



# CHEST WALL INJURIES

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**Encore Sports Medicine Symposium**

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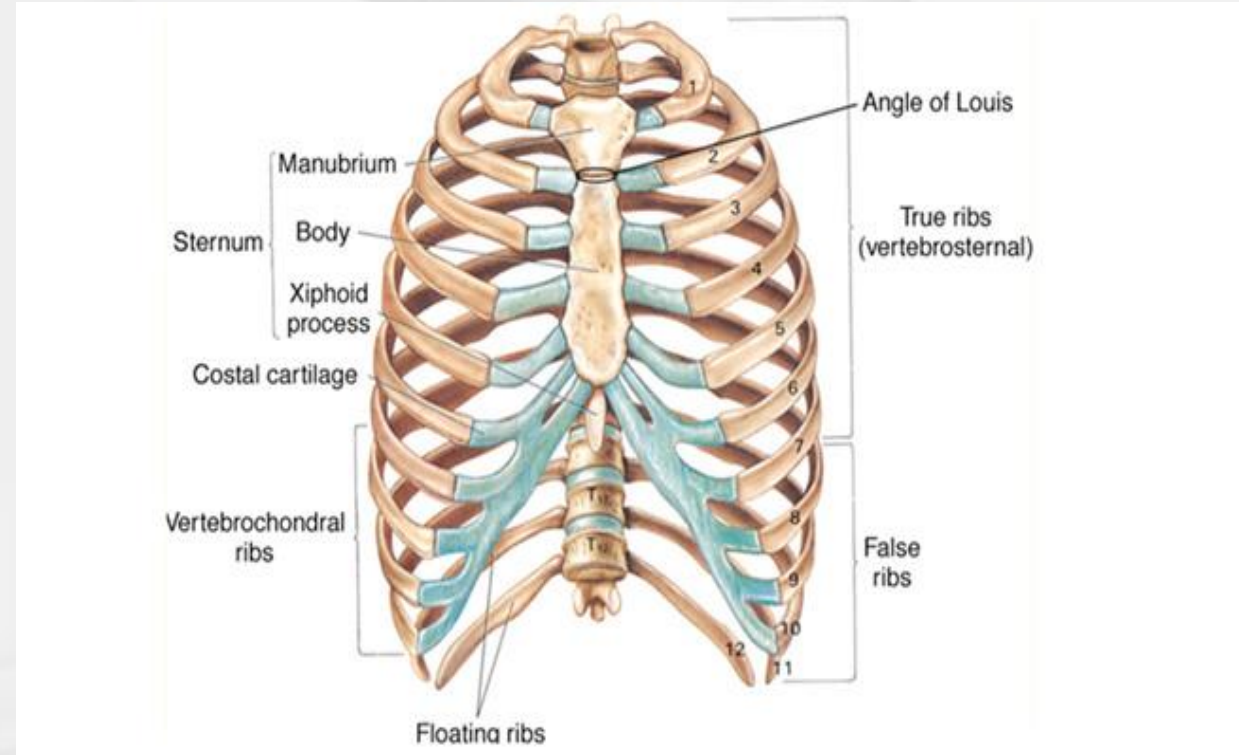
# OBJECTIVES

- 🏈 To discuss the general anatomy of the rib cage components
- 🏈 To discuss diagnosis of chest wall injuries on the sidelines
- 🏈 To discuss the acute care of chest wall injuries
- 🏈 To discuss the return to play decision making
- 🏈 Disclaimer:



# Anatomy

- 🏈 12 sets of paired ribs
- 🏈 7 pairs with direct costo-sternal connections
- 🏈 3 pairs with conjoined costo-sternal connections
- 🏈 2 pair of free “floating” ribs





# EPIDEMIOLOGY

 3.9% injuries to thorax and ribs  
in NFL study

Mall NA, Buchowski J, Zebala L, Brophy RH, Wright RW, Matava MJ. Spine and axial skeleton injuries in the National Football League. *Am J Sports Med.* 2012;40:1755-1761.



# TYPES OF CHEST WALL INJURIES

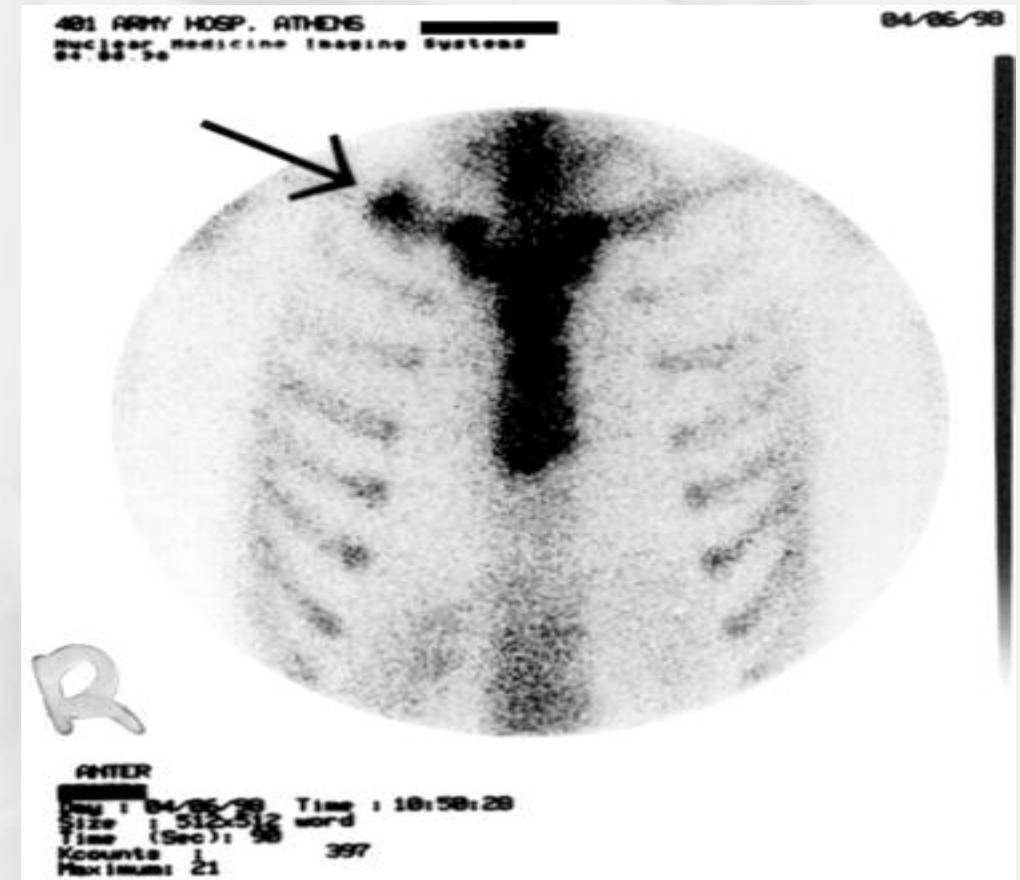
-  Rib Fractures
-  Stress Fractures
-  Costochondral Injuries
-  Sternal Injuries
-  Slipping Rib
-  Muscular Injuries



# RIB FRACTURES

# MECHANISM OF INJURY

- 🏈 Direct blow
- 🏈 Falling on an object
- 🏈 Hitting the ground
- 🏈 Stress Fracture





# DIAGNOSIS

## History

- 🏈 History of trauma
  - 🏈 Ribs 4-9 most common
  - 🏈 Weakest at posterior angle
- 🏈 Localized pain over rib cage
- 🏈 Pain with inspiration and cough
- 🏈 Dyspnea
- 🏈 Hematuria: 11<sup>th</sup> and 12<sup>th</sup> ribs





# Diagnosis






## Physical exam

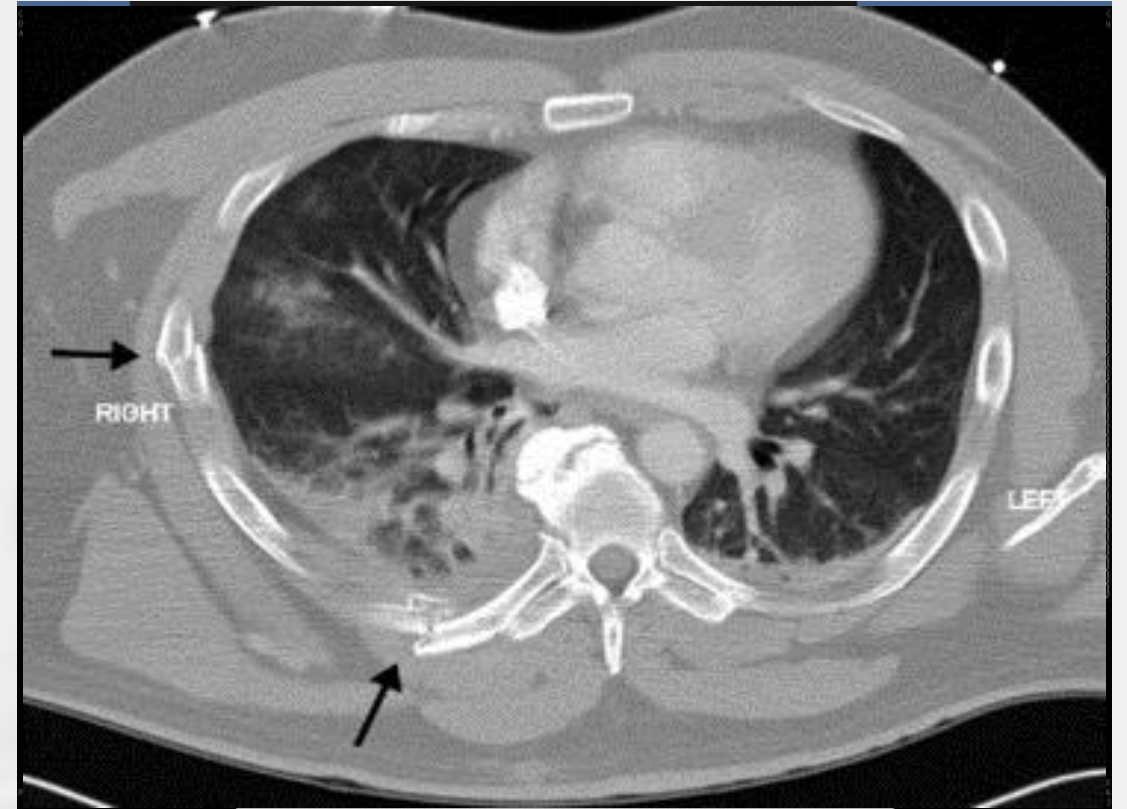
- 🏈 Tender to palpation
- 🏈 Ecchymosis
- 🏈 Hematoma
- 🏈 Tachypnea
- 🏈 Splinting
- 🏈 Crepitus
- 🏈 Positive squeeze tests:
  - 🏈 Anterior-Posterior
  - 🏈 Lateral
- 🏈 Subcutaneous emphysema
- 🏈 Auscultation
- 🏈 O<sub>2</sub> saturation



# DIAGNOSIS

## Imaging

-  Chest X-ray: PA (positive 90%)
-  Rib views: Bucky view
-  Ultrasound
-  Bone Scan
-  CT if concern for pulmonary contusion (hemoptysis) or Chondral fractures



# DIFFERENTIAL DIAGNOSIS

- 🏈 Contusion
- 🏈 Costochondral separations
- 🏈 Chondral rib fractures
- 🏈 Muscle strains:
  - 🏈 Intercostal
  - 🏈 Abdominal obliques
  - 🏈 Serratus Anterior
  - 🏈 Rectus Abdominus
- 🏈 Spontaneous Pneumothorax
- 🏈 Occult Fracture-periosteum intact
- 🏈 Slipping Rib Syndrome





# “WHAT’S UNDERNEATH CAN KILL YOU”

- 🏈 Pneumothorax
- 🏈 Hemothorax
- 🏈 Flail chest
- 🏈 Pulmonary contusion
- 🏈 Kidneys
- 🏈 Spleen
- 🏈 Hollow organs
- 🏈 Diaphragm
- 🏈 Cardiac contusion
- 🏈 Cardiac tamponade
- 🏈 Comotio cordis





# TREATMENT

 Ice

 NSAIDs

 Diclofenac potassium

 Ketoralac

 Others

 Rib belt

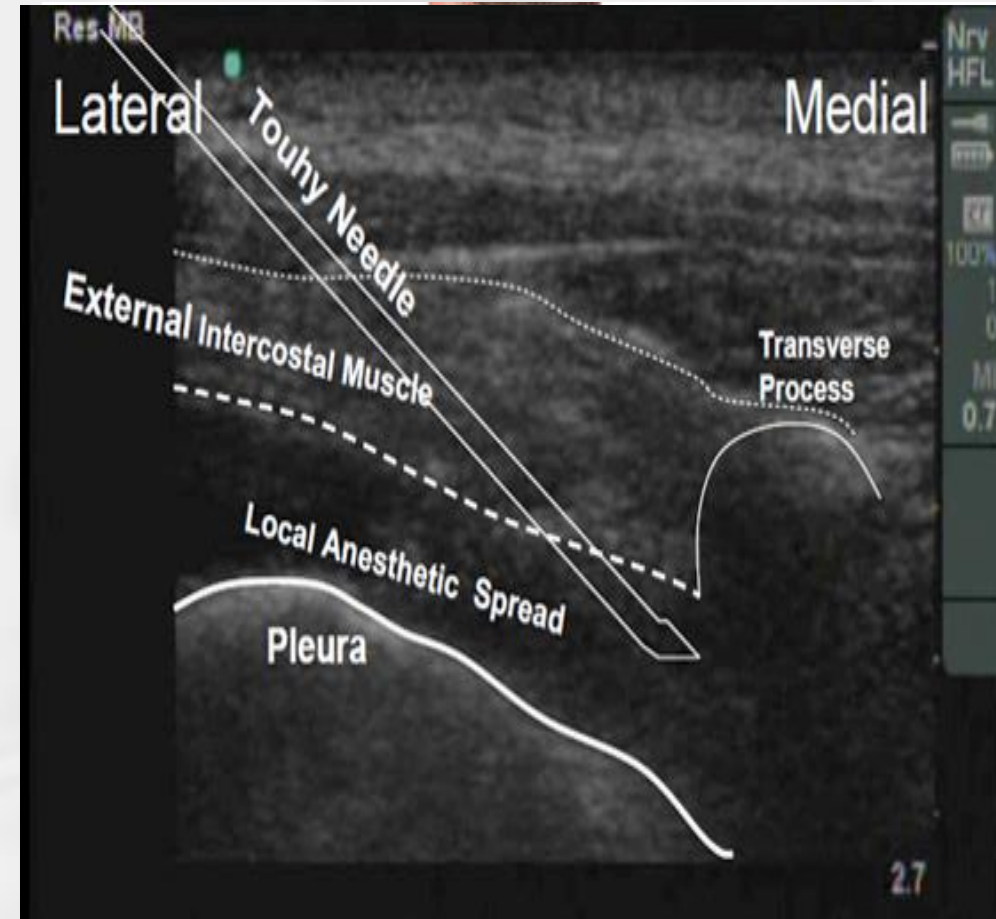
Quick G. A randomized clinical trial of rib belts for simple fractures. Am J Emerg Med. 1990;8:277-281

 Epidural Nerve Block: best

Comparison of analgesic interventions for traumatic rib fractures: a systematic review and meta-analysis. Eur J Trauma Emerg Surg. 2018 Feb 6

 Intercostal nerve Block

 Paravertebral Nerve Block



# IN-GAME MANAGEMENT

## College or Professional

### 🏈 Analgesia:

🏈 Diclofenac potassium: 50-100mg

🏈 Ketorolac nasal: 1 spray  
(15.75mg) per nostril

🏈 Must be kept cold

🏈 Expensive: \$54/bottle (8 sprays)

### 🏈 Intercostal nerve block

🏈 3cc 0.5% bupivacaine plain

🏈 3cc 1.3% bupivacaine liposomal

🏈 Lowest percentage of athletes felt helpful

Orchard JW, Steet E, Massey A, Dan S, Gardiner B, Ibrahim A. Longterm safety of using local anesthetic injections in professional rugby league. Am J Sports Med. 2010;38:2259-2266.



# RIB INJECTIONS

- 🏈 Retrospective study of 100 players over 10 seasons
- 🏈 23 ribs injected 74 times
- 🏈 Highest percentage of players feeling they were not useful: 14%
- 🏈 Side effects:
  - 🏈 None- 38%
  - 🏈 Worsened with injection- 14%
- 🏈 Orchard, JW. Et al FACSP: Long-Term Safety of Using Local Anesthetic Injections in Professional Rugby League. *The American Journal of Sports Medicine*, Vol. 38, No. 11





# LOCAL ANESTHETICS

June 1992 • Revised June 2004

The use of local injectable anesthetics to treat sports- related injuries in college athletics is primarily left to the discretion of the physician treating the individual, since there is little scientific research on the subject. This guideline provides basic recommendations for the use of these substances, which commonly include lidocaine (Xylocaine), 1 or 2 percent; bupivacaine (Marcaine), 0.25 to 0.50 percent; and mepivacaine (Carbocaine), 3 percent. The following recommendations do not include the use of corticosteroids.

It is recommended that:

1. These agents should be administered only by a qualified clinician who is licensed to perform this procedure and who is familiar with these agents' actions, reactions, interactions and complications. The treating clinician should be well aware of the quantity of these agents that can be safely injected.
2. These agents should only be administered in facilities equipped to handle any allergic reaction, including a cardiopulmonary emergency, which may follow their use.
3. These agents should only be administered when medically justified, when the risk of administration is fully explained to the patient, when the use is not harmful to continued athletics activity and when there is no enhancement of a risk of injury.

The following procedures are not recommended:

1. The use of local anesthetic injections if they jeopardize the ability of the student-athlete to protect himself or herself from injury.
2. The administration of these drugs by anyone other than a qualified clinician licensed to perform this procedure.
3. The use of these drugs in combination with epinephrine or other vasoconstrictor agents in fingers, toes, earlobes and other areas where a decrease in circulation, even if only temporary, could result in significant harm.

## 2014-15 NCAA<sup>®</sup>

### Sports Medicine Handbook



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# IN-GAME MANAGEMENT

## Padding:

-  Evo Shield
-  Back Flap
-  Rib pads
-  Foam
-  Orthoplast

## Support:

-  Ace wrap
-  Neoprene Rib belt
-  Tape





# RETURN TO PLAY

- 🏈 Depends on number of ribs and location
- 🏈 Same day
- 🏈 Limited by pain
- 🏈 Up to 3 weeks





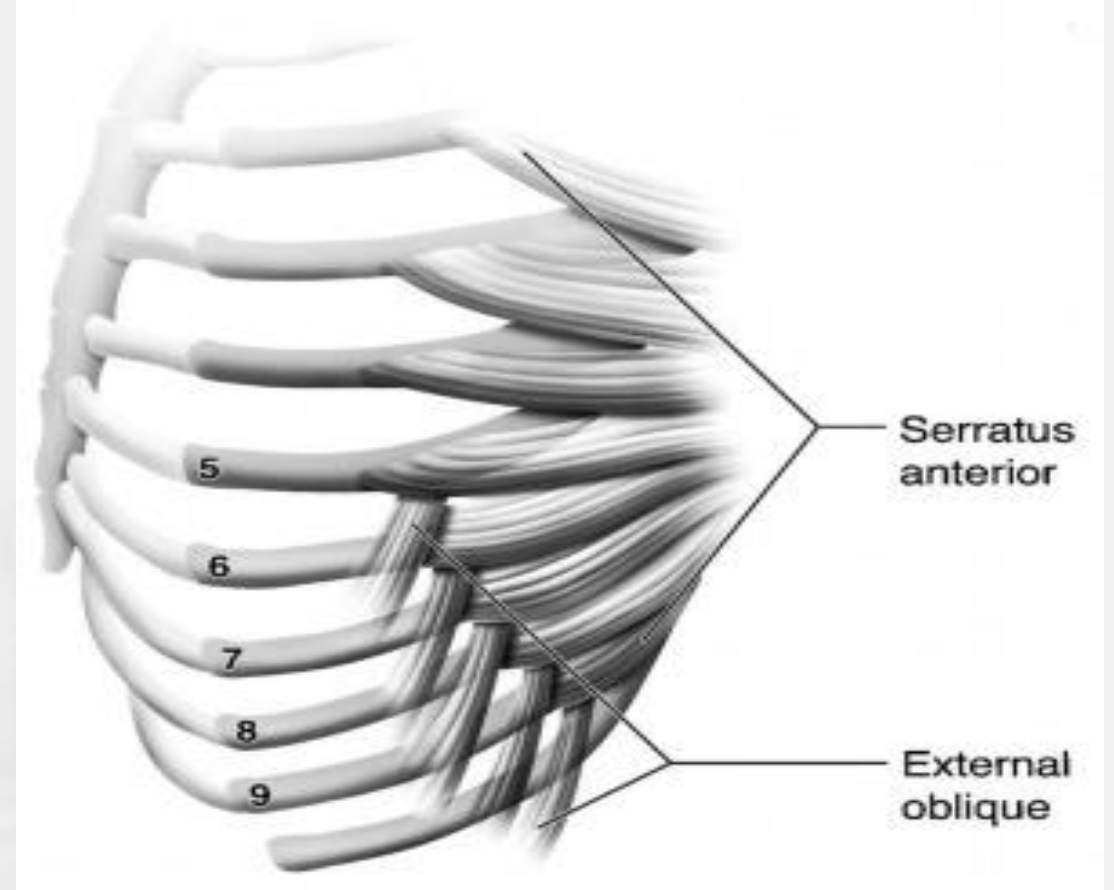
# COMPLICATIONS

- 🏈 Worsening of fracture
- 🏈 Pneumothorax
- 🏈 Hemothorax
- 🏈 Pulmonary contusion
- 🏈 Non-union



# SPECIAL CONSIDERATIONS

- 🏈 Inferior (floating) ribs:
  - 🏈 Increased trauma
  - 🏈 Damage to underlying organs
    - 🏈 Liver
    - 🏈 Spleen
    - 🏈 Kidneys
  - 🏈 Avulsion of external oblique
    - 🏈 Baseball batters or pitchers
    - 🏈 Sudden vigorous contraction





# STRESS FRACTURES

# STRESS FRACTURES

- 🏈 Overuse injury
- 🏈 Most common in rowers and golfers
- 🏈 Site is usually insertion of Serratus Anterior along ribs 1-9
- 🏈 Fractures occur at posterior-lateral corner





# STRESS FRACTURES

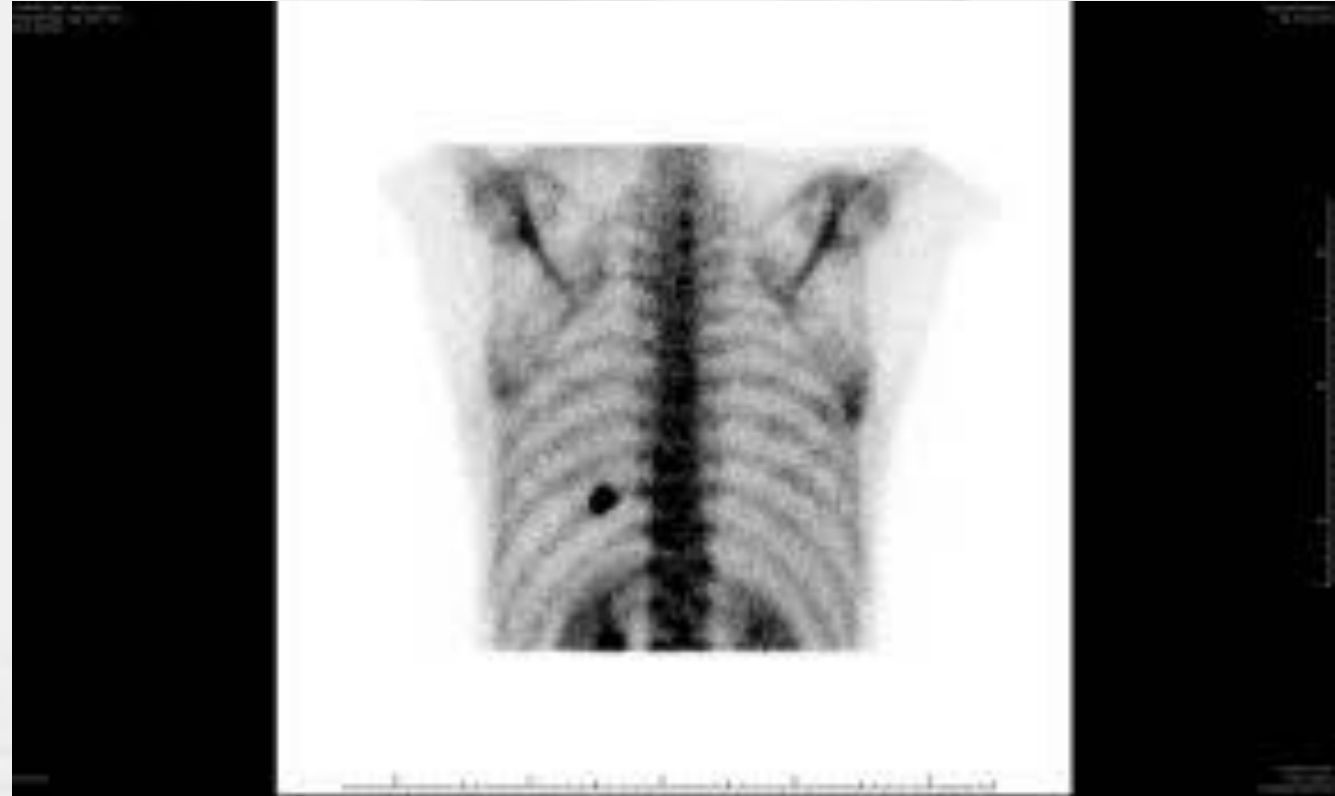
## History and Physical Exam

- 🏈 Dull vague chest pain that progresses to sharp pain that prohibits activity
- 🏈 Pain usually located posteriorly
  - 🏈 Weakest spot
  - 🏈 Under scapula
- 🏈 Pain can radiate along intercostal nerve
- 🏈 Pain worse with deep breath or cough
- 🏈 Tender to palpation
- 🏈 “+” squeeze test

# STRESS FRACTURES

## Diagnosis

- 🏈 High clinical suspicion
- 🏈 Plain radiographs unrewarding
- 🏈 Triple Phase Bone Scan



# STRESS FRACTURES

## Treatment

- 🏈 Can take 4-8 weeks to heal
- 🏈 Treat same way as acute fractures
- 🏈 May have to limit activity
- 🏈 Rib belts or tape
- 🏈 Strengthen scapular stabilizers:  
Less protraction as oars enter water and less retracted at end of stroke





# STRESS FRACTURES OF FIRST RIB

## 🏈 Acute traumatic

- 🏈 Fall on outstretched arm, HyperABduction, direct blow
- 🏈 Occurs in subclavian sulcus: groove where subclavian artery crosses rib

## 🏈 Stress Fracture

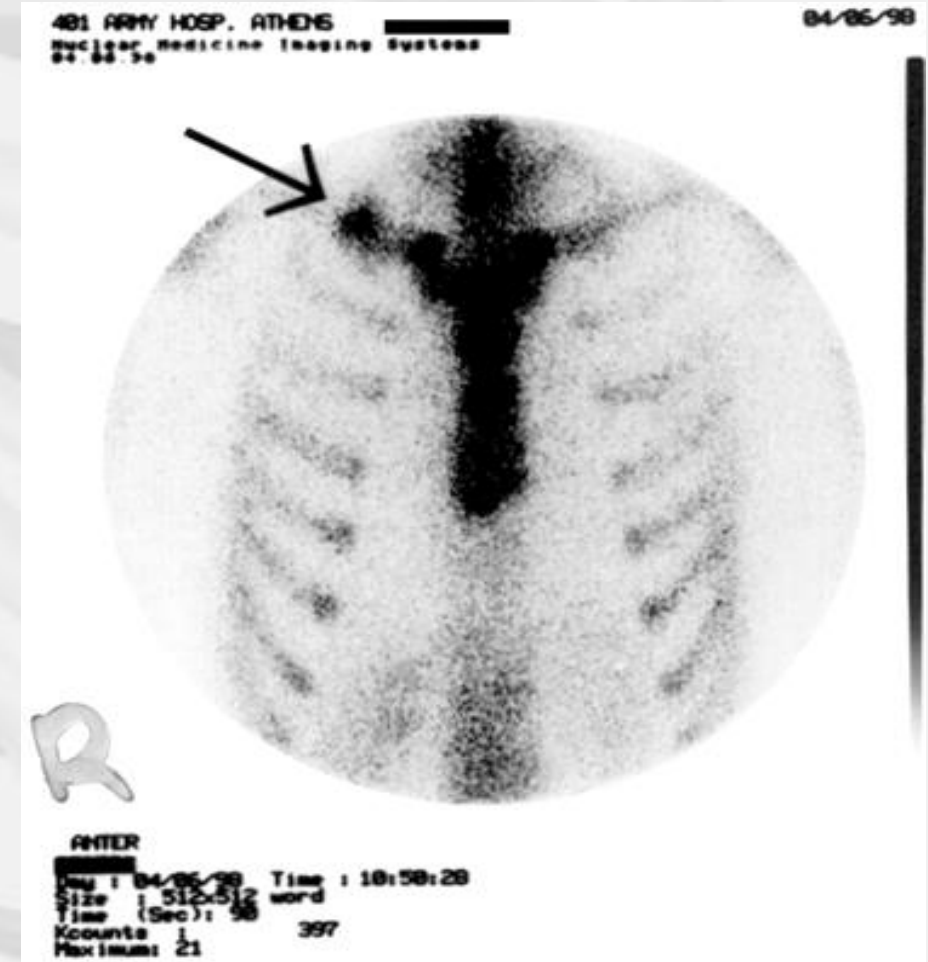
- 🏈 Weight lifting, pitching, tennis, rowing
- 🏈 Cephalad pull of scalenes against intercostals and serratus anterior
- 🏈 Can go to non-union and pseudoarthrosis



# SPECIAL CONSIDERATIONS

## First Rib







- Usually vague pain in supraclavicular fossa or posterior shoulder that can radiate
- Pain with deep inspiration, cough
- Pain with shoulder flexion and **Ab**duction
- Downward traction on arm and lateral flexion of neck to contralateral side may cause pain
- Diagnose: Plain film, CT, bone scan

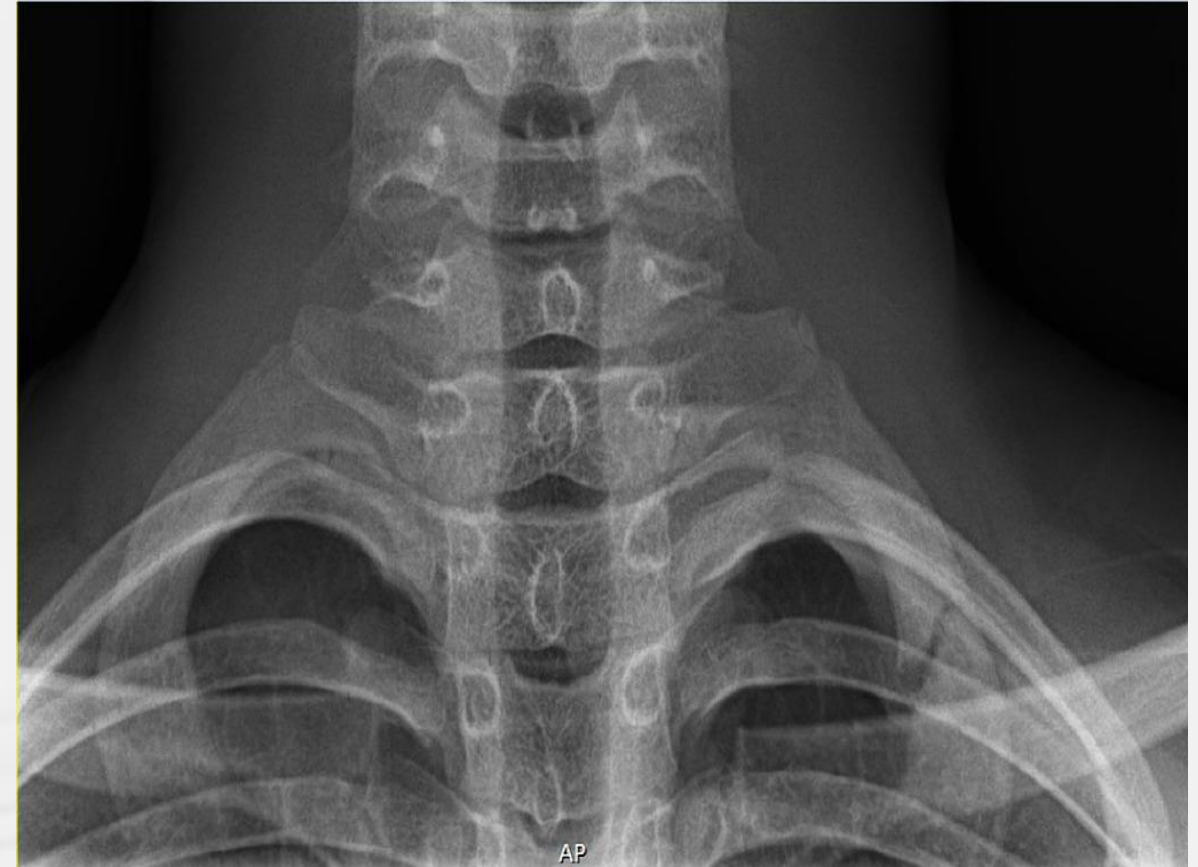


# SPECIAL CONSIDERATIONS

## First Rib

### Treatment:

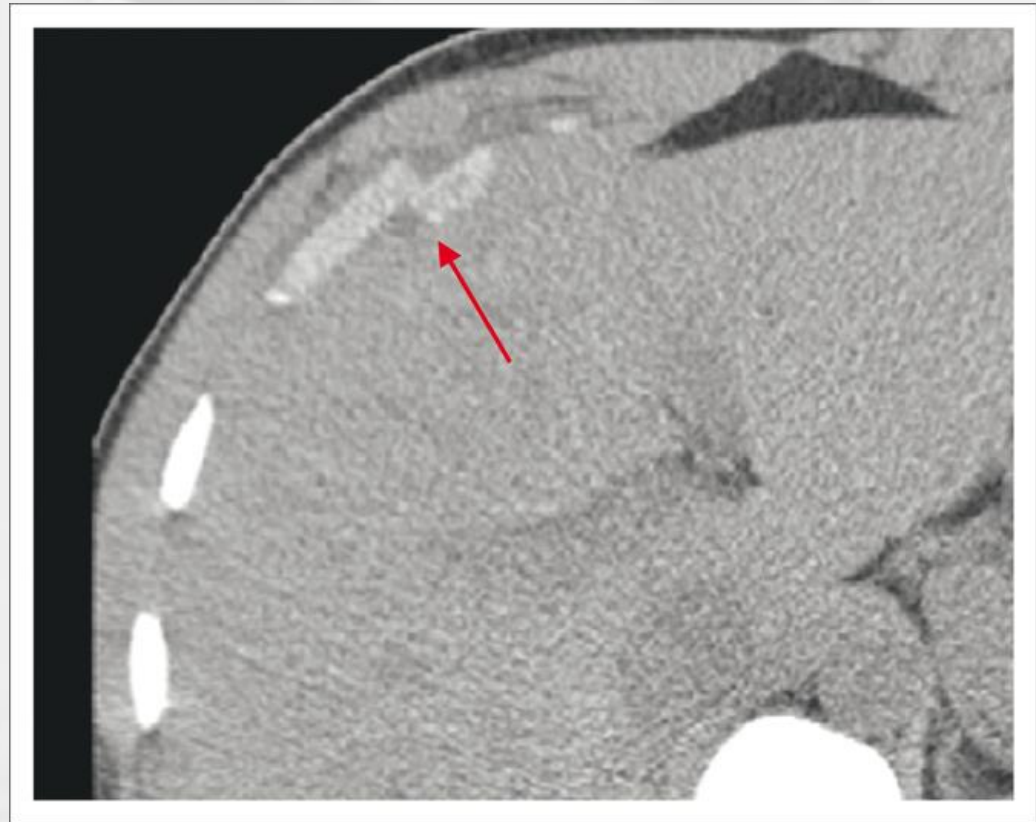
-  Rest until pain tolerated
-  Can condition or cross train
-  Gradual return to activity: usually 4 weeks
-  Monitor mechanics of weight lifting
-  No backpacks
-  Can go to non-union and pseudoarthrosis





# COSTOCHONDRAL INJURIES

- 🏈 Acute chondral fractures
- 🏈 Costochondritis
- 🏈 Tietze's Syndrome
- 🏈 Costosternal subluxation
- 🏈 Costovertebral subluxation



**FIGURE 3:** Axial computed tomography (CT) scan of the chest wall demonstrating a displaced fracture of the costochondral cartilage – an example of ‘cartilage overlap’ sign (arrow).

# CHONDRAL FRACTURES

- 🏈 Usually in the lower conjoined ribs (8-10)
- 🏈 Sudden contraction of abdominal obliques
- 🏈 Acute pain, often a palpable “click” at fracture site
- 🏈 Imaging unrewarding, sometimes can see on CT
- 🏈 Treatment: Often surgery after failed conservative

# COSTOCHONDRITIS

- 🏈 Pain and tenderness at the costochondral or chondrosternal junction in the absence of swelling
- 🏈 Common cause of MSK chest pain: 30% ER visits for chest pain
  - 🏈 More common in: women, age >40, Hispanics
- 🏈 An inflammatory condition of unknown etiology
  - 🏈 Can be infectious: post-viral, bacterial
- 🏈 Pain worse with movements, inspiration and palpation
- 🏈 Usually involves ribs 2-5 anteriorly



# COSTOCHONDRITIS

## Treatment

- 🏈 NSAIDs (10-14 days)
  - 🏈 Oral: indomethacin, prednisone
  - 🏈 Topical: diclofenac gel, patch
- 🏈 Corticosteroid injection



# TIETZE'S SYNDROME

- 🏈 First described in 1921

Tietze A. Über eine eigenartige Haufung von Fäuen mit Dystrophie der Rippenknorpel. Berl Klin Wochenschr 1921; 58: 829-31

- 🏈 Similar onset and presentation as costochondritis

- 🏈 Painful ***swelling*** of one costochondral/chondrosternal junction only

- 🏈 Usually 2<sup>nd</sup> or 3<sup>rd</sup> but can even be SC joint

- 🏈 Thought to be inflammatory, possibly a seronegative rheumatological condition

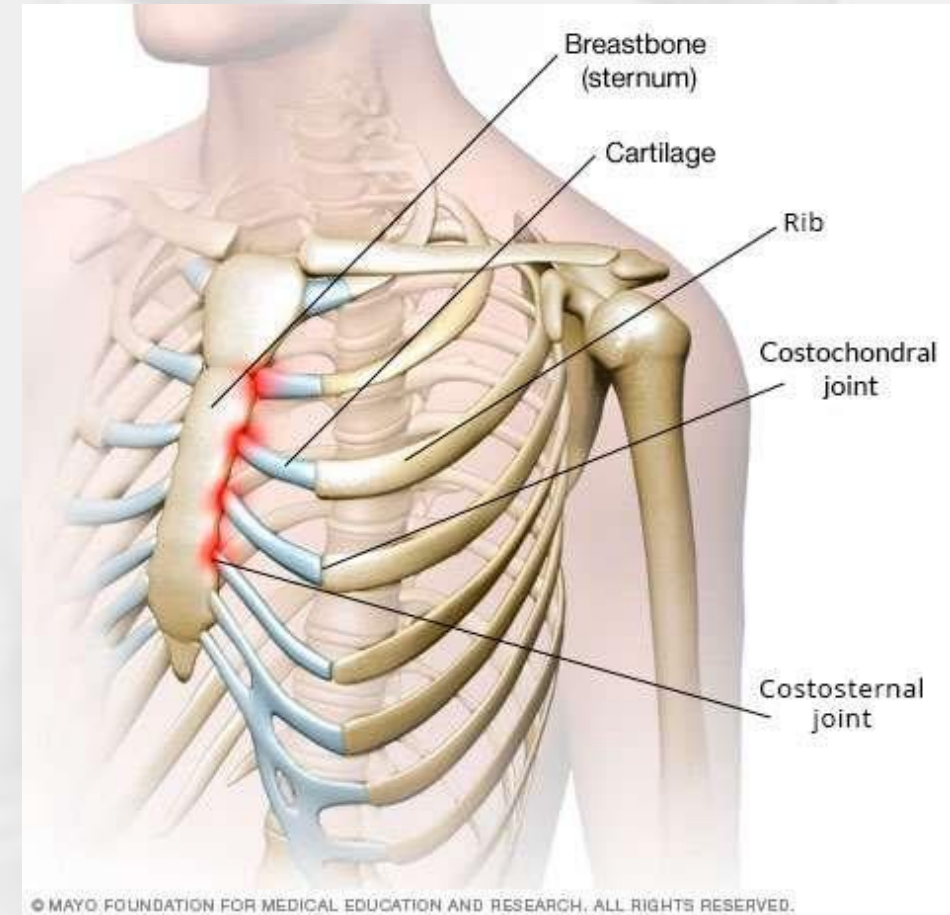
- 🏈 Joint usually warm and swollen

- 🏈 Can show as “+” bone scan or gallium scan

- 🏈 Treatment same as costochondritis

# COSTOSTERNAL SUBLUXATION

- 🏈 Rare
- 🏈 Reported in a wrestler but also in collision sports
- 🏈 Usually a twisting mechanism
- 🏈 Pain and tenderness at site
- 🏈 Palpable deformity and click





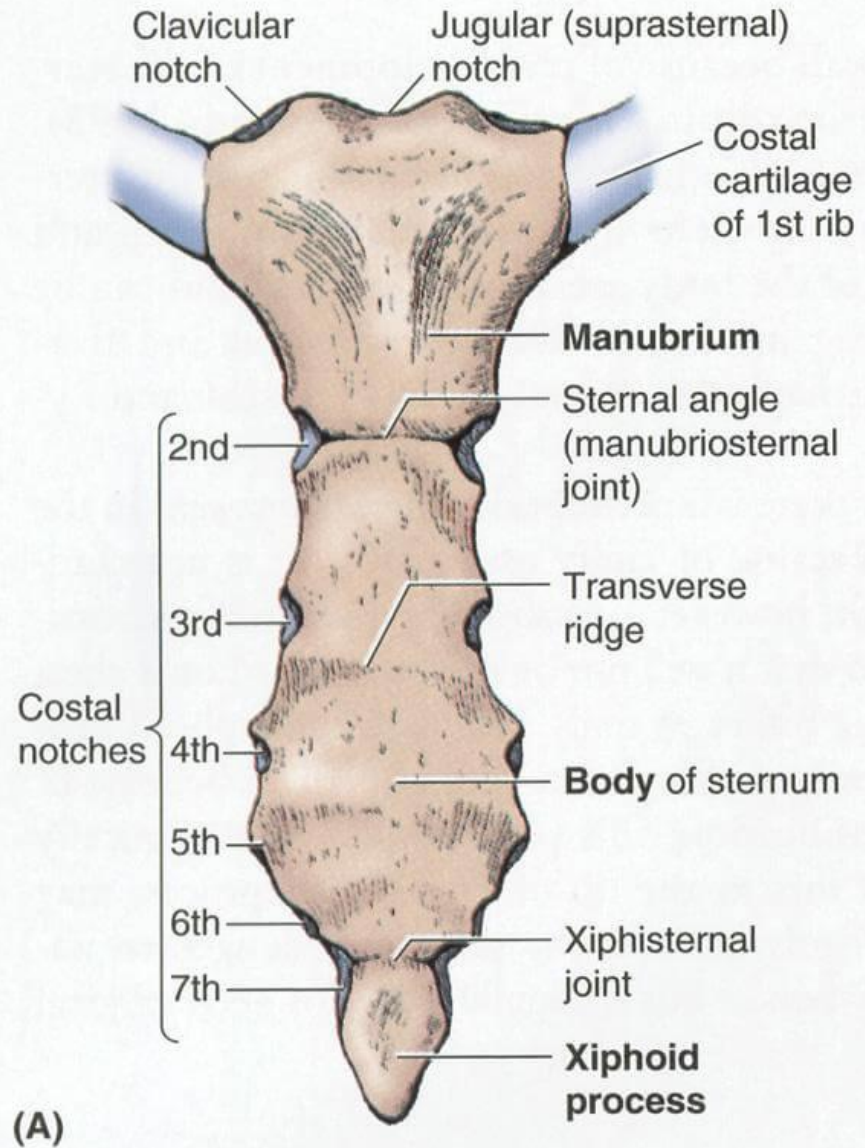
# COSTOVERTEBRAL SUBLUXATION

- Common cause of upper thoracic back pain and can radiate to lateral chest wall (butterfly swimmers, rowers)
- Often misdiagnosed as rhomboid strain or thoracic strain
- Proposed malalignment of rib articular surface and transverse process
- Tender to palpation just lateral to spinous process
- Unable to image
- Treatment: osteopathic manipulation

# STERNAL INJURIES

🏈 Sternal Stress Fractures

🏈 Painful Xiphoid syndrome



# STERNAL STRESS FRACTURE

- 🏈 0.5% of all sternal injuries
- 🏈 Usually from repetitive hyperflexion of torso and sit-ups
- 🏈 Opposing forces of pec major and SCM against rectus abdominus
- 🏈 Gradual onset of pain with point tenderness over sternum
- 🏈 Image with bone scan or MRI
- 🏈 Treat with rest 2-15 months



# PAINFUL XIPHOID SYNDROME

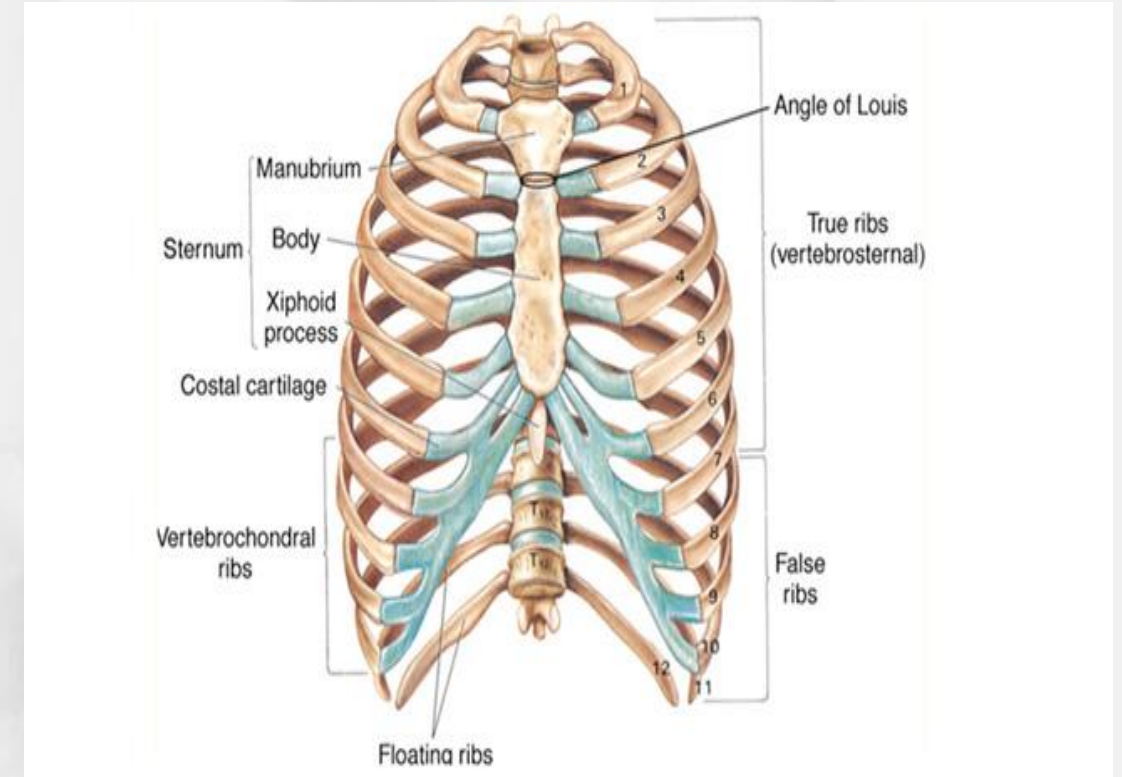
- 🏈 Etiology unknown- possibly inflammatory
- 🏈 Pain and tenderness localized to xiphoid
- 🏈 May present with abdominal pain and even nausea and vomiting
- 🏈 Treatment same as costochondritis and injection can be done with ultrasound





# SLIPPING RIB SYNDROME

- 🏈 First described by Cyriax in 1919
- 🏈 Aka “rib tip syndrome”, “Cyriax syndrome”, “clicking rib syndrome”
- 🏈 Affects lowest “floating” ribs most but can affect false ribs
- 🏈 Symptoms caused by rib tip irritating intercostal nerve, intercostal muscles, or cartilage
- 🏈 Rib slips under one superior to it




# SLIPPING RIB SYNDROME

## History


- 🏈 Intermittent sharp pain at lower costal margin followed by a dull ache which may last days
- 🏈 Almost always unilateral
- 🏈 Possible antecedent trauma, even months or years prior
- 🏈 Can present as upper visceral abdominal pain due to close approximation of lower thoracic nerves and visceral sympathetic nerves
- 🏈 Pain worse with certain movements: twisting, bending, stretching, coughing
- 🏈 Often feel slip, click, or pop

# SLIPPING RIB SYNDROME

## Diagnosis

 Hooking maneuver: patient lies on unaffected side, lowest ribs are grabbed from abdominal side and lifted over adjacent ribs which will reproduce symptoms

Heinz GJ, Zavala DC. Slipping rib syndrome. JAMA 1977; 237 (8): 794-5

 Ultrasound can often demonstrate subluxation

 Other tests done because of abdominal pain: CT, Gallbladder

# SLIPPING RIB SYNDROME

## Treatment

🏈 Reassurance

🏈 NSAIDs

🏈 Rib Belt

🏈 Intercostal nerve block

🏈 Radiofrequency nerve ablation  
of dorsal root ganglia

🏈 Surgical excision

🏈 PT

🏈 Avoiding painful activity

🏈 Heat, cold, ultrasound

🏈 Manual therapy of costovertebral  
junction





# CONCLUSION

- 🏈 Rib fractures occur occasionally in sport.
- 🏈 Diagnosis can be made on the sideline.
- 🏈 Treatment on the sideline can be done with analgesia and pads.
- 🏈 Return to play is limited by pain and level of play.
- 🏈 Complications can occur with pneumo/hemothorax and non-union of fracture.

# THANK YOU

