

Radiologic Evaluation of Abnormalities of the Sternum and Sternoclavicular Joints

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Disclosures

The authors do not have a financial relationship with a commercial organization that may have a direct or indirect interest in the content.

Goals and Objectives

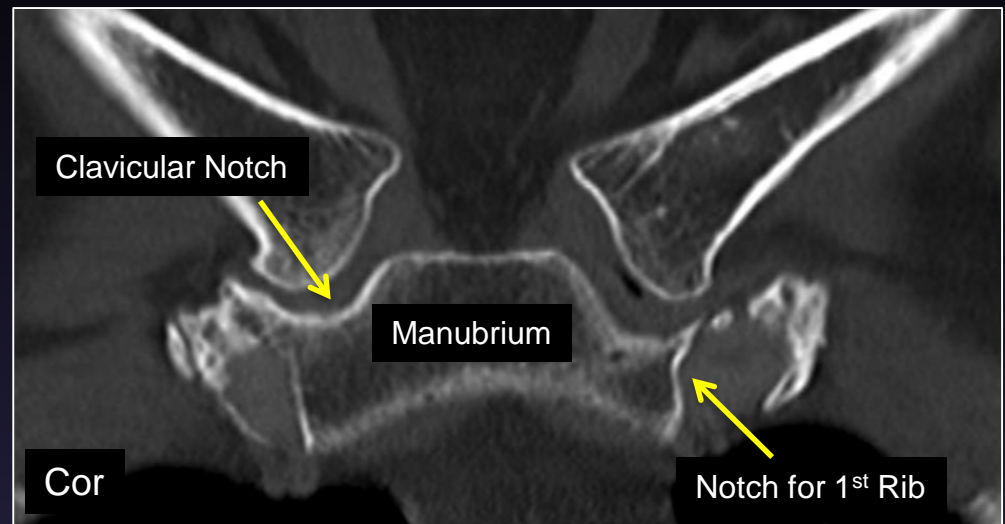
- Review normal anatomy of the sternoclavicular joint (SCJ) and sternum
- Discuss
 - Commonly seen congenital or developmental anomalies
 - Traumatic abnormalities
 - Post operative complications
 - Infectious, inflammatory processes and osteoarthritis
 - Neoplastic processes
- Understand value of various imaging modalities to assess the sternum and sternoclavicular joints

Introduction

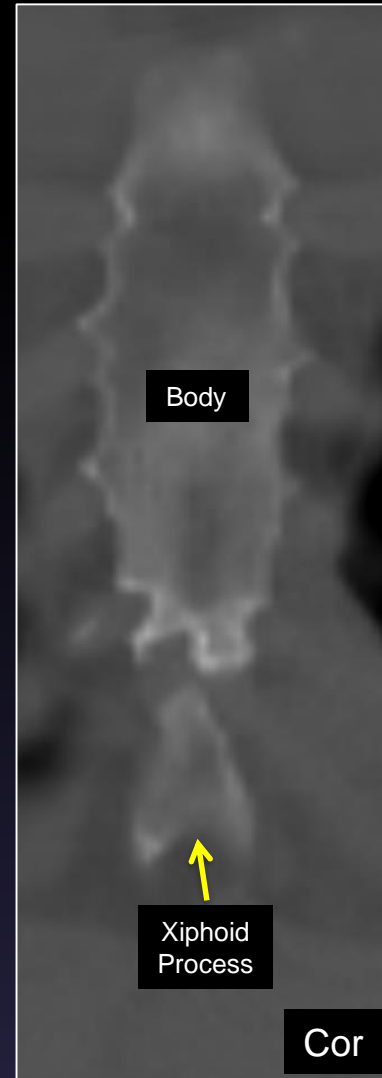
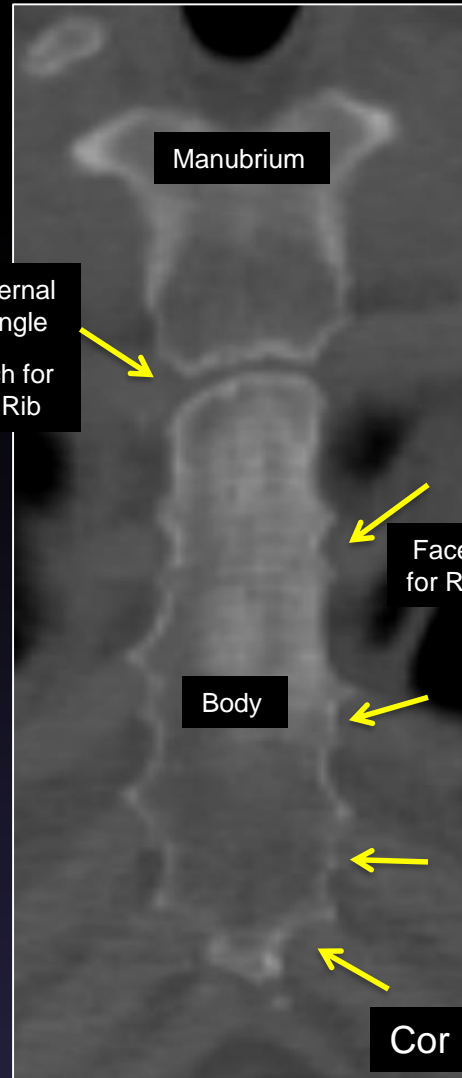
- **Sternum and sternoclavicular joints**
 - Difficult to assess on radiographs
 - Often overlooked with only a perfunctory glance on routine CT imaging of Chest
- **Many anatomic variants**
 - Recognizing these important in order to avoid wrong diagnosis
- **Congenital anomalies**
 - Imaging may be useful for making a diagnosis and for surgical planning
- **Close proximity to vital mediastinal structures**
 - Trauma may result in injury to deeper structures
 - Postoperative complications may cause mediastinal pathology
- **Synovial joint**
 - Inflammatory arthritides
 - Need to distinguish between osteoarthritis, inflammatory and infectious processes
- **CT and MRI are the best imaging modalities to assess the sternum and SCJs**

Normal Anatomy

- Sternoclavicular Joint
 - Diarthrodial joint
 - Synovial articulation
 - Fibrocartilage disk in the SCJ
 - Articulation between the axial skeleton and upper extremity
 - Stabilized by ligaments and subclavius muscle



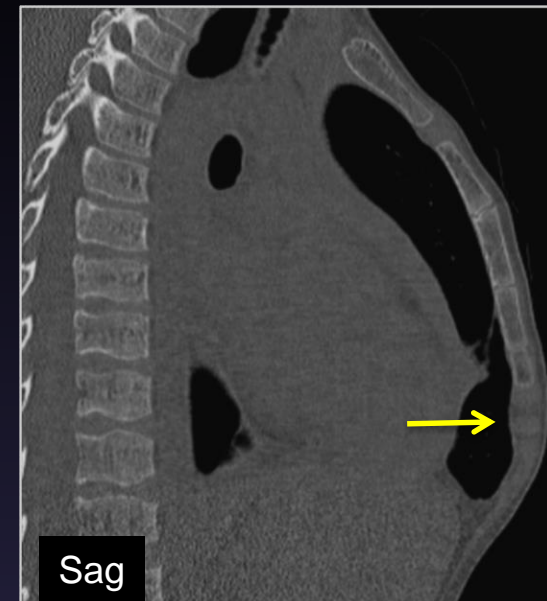
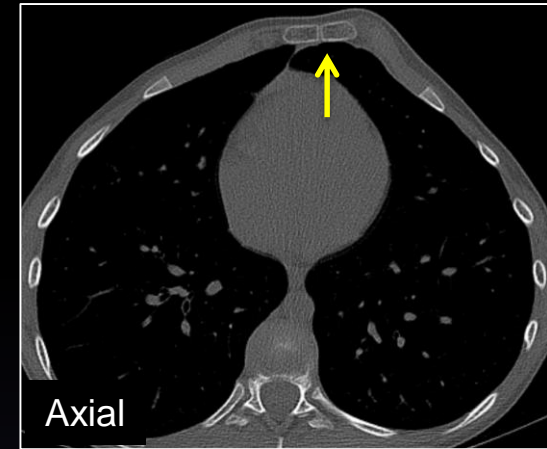
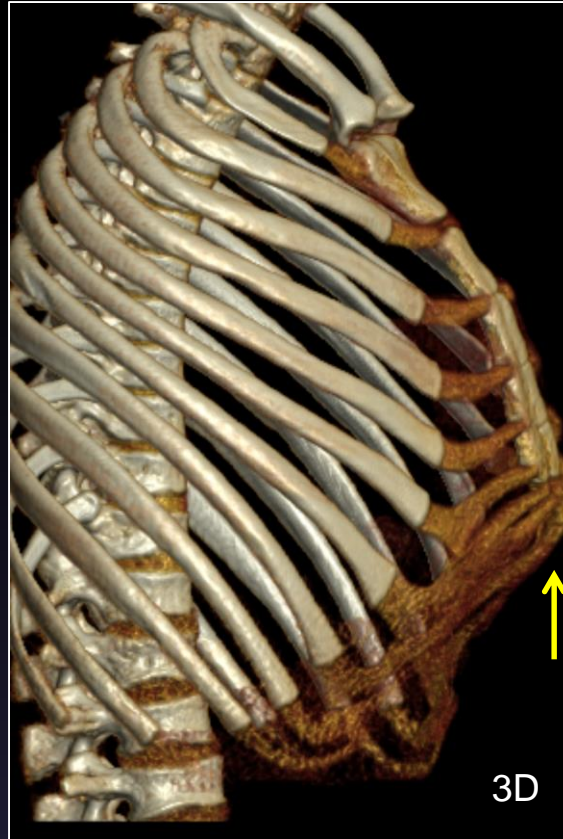
Normal Anatomy



- Sternal anatomy can have many variants and anomalies

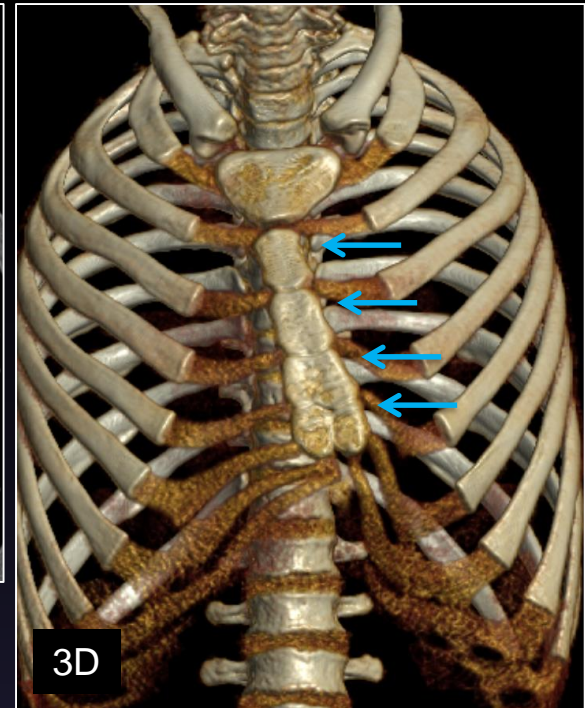
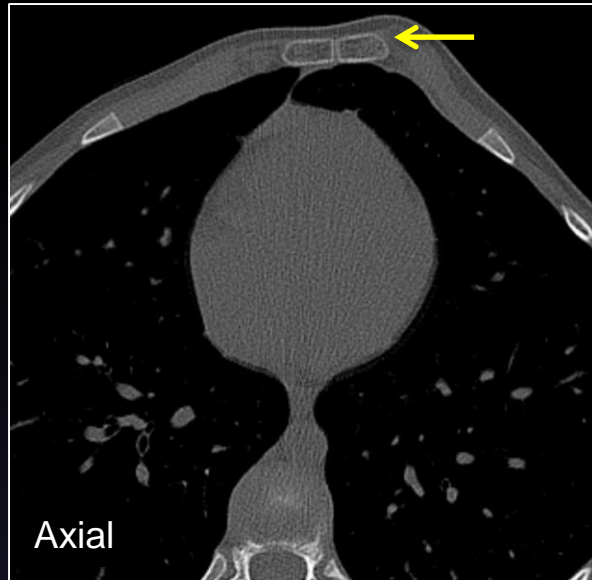
Pectus Carinatum

- Anterior displacement of sternum
- More common in males
- May be familial
- May be associated with congenital heart deformities and scoliosis
- Symptoms include shortness of breath with exercise, fatigue and tachycardia
- Improved symptoms with surgery
- Can be seen on lateral radiographs
- Better evaluated with CT or MRI

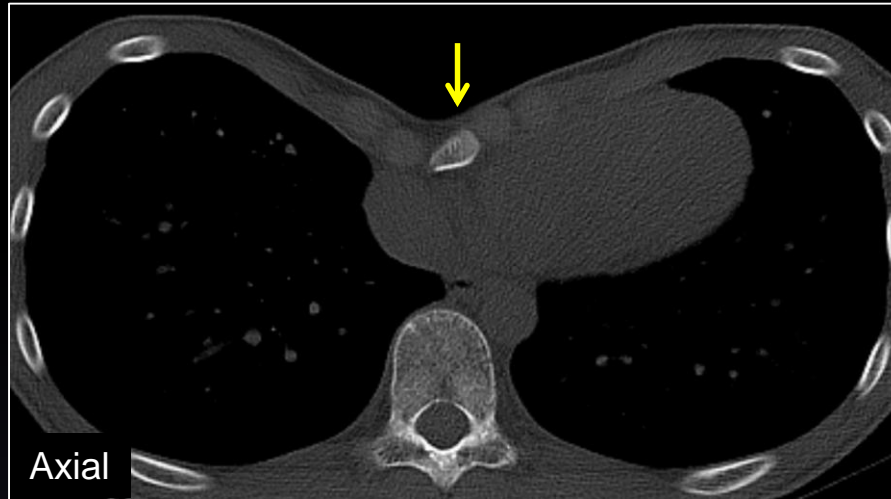


Sternal Tilt

- Note that left side of sternum is more anterior than the right side
- Also note leftward tilt of sternum (blue arrows)
- May be associated with other sternal anomalies as in this case with pectus carinatum



Pectus Excavatum

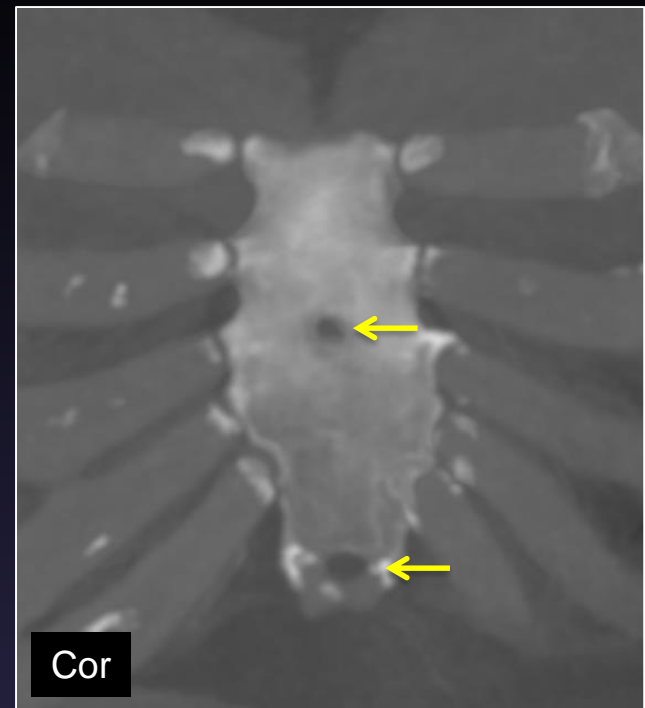
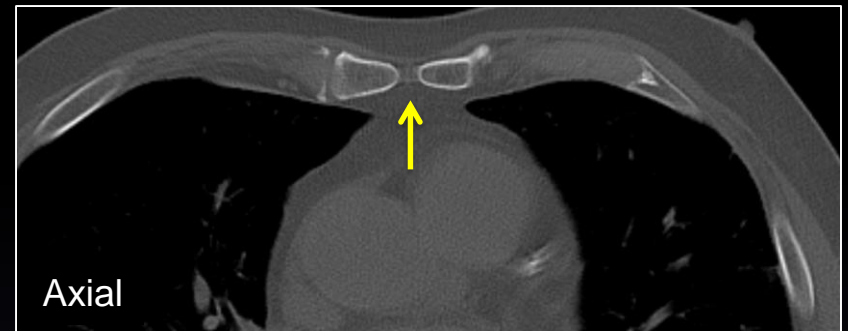


- Posterior displacement of sternum
- Decreased prevertebral space
- May be familial
- May be associated with scoliosis, congenital heart deformities, and other syndromes
- Most common congenital anomaly of sternum
- May be seen with radiographs but better evaluated with CT or MRI
- Improved symptoms with surgery



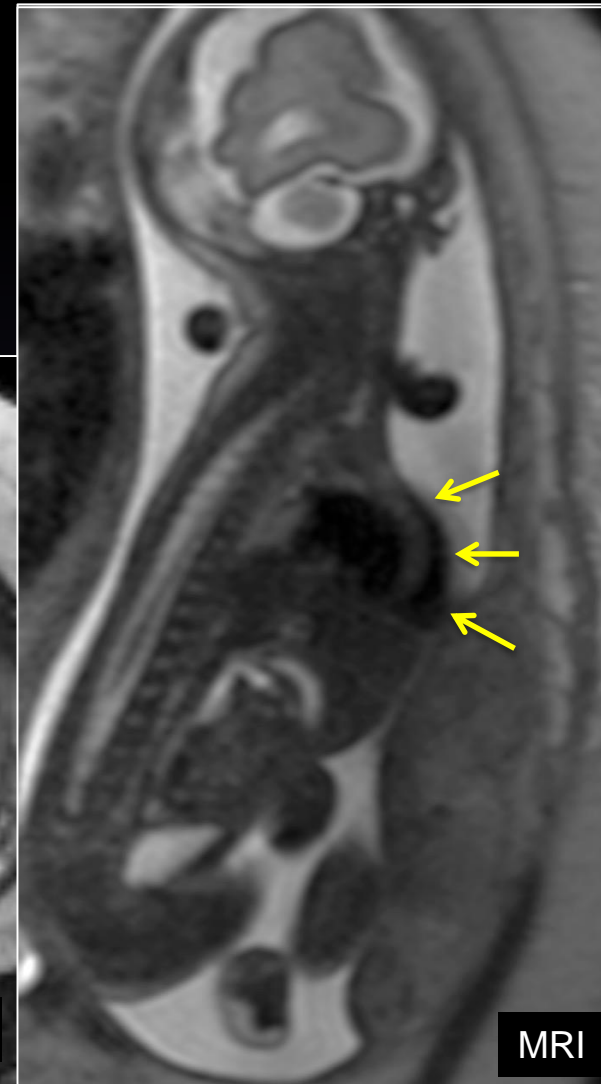
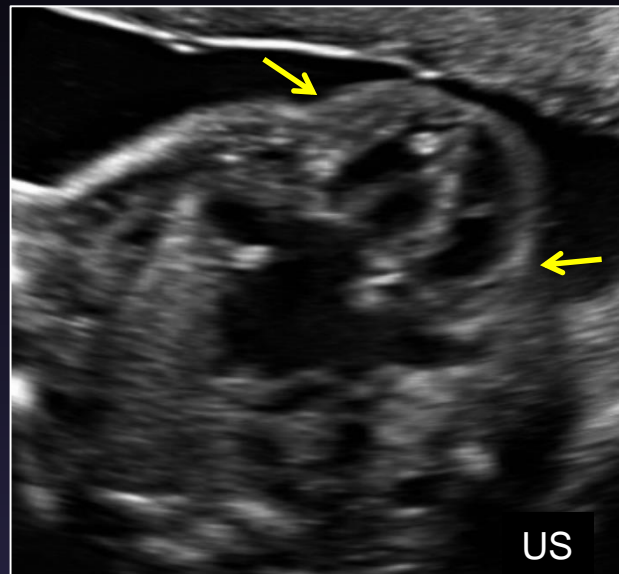
Sternal Foramen

- Multiple sternal variants include (but not limited to)
 - Sternal foramen
 - Sternal Band and Cleft
 - Accessory ossicles related to the manubrium
 - Variations in ossification of the xiphoid
 - Manubriosternal fusion
 - Sternoxiphoidal fusion
- Best evaluated by CT
 - multiplanar reformatted images
 - 3D images may also be of benefit



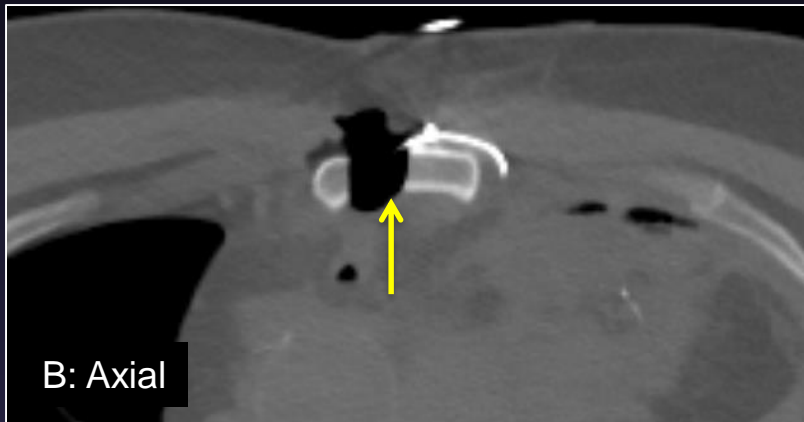
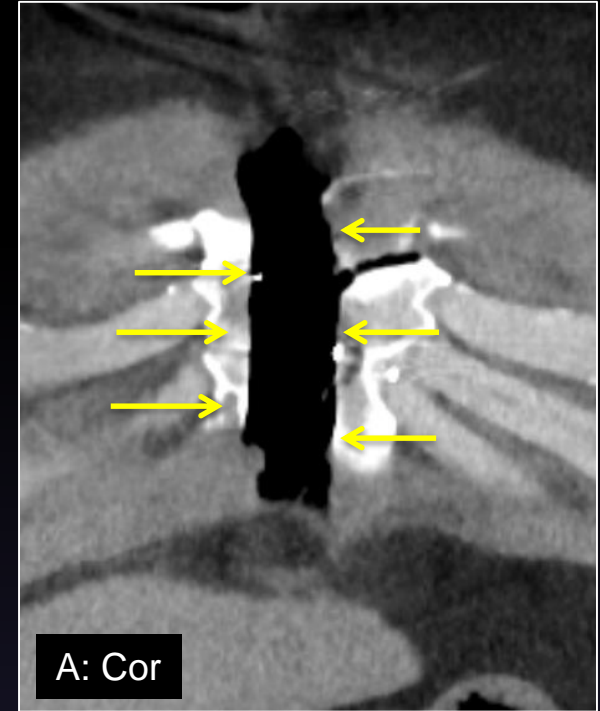
Pentalogy of Cantrell

- Note partial Ectopic cordis on Fetal Ultrasound and MRI
 - Defect in sternum
 - Heart seen partially outside the thorax

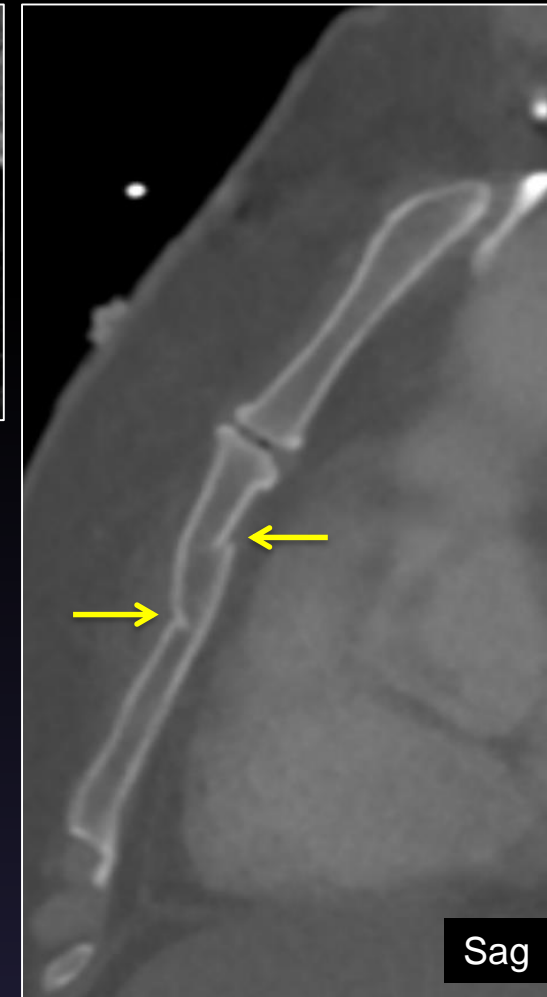
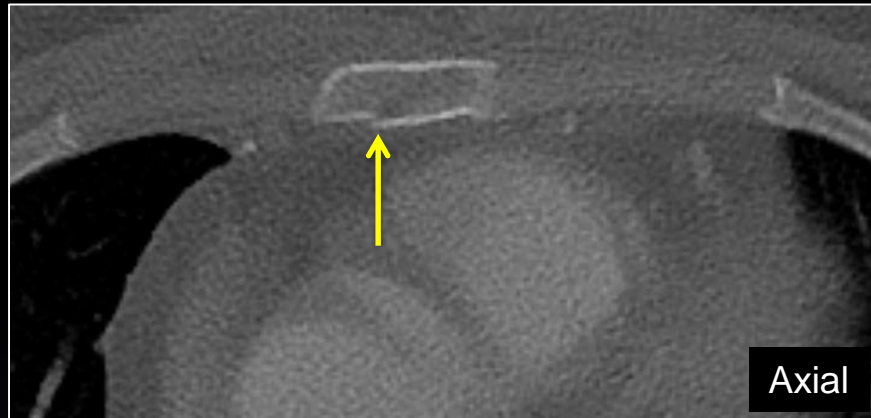


Sternal Dehiscence

- Gap wider than 3mm
- Often seen on radiographs with fractured or displaced sternal wires
- Better evaluated by CT
 - Note displaced sternal wire in fig C
- Paramedian sternotomy has increased risk of dehiscence
- Often associated with mediastinitis
 - Increased risk of mortality
- May result in non-union

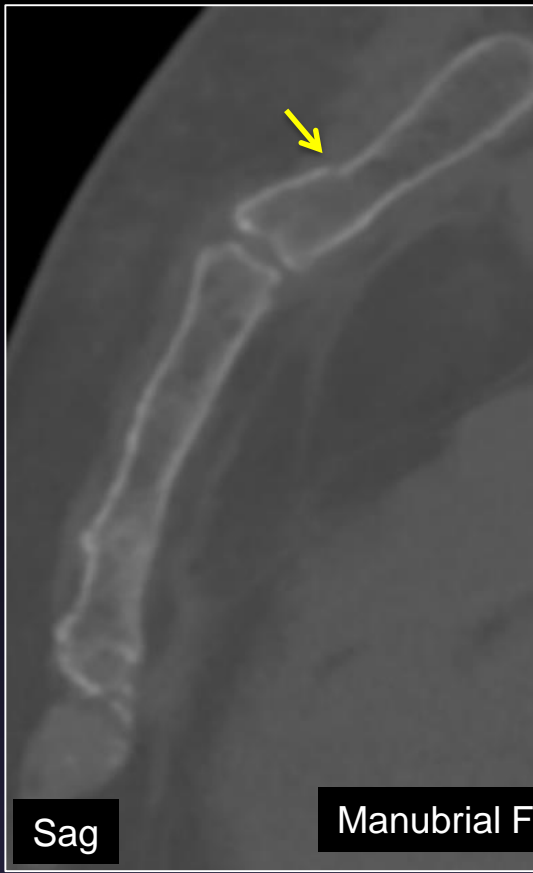


Traumatic Sternal Fractures

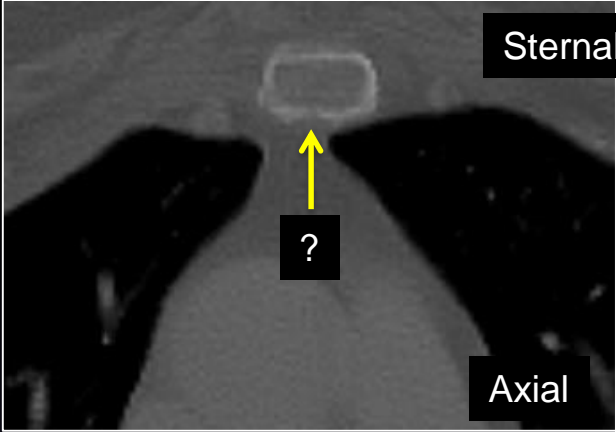


- Usually associated with high energy trauma
- Associated injuries should be suspected
 - including vessels, heart, ribs and lungs
- Difficult to see on radiographs
- CT with multiplanar reformatted images is modality of choice
 - Sagittal images are most valuable
 - Fractures are not well seen or are occult on axial images
 - Easily visualized on sagittal images
- CT also useful to detect associated soft tissue injuries
- Stress fractures may be seen with
 - neoplasms, infection, osteoporosis or heavy lifting

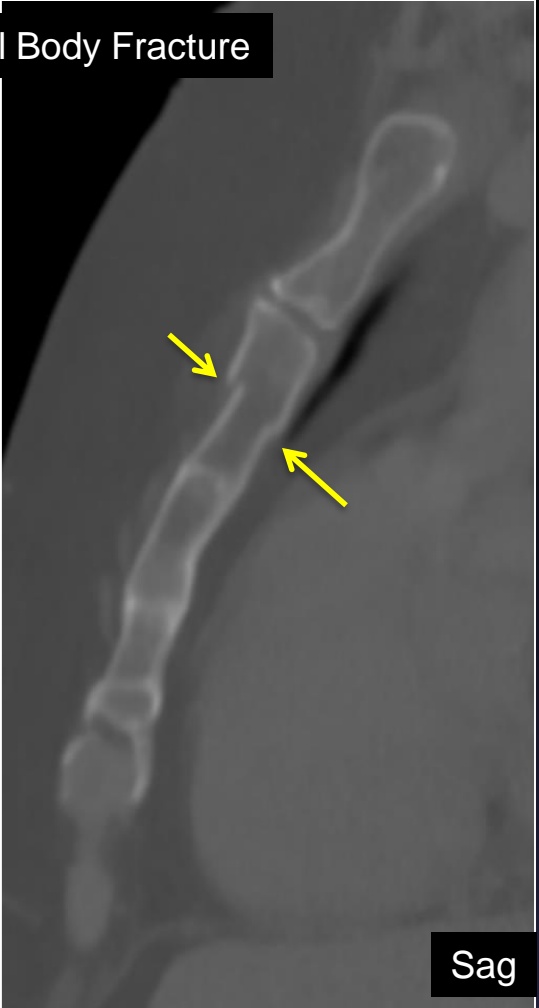
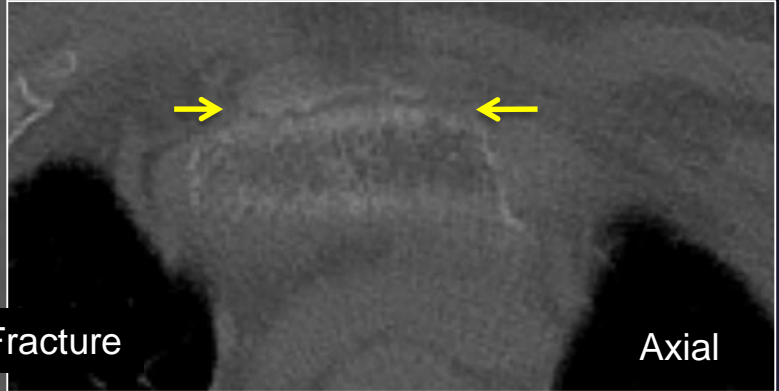
Traumatic Sternal Fractures



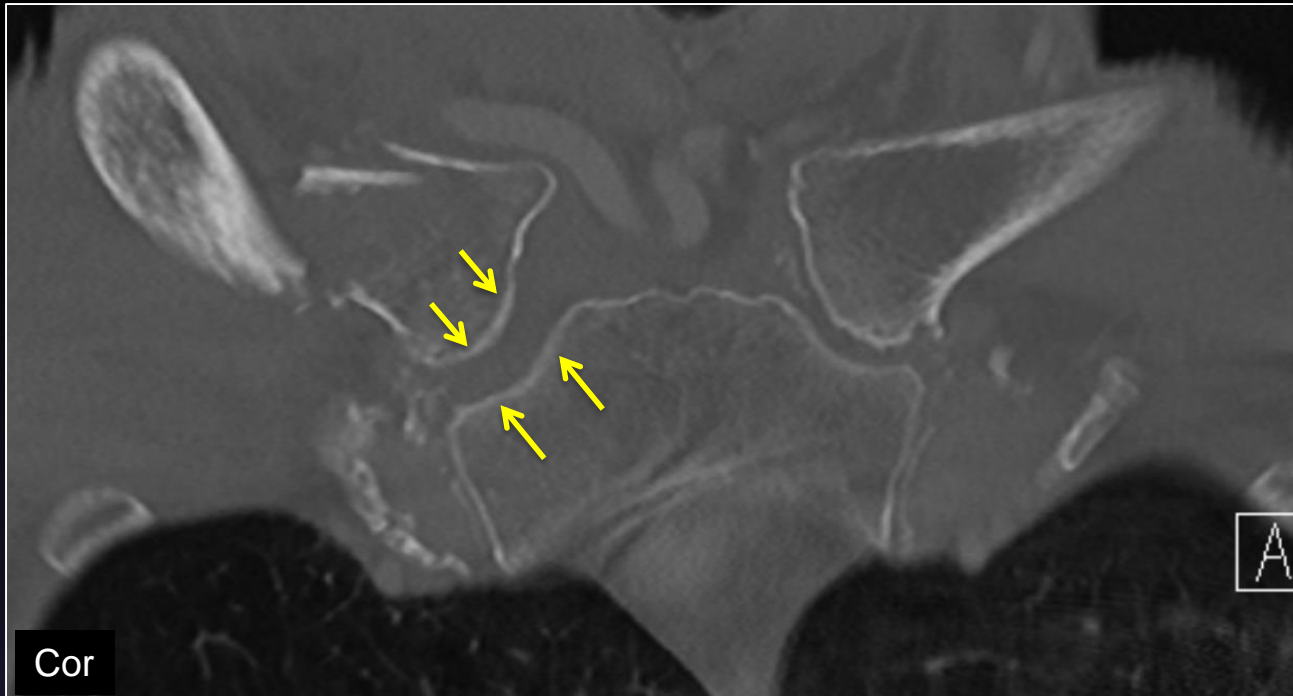
Manubrial Fracture



Sternal Body Fracture



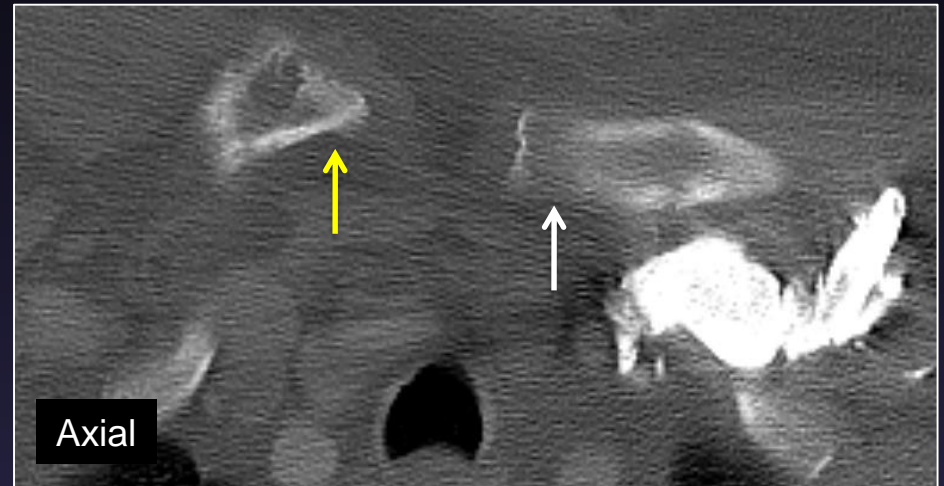
SCJ Widening



- Comminuted fracture of the distal clavicle
- Slight widening of the right SCJ (yellow arrows)

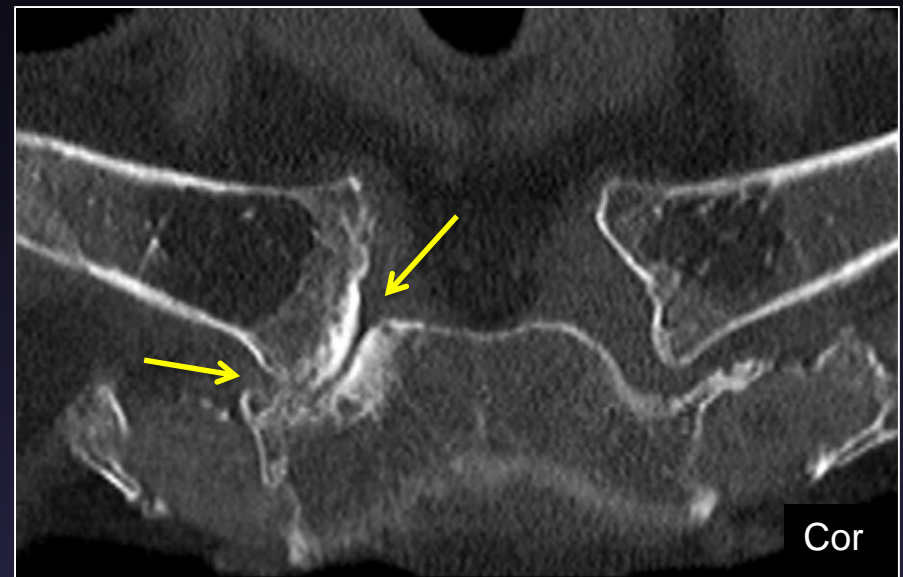
Sternoclavicular Dislocation

- Seen with blunt trauma
- Rare injury
- Anterior dislocation of clavicle more common
- May be seen on radiographs
- CT modality of choice for evaluation
- May be difficult to diagnose on axial images
- CT also useful to assess for adjacent soft tissue injuries
- Note right clavicle (yellow arrow) displaced anterior to manubrium (blue arrow) and normal location of left clavicle (white arrow)

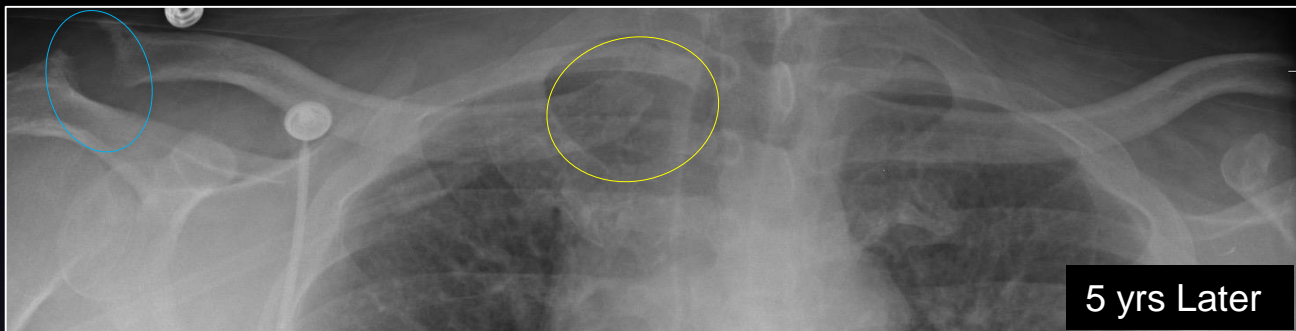
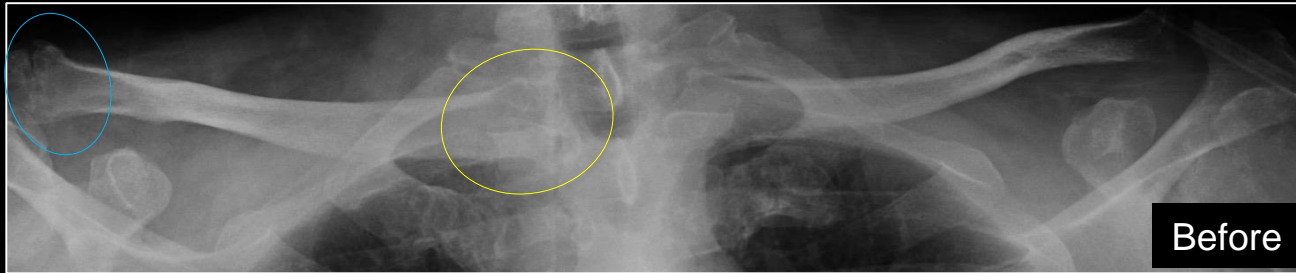


Osteoarthritis

- Most common abnormality of the SCJ
- Findings include osteophytes, joint space narrowing, subchondral cysts, subchondral sclerosis, and degeneration of the fibrocartilage disk
- May be asymmetric
- Patients may present with pain and swelling
- Often seen in
 - Older patients
 - Post menopausal women
 - Patients with SCJ instability
 - History of neck surgery
 - Patients who perform manual labor



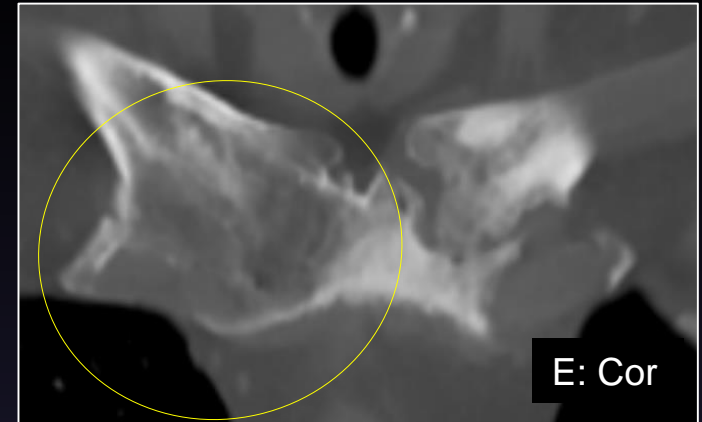
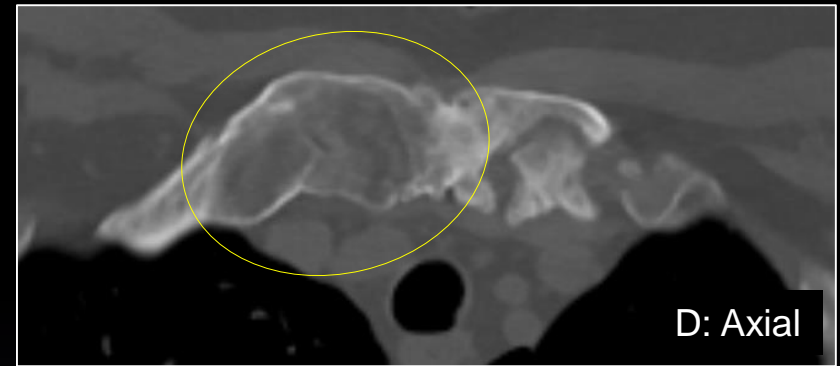
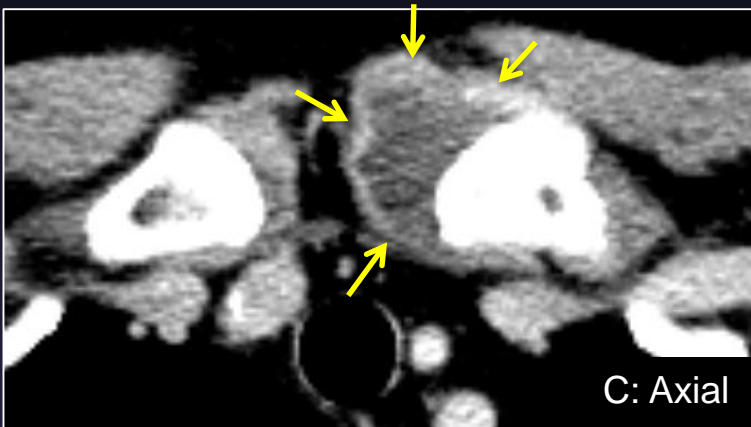
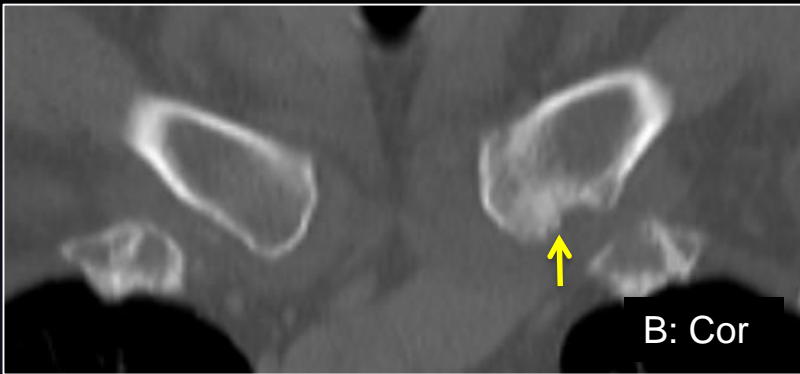
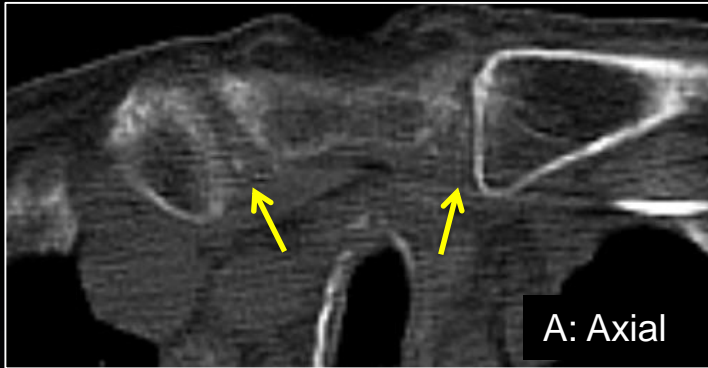
Rheumatoid Arthritis



- Rheumatoid arthritis may affect the SCJ (yellow ellipse) as other joints such as the acromioclavicular joint (blue ellipse)
- Findings may include erosions, degeneration of the disk, synovitis, and bone marrow edema
- May be seen on radiographs
- Better seen on CT and MRI

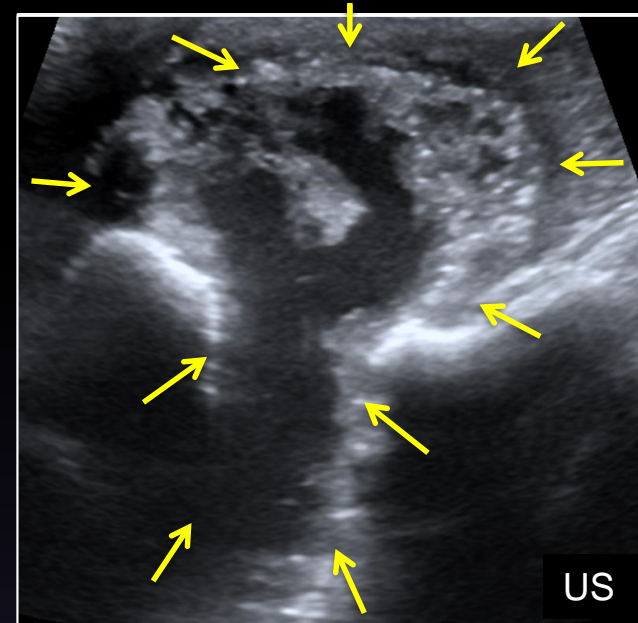
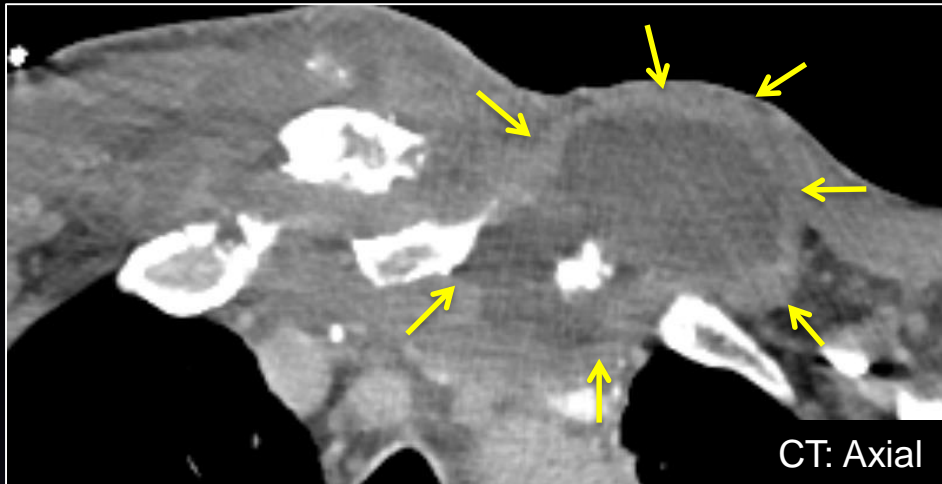


Inflammatory Arthritides



- A: Crystal deposition in the SCJs
- B-C: Erosions with fluid in the joint
- D-E: Ankylosis of the right SCJ - may be seen with seronegative arthritides
- Other arthritides include SAPHO – synovitis, acne, pustulosis, hyperostosis and osteitis

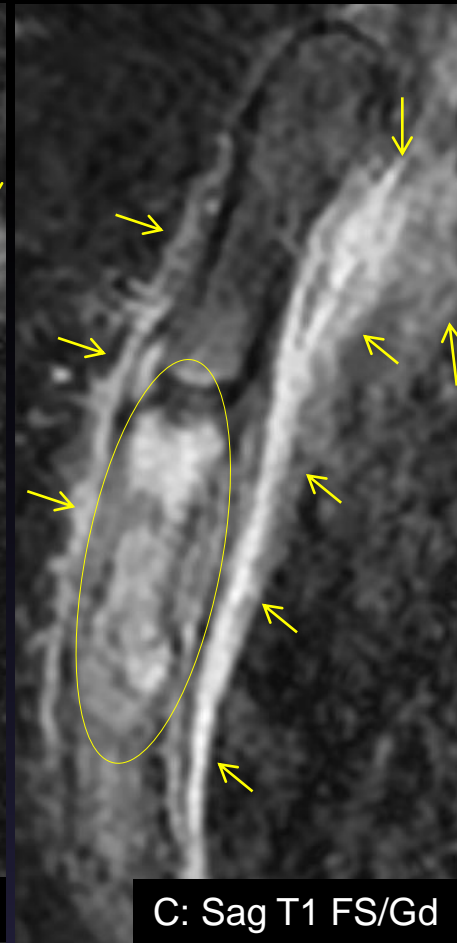
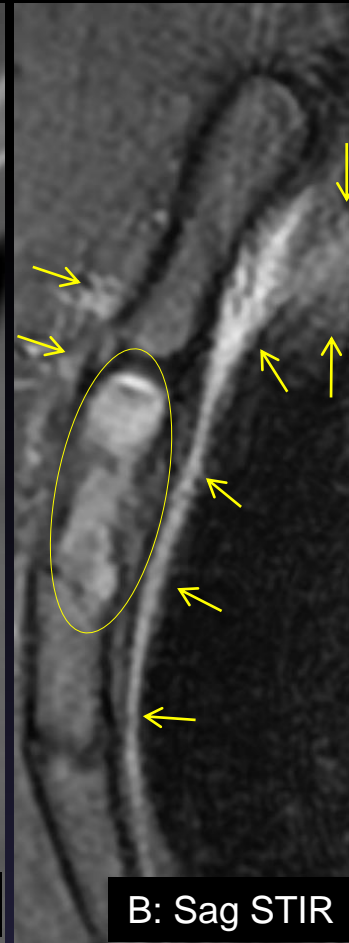
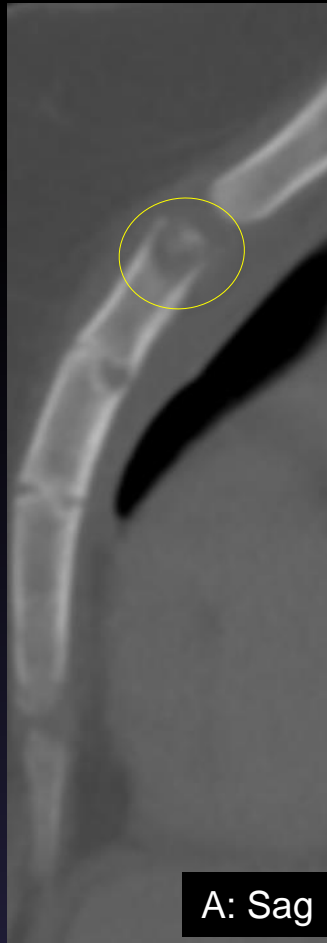
Septic Arthritis



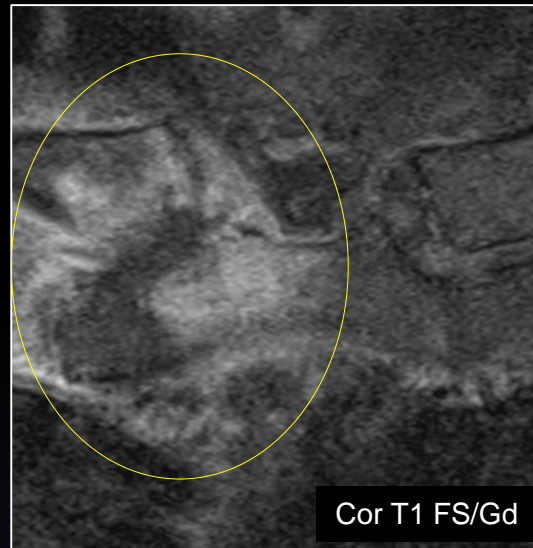
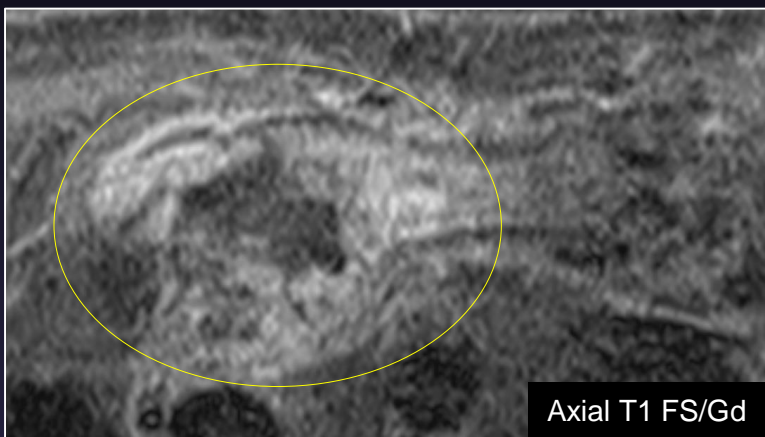
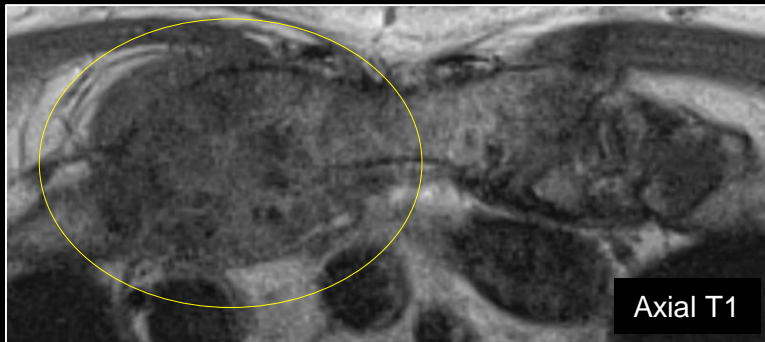
- Fluid in the SCJ and erosions may be present with inflammatory arthritides
- Need to distinguish from septic arthritis
- CT useful to assess the joint and the surrounding structures
- Ultrasound may also help, especially for intervention
- Ultrasound guided aspiration of left SCJ confirmed septic arthritis in this case

Osteomyelitis

- CT
 - Erosions
 - Associated soft tissue abnormalities
- MRI
 - Better for earlier detection
 - Assessment of adjacent structures
 - Extent of soft tissue involvement
 - Detection of abscess and sinus tracts
- A: Erosion in sternal body. Soft tissue changes were subtle on CT.
- B-C: Bone marrow edema signal and enhancement in the sternum and adjacent soft tissues.

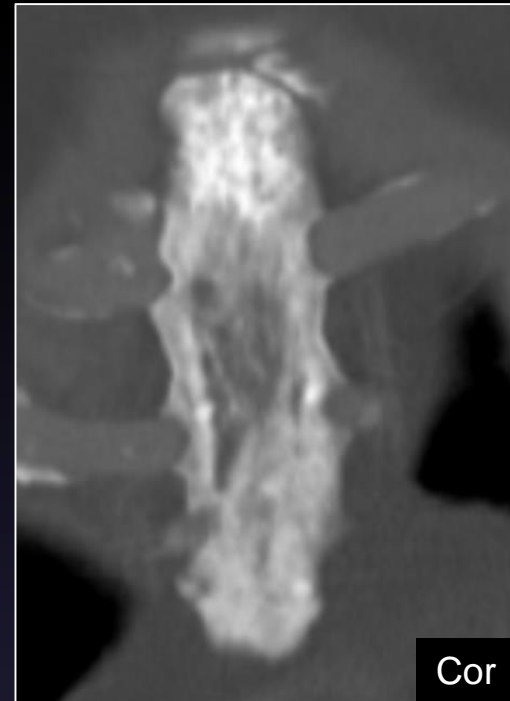
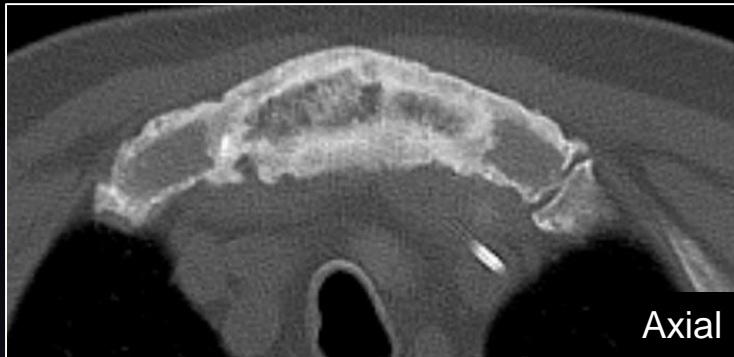


Osteomyelitis and Septic Arthritis



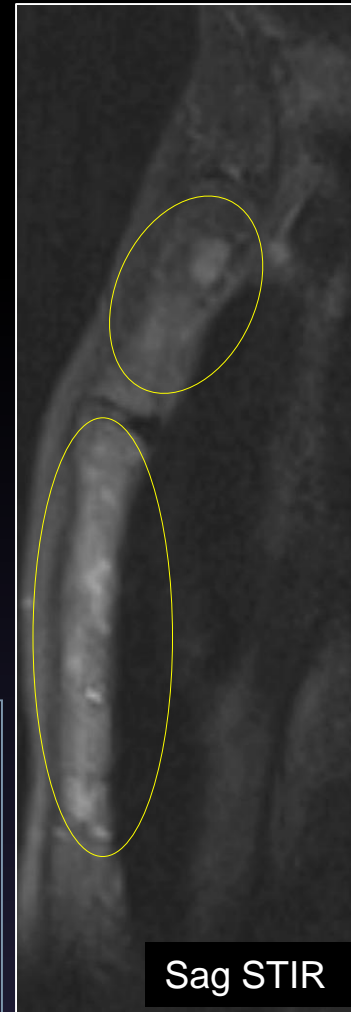
- Osteomyelitis may relate to various pathogens including gram positive and negative organisms
- Risk factors include sternotomy or other surgeries, tooth extraction, intravenous drug abuse, diabetes, trauma or infection at other sites
- Note bone marrow and soft tissue edema and enhancement, erosions, and complex fluid in the joint in this example

Paget's Disease



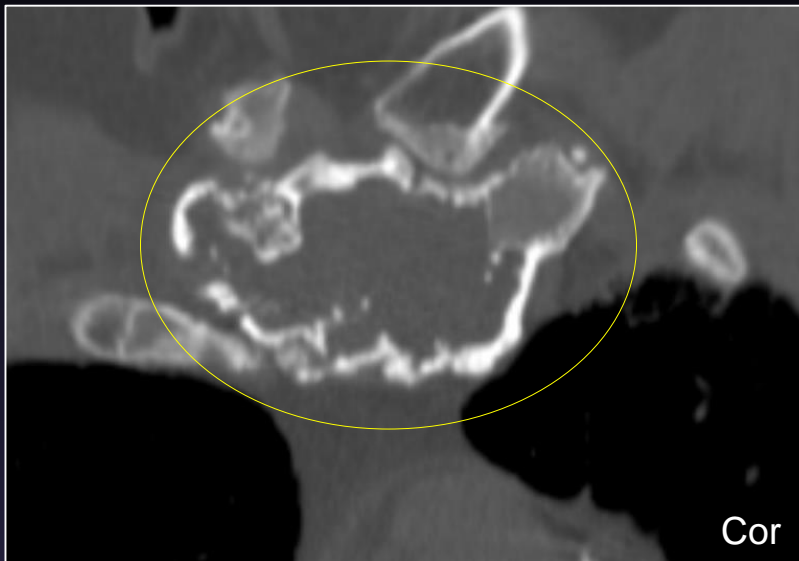
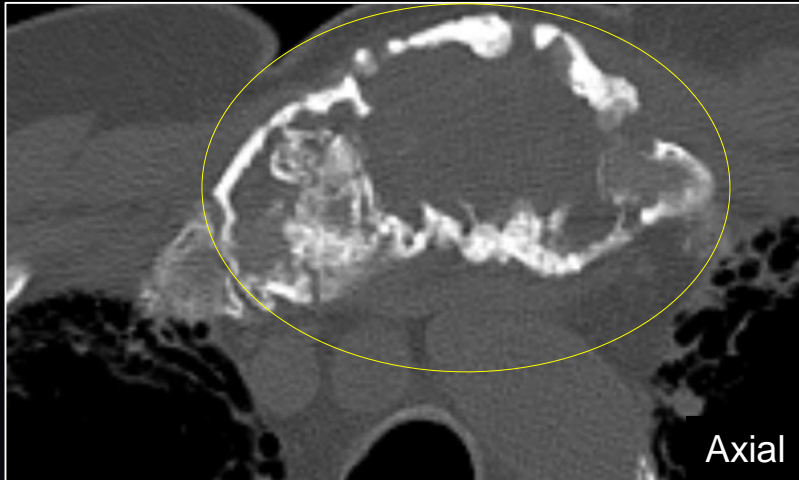
- One of the benign conditions that may affect the sternum include Paget's Disease as seen here
- Benign neoplasms of the sternum are rare

Metastasis



- Metastasis is the most common malignancy of the sternum
- Metastatic lesions may be sclerotic or lytic
- Primary neoplasms of sternum are rare
 - malignant more common than benign
- Chondrosarcoma is the most common primary malignancy
- A-B: Note sclerotic sternal metastasis in patient with breast cancer
- C: Sternal metastasis in patient with lung cancer

Plasmacytoma



Summary

- Sternum and SCJs are affected by multiple disease processes including trauma, infection, inflammatory arthritides and neoplasms
- Many anatomic variants and congenital anomalies may also be present
- Important for radiologists to be familiar with the anatomic variants and pathologic conditions affecting the sternum and SCJs in order to make the correct diagnosis and to avert serious morbidity and mortality
- Difficult to assess the sternum by radiography
- CT with reformatted images is the most common and preferred imaging modality
- MRI allows for more detailed evaluation, especially of the surrounding structures

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