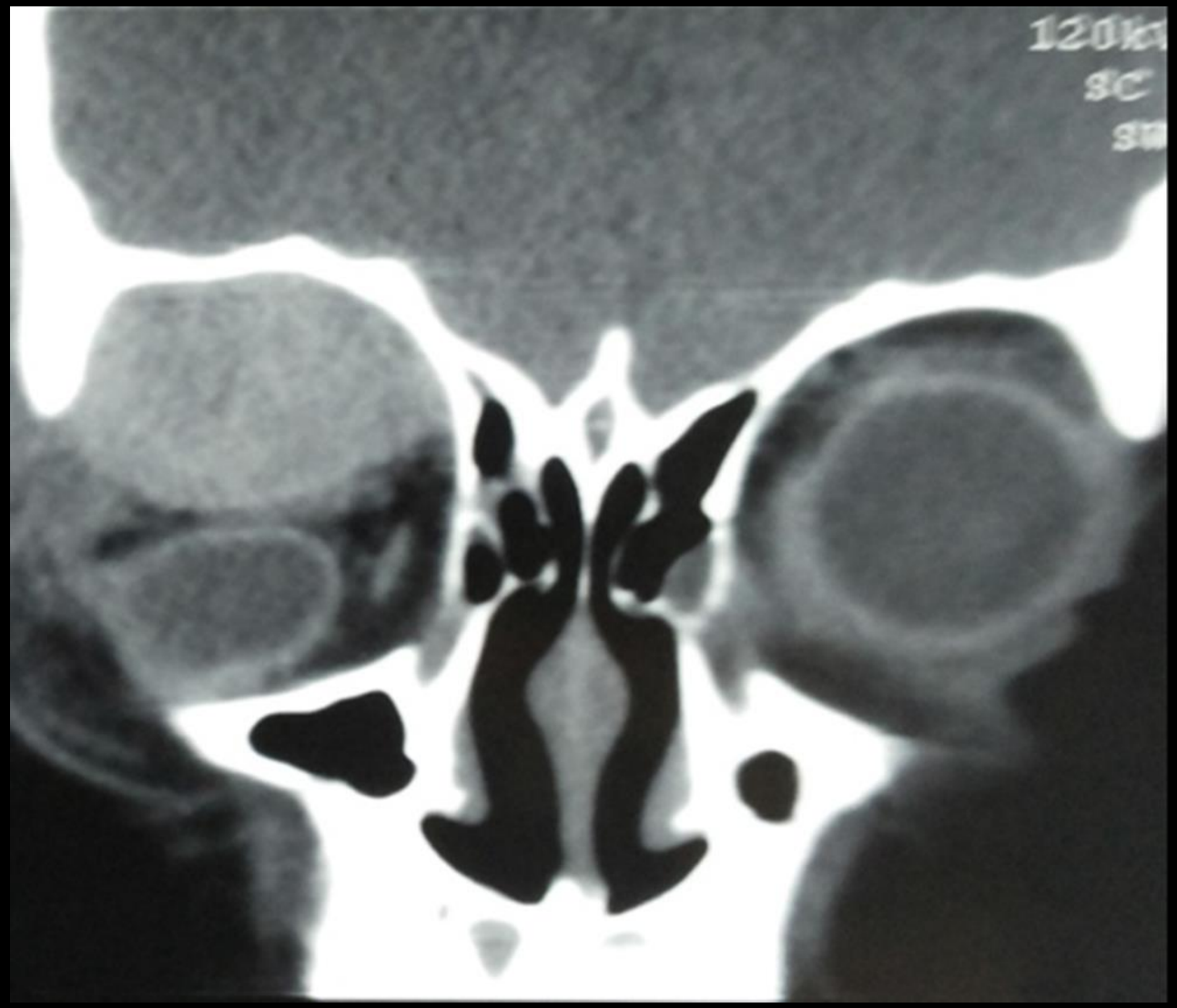


Cases 5

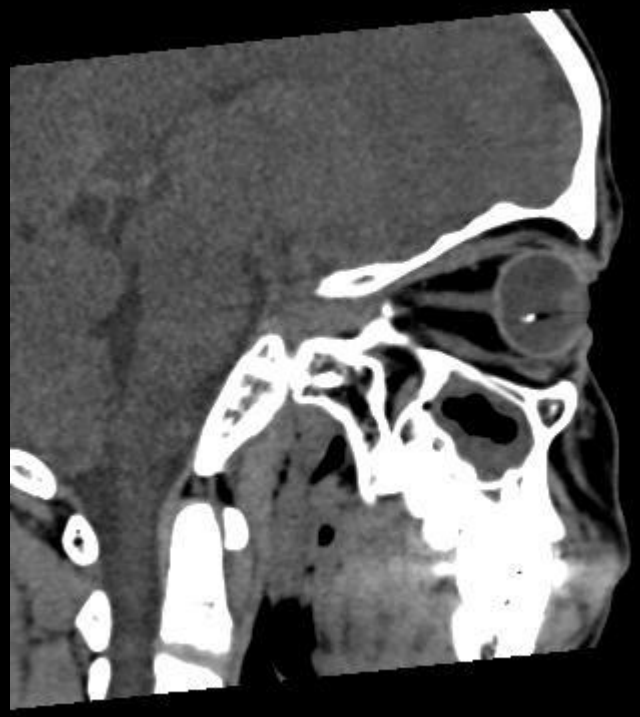


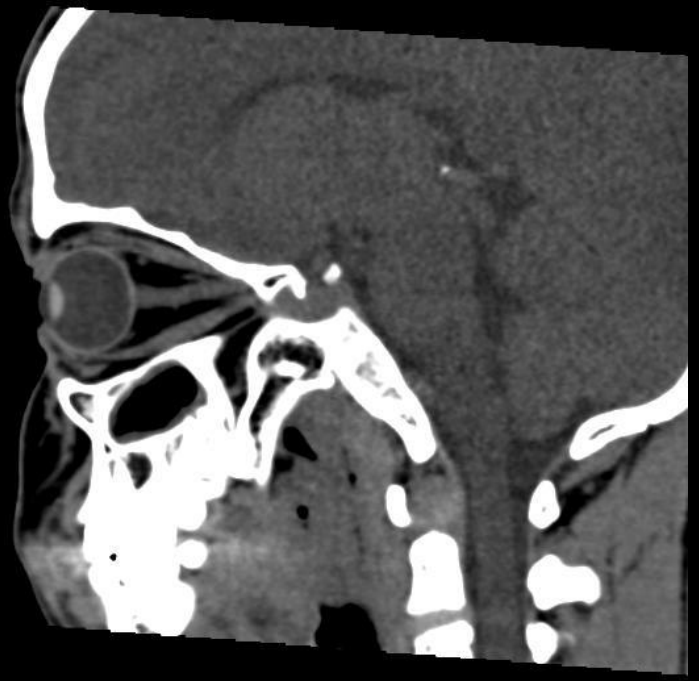


Cases 6

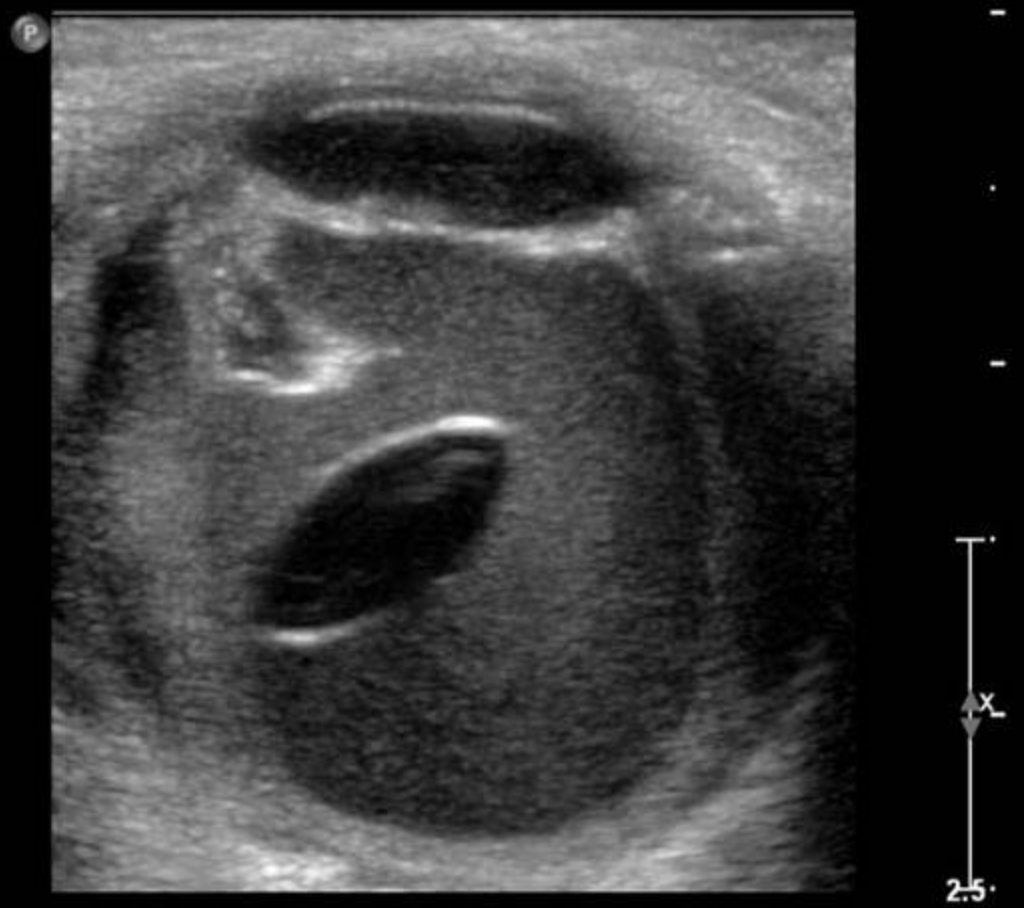


Cases 7





Cases 8

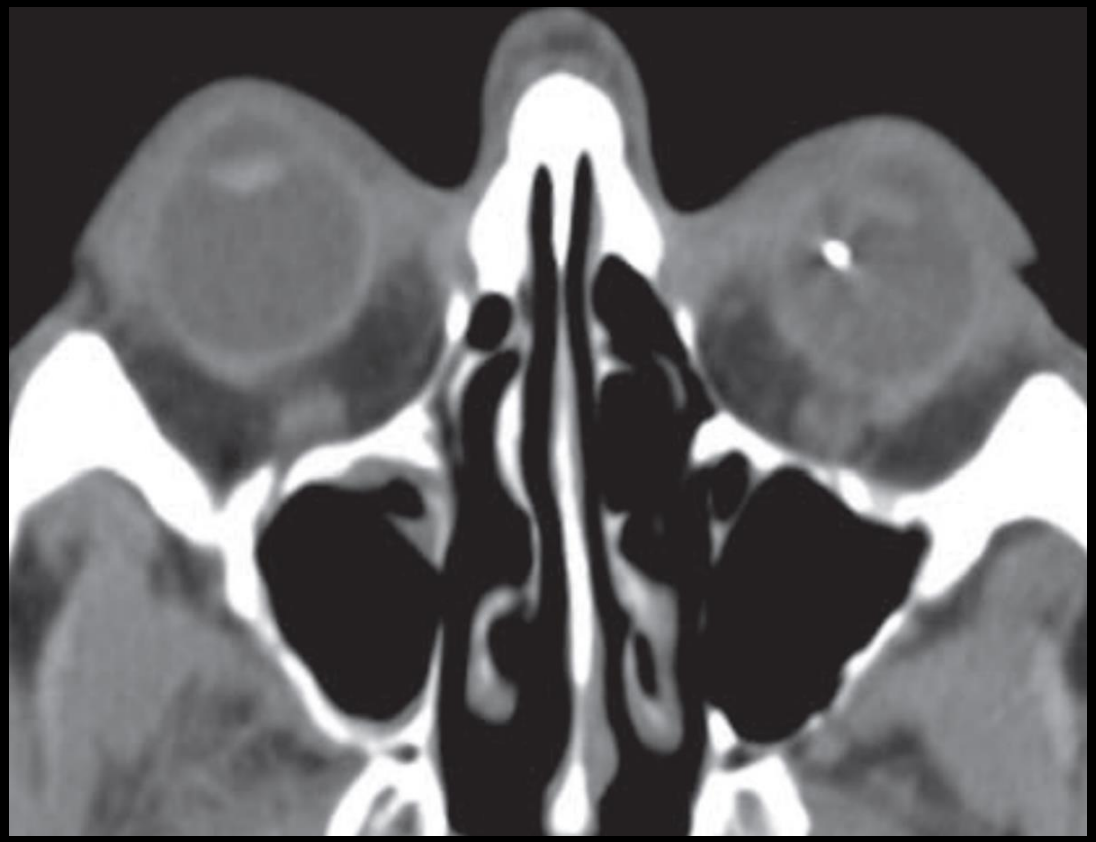


Cases 9 & 10

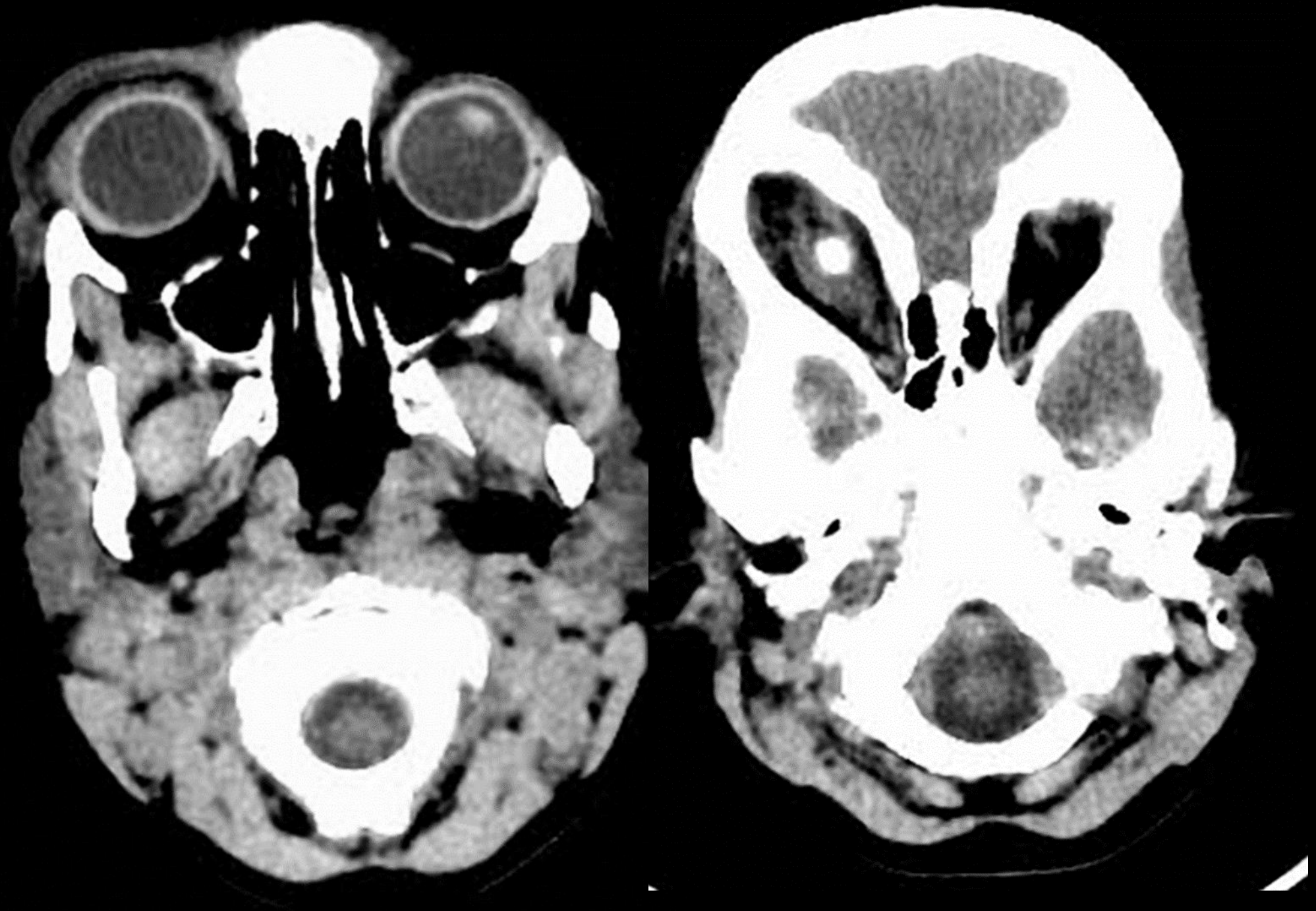
Radiological Evaluation Corpus Alineum Orbita

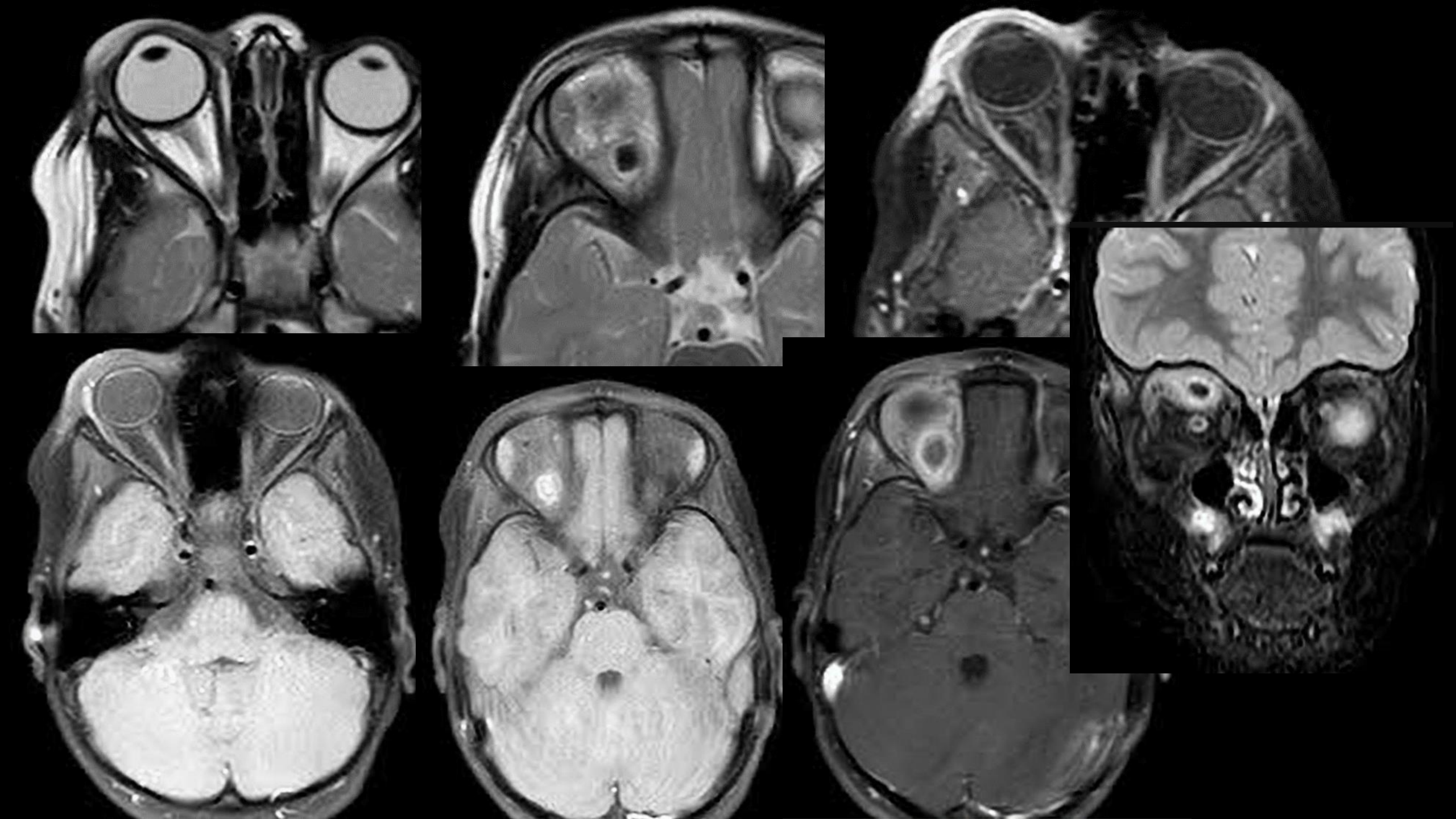
Imaging Modality	Advantages	Limitation	Purpose
Conventional Radiography	- Effective for detecting opaque korpus alienum - Quick and widely available	Cannot precisely determine the location	Confirms the presence of opaque korpus alienum before MRI
MDCT (Multi-Detector Computed Tomography)	- Preferred imaging modality for korpus alienum detection - Safe for ferromagnetic materials (MRI contraindicated) - Helps classify metallic, non-metallic inorganic, or organic materials	Higher radiation exposure compared to radiography	Aids in surgical planning by classifying korpus alienum
Further Evaluation	- Assesses size, location, and composition - Evaluates damage to surrounding structures - Differentiates orbital calcifications from intraocular korpus alienum	Requires detailed analysis by a specialist	Determines surgical risks and strategy

Cases 11 Foreign body dd/ calcified intraocular lesion



Cases 12





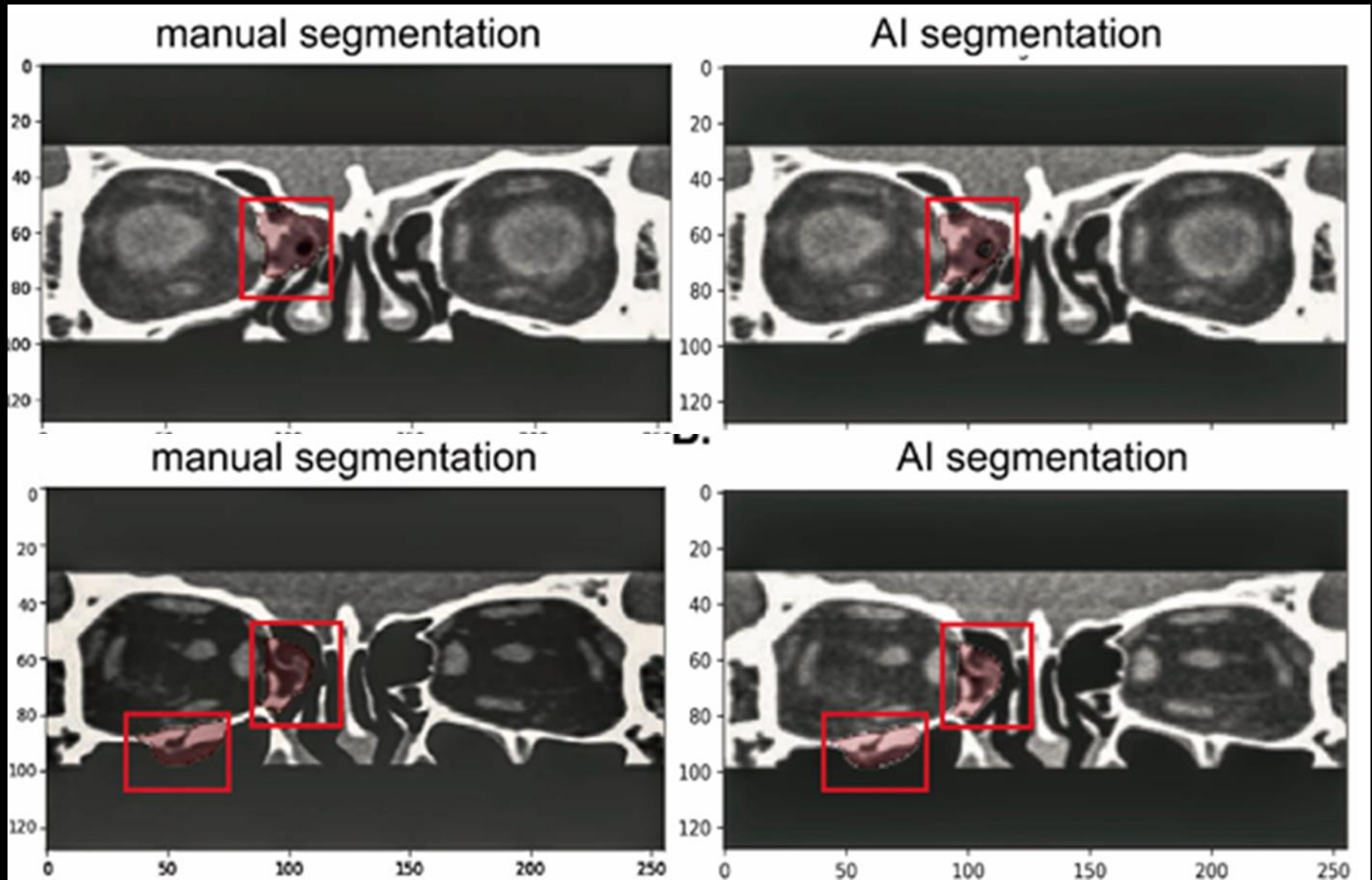
Imaging checklist for orbital trauma : pts history ⟶ CT Protocol

1. Bone reconstruction
   - which bones are involved?
   - look for associated fractures
   - if fractures (-) : look for indirect sign : asymmetrics, associated fractures of other maxillary bones
2. Soft tissue reconstruction
   - air bubbles within the orbit (eyebrow sign)
   - hyperdensity of infraorbital tissue
   - asymmetries, associated fractures of other maxillary bones
3. Studying of the intraorbital space

Artificial Intelligence In The Diagnosis and Management Of Orbital Fractures

- Aintelligence (AI) system utilizing two deep learning networks: DenseNet-169 and UNet.
- The AI system trained using the JPG format instead of the DICOM format data generated from the imaging equipment
- The system is designed to perform:
  - Fracture identification
  - Fracture side classification
  - Fracture area segmentation
- This AI-driven approach enables automatic identification and annotation of orbital blowout fracture (OBF) regions.
- The implementation of this technology has the potential to:
- Streamline the pre-operative design process
- Enhance surgical accuracy and efficiency

Manual and AI segmentation for various types of orbital blowout fractures



Take Home Massage

- Orbital trauma encompasses a wide variety of mechanisms of injury and resulting fracture patterns.
- A variety of surgical approaches to the orbit exist as has been discussed allowing the surgeon access to all area of interest.
- Regard less of the fracture complexity, the principles of atraumatic technique, anatomic reduction, and stable fixation apply in all cases.
- the evaluation of imaging in orbital trauma can be effectively performed using the CT scan - BALPINE technique, which provides a structured approach to assess the extent and nature of orbital injuries

Thank You