Upper Extremity Trauma

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Introduction

- Traumatology
- AO Trauma
  - AO Surgery reference
    - https://www2.aofoundation.org/wps/portal/surgery

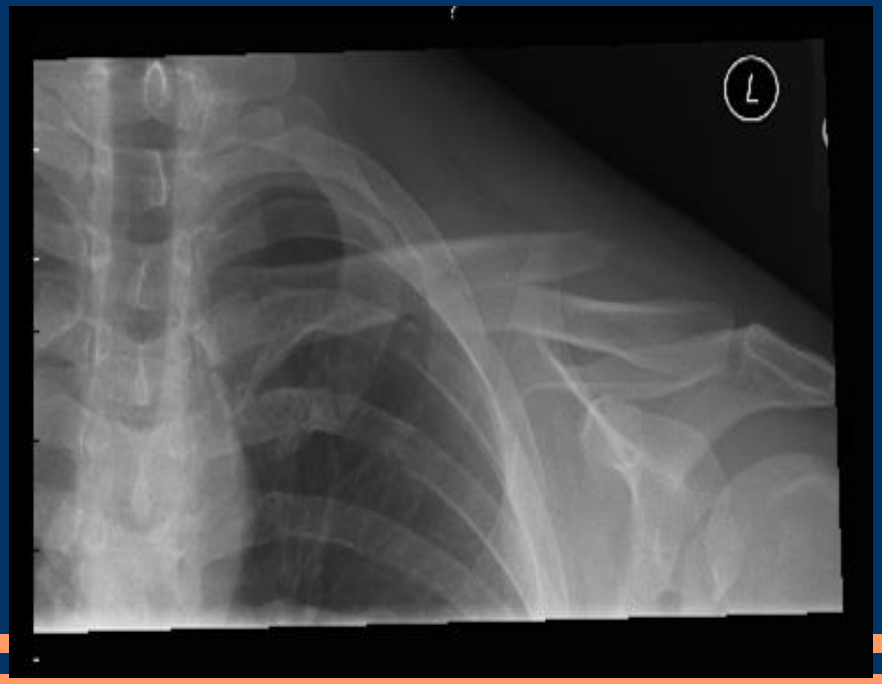
Topics

- Soft tisues
- Muscles and tendons
- Joints
- Bones
- Vessels and nerves

Topics

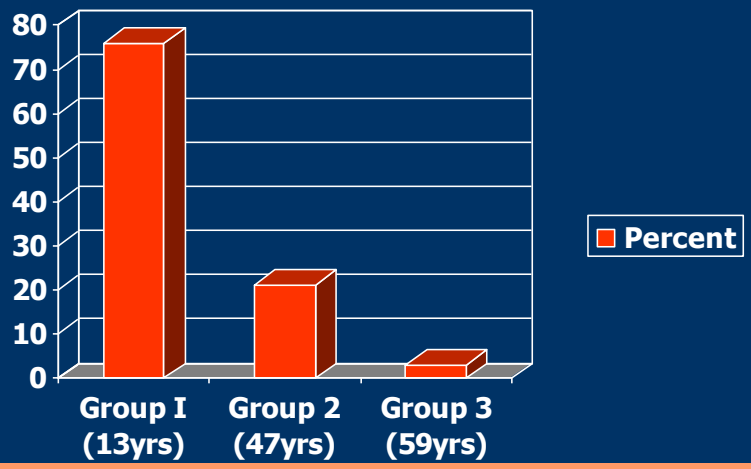
- Clavicle
- Scapula
- AC Joint Dislocation
- Shoulder Dislocation
- Humerus
- Elbow
- Forearm
- Distal Radius
- Hand

Clavicle Fractures



Clavicle Fractures

- Mechanism
  - Fall onto shoulder (87%)
  - Direct blow (7%)
  - Fall onto outstretched hand (6%)
- Trimodal distribution



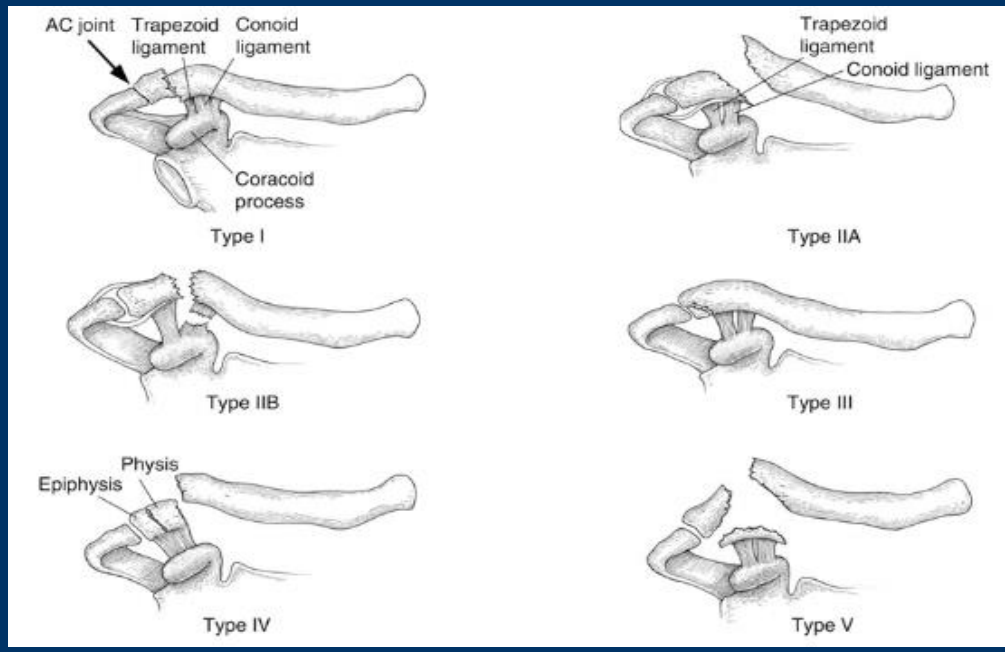
Clavicle Fractures

- Clinical Evaluation
  - Inspect and palpate for deformity/abnormal motion
  - Thorough distal neurovascular exam
  - Auscultate the chest for the possibility of lung injury or pneumothorax
- Radiographic Exam
  - AP chest radiographs.
  - Clavicular 15-45deg A/P oblique X-rays
  - Traction pictures may be used as well

Clavicle Fractures

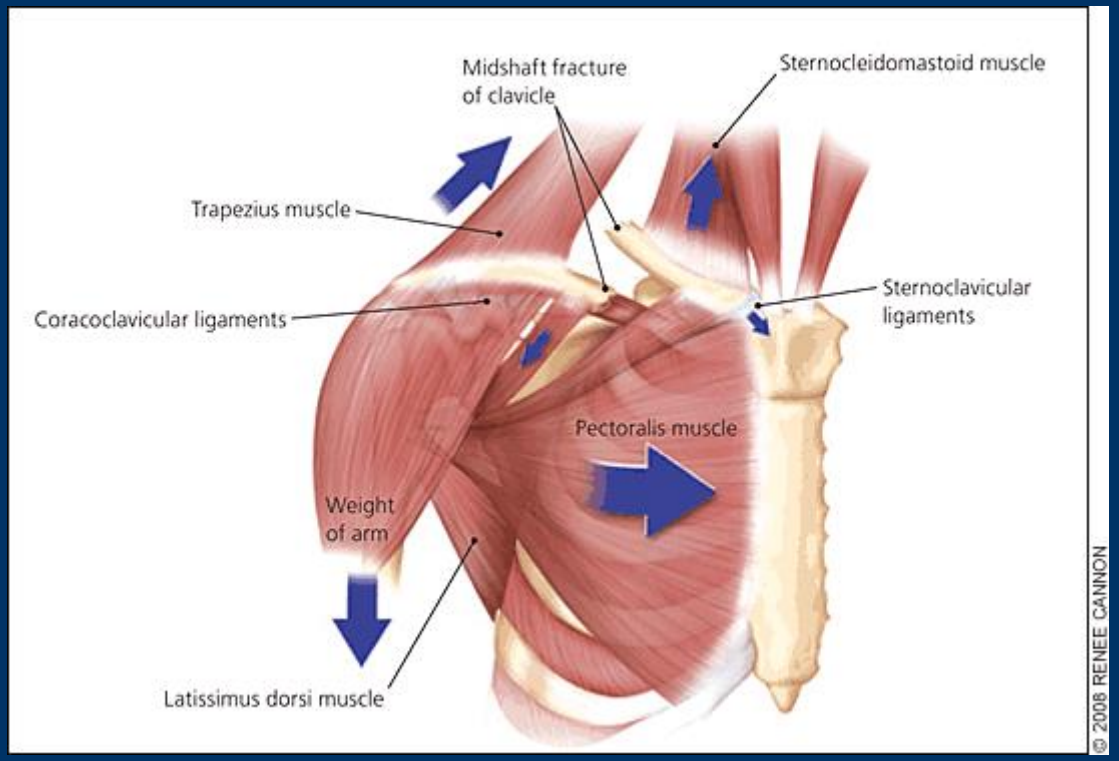
- Type I Middle Third (80%)
- Type II Distal Third (15%)
  - Differentiate whether ligaments attached to lateral or medial fragmen
- Type III Medial Third (5%)

- Allman clasification
- Neer clasification



Clavicle Fractures

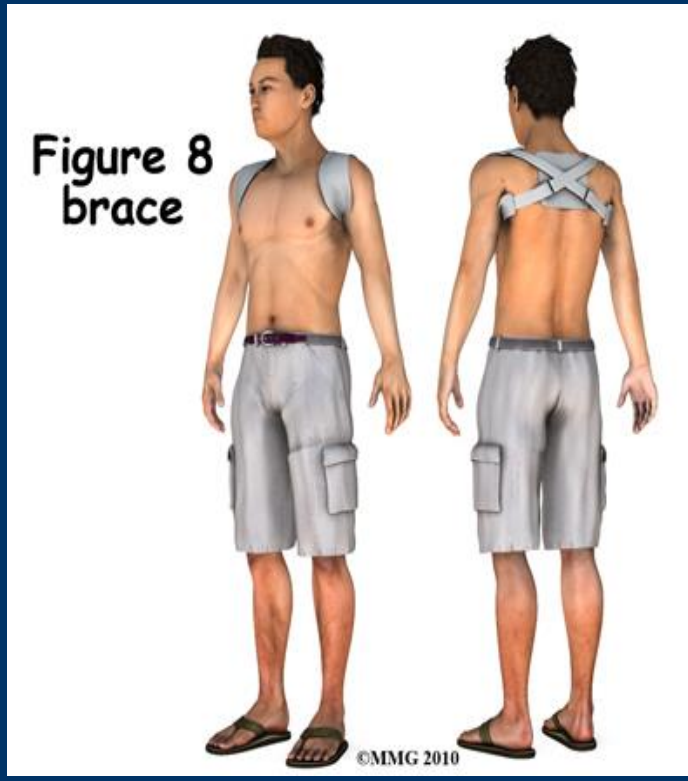
- Dislocation



Clavicle Fracture

- Closed Treatment
  - Sling immobilization for usually 3-4 weeks with early ROM encouraged
- Operative intervention
  - Fractures with neurovascular injury
  - Fractures with severe associated chest injuries
  - Open fractures
  - Group II, type II fractures and those with 100% disl., more than 2cm shortening
  - Cosmetic reasons, uncontrolled deformity
  - Nonunion

Clavicle Fracture



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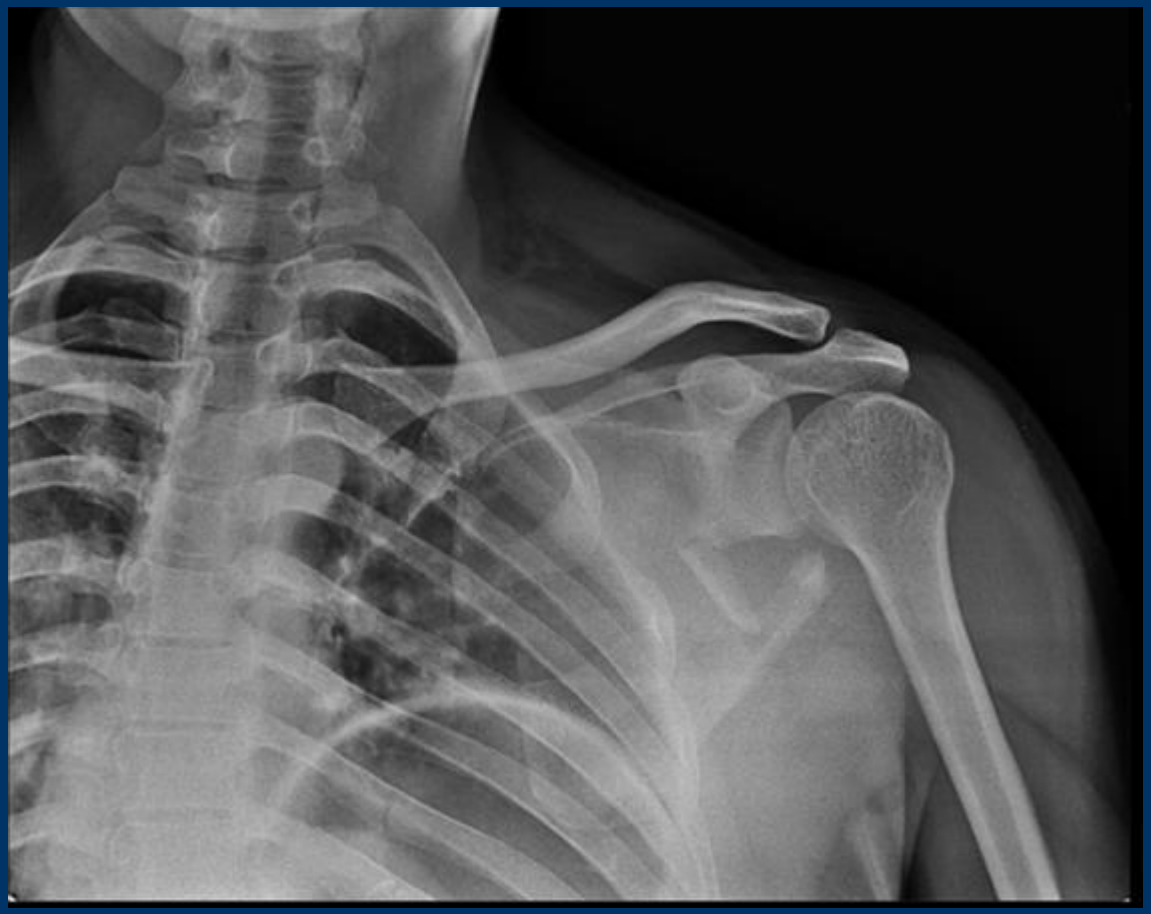
Clavicle Fracture

- Associated Injuries
  - Brachial Plexus Injuries
    - Contusions most common, penetrating (rare)
  - Vascular Injury
  - Rib Fractures
  - Scapula Fractures
  - Pneumothorax



Scapula Fracture

- Uncommon fracture pattern associated with high energy trauma
  - 2-5% associated mortality rate
    - usually pulmonary or head injury
    - associated with Increased Injury Severity Scores
- Epidemiology
  - incidence
    - less than 1% of all fractures
  - location
    - 50% involve body and spine
- Associated injuries (in 80-90%)

Scapula Fracture

- Classification is based on the location of the fracture and includes
  - coracoid fractures
  - acromial fractures
  - glenoid fractures (Ideberg)
  - scapular neck fractures
    - look for associated AC joint separation or clavicle fracture
    - known as "floating shoulder"
  - scapular body fractures
    - described based on anatomic location
- scapulothoracic dissociation

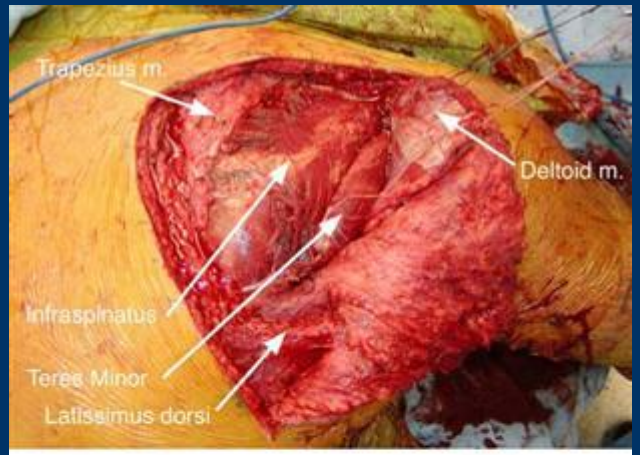
Scapula Fracture

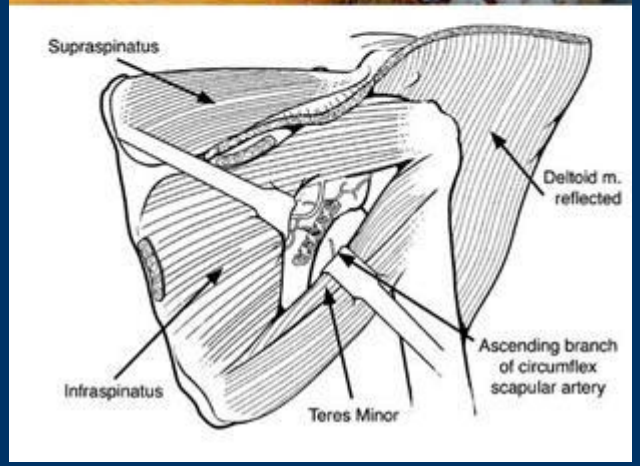
- Imaging
  - Radiographs
    - recommended views
  - true AP, scapular Y and axillary lateral view
  - CT
    - intra-articular fracture
    - significant displacement
    - three-dimensional reconstruction useful

Scapula Fracture

- Treatment
  - Nonoperative
    - sling for 2 weeks, followed by early motion
    - indications
      - indicated for vast majority of scapula fractures
      - 90% are minimally displaced and acceptably aligned
    - outcomes
      - union at 6 weeks
      - can expect no functional deficits
  - Operative
    - open reduction internal fixation

Scapula Fracture

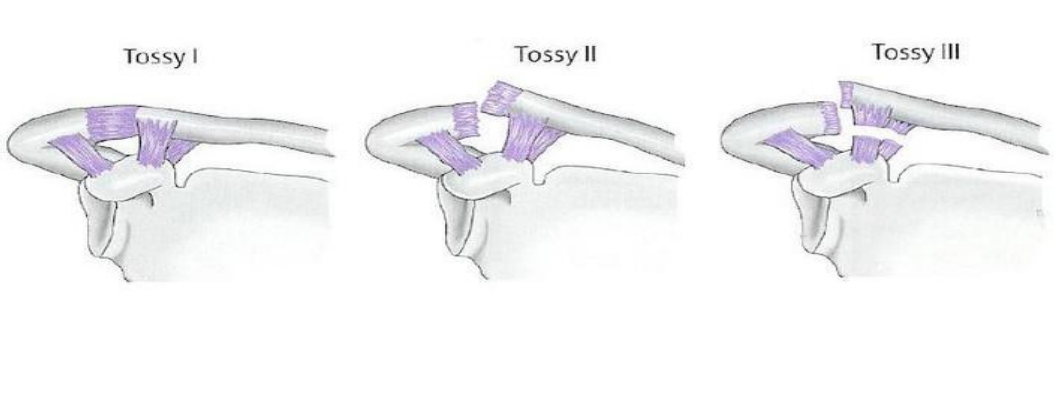


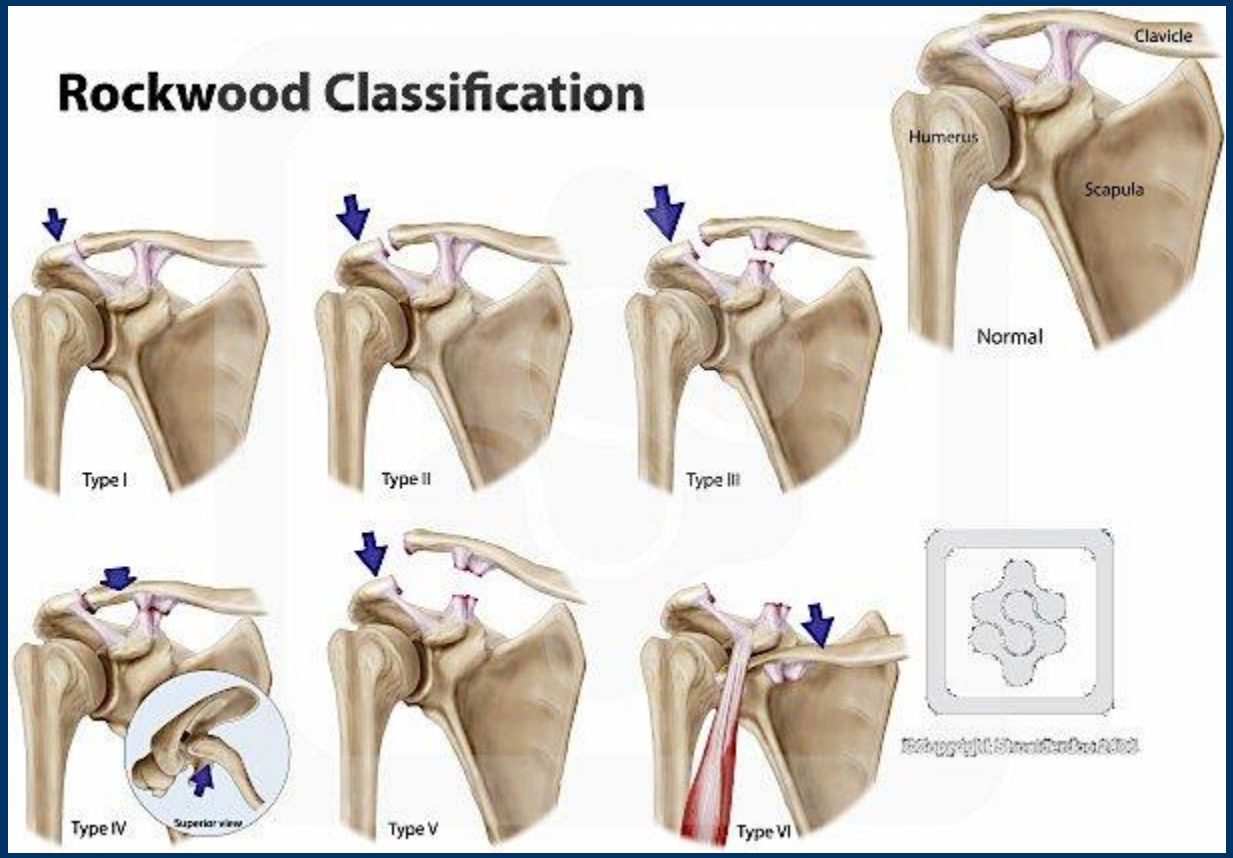


AC Joint Dislocations

- Primarily in male
- 25% of the dislocations of the shoulder girdle
- Number 1 injury in bicycle accidents
- Mechanism: fall or direct blow to the point of shoulder with arm adducted

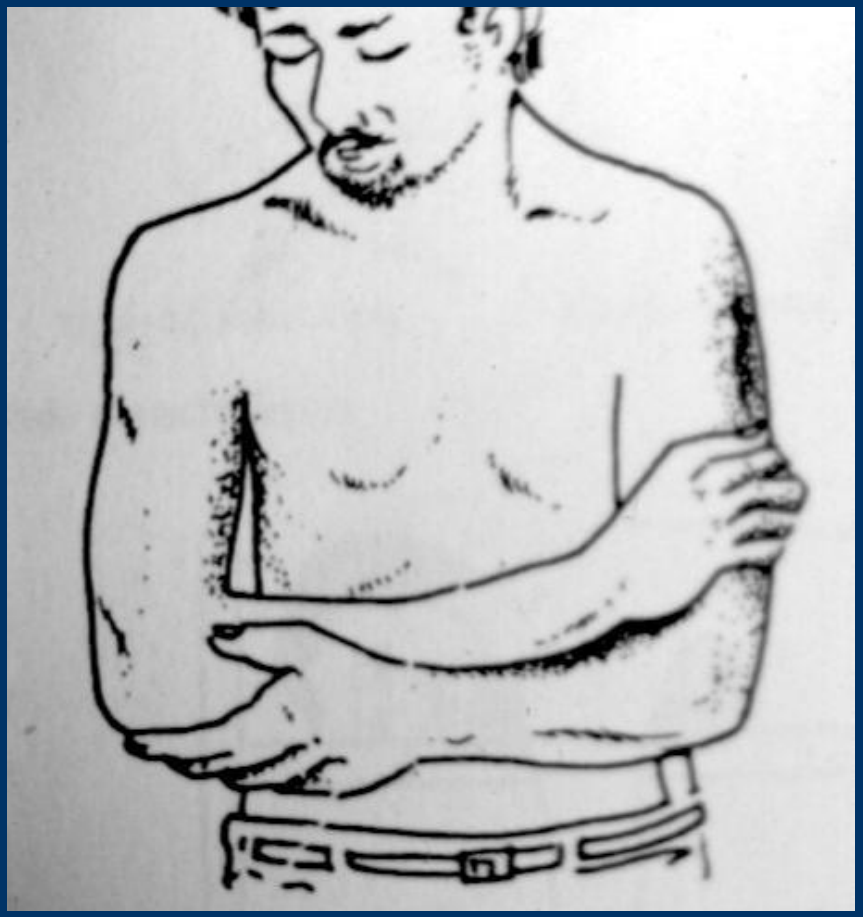
AC Joint Dislocations





AC Joint Dislocations

- Treatment
  - Grade I, II
    - Immobilization in a sling
  - Grade III
    - Controversy with regard to op vs conservative tx
  - Grade IV, V, VI
    - Early surgery in young individuals



Shoulder Dislocations

- Epidemiology
  - Anterior: Most common
  - Posterior: Uncommon, 10%, Think Electrocutions & Seizures
  - Inferior (Luxatio Erecta): Rare, hyperabduction injury

Shoulder Dislocations

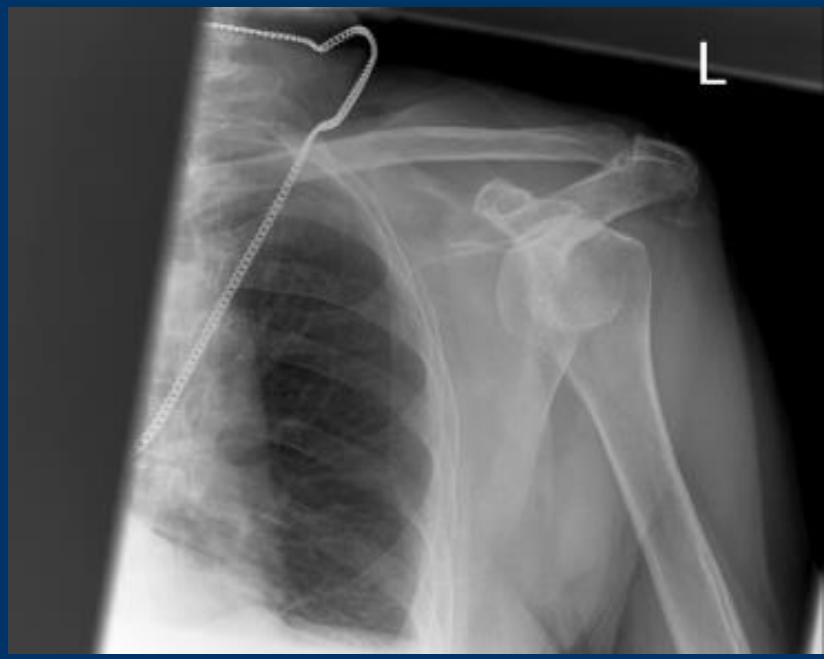
- Clinical Evaluation
  - Examine axillary nerve (deltoid function, not sensation over lateral shoulder)
  - Examine M/C nerve (biceps function and anterolateral forearm sensation)
- Radiographic Evaluation
  - True AP shoulder
  - Axillary Lateral
  - Scapular Y
  - Stryker Notch View (Bony Bankart)

Shoulder Dislocations

- Anterior Dislocation Recurrence Rate
  - Age 20: 80-92%
  - Age 30: 60%
  - > Age 40: 10-15%
- Look for Concomitant Injuries
  - **Bony:** Bankart, Hill-Sachs Lesion, Glenoid Fracture, Greater Tuberosity Fracture
  - **Soft Tissue:** Subscapularis Tear, RCT (older pts with dislocation)
  - **Vascular:** Axillary artery injury (older pts with atherosclerosis)
  - **Nerve:** Axillary nerve neuropraxia

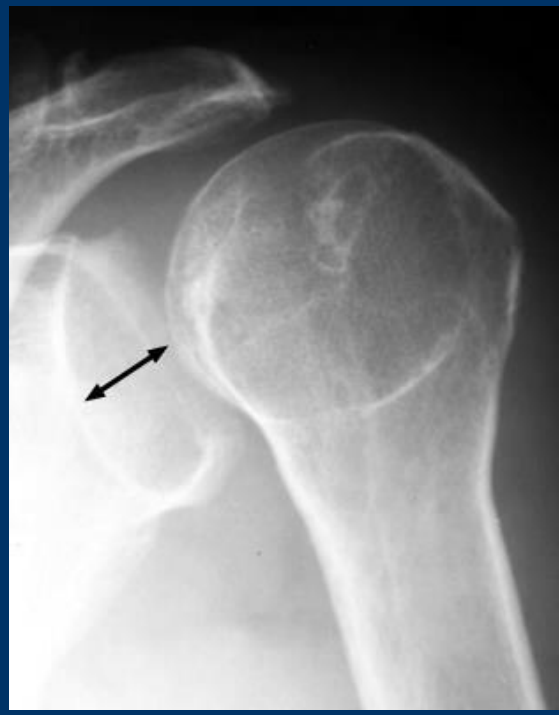
Shoulder Dislocations

- Anterior Dislocation
  - Traumatic
  - Atraumatic
    (Congenital Laxity)
  - Acquired
    (Repeated Microtrauma)



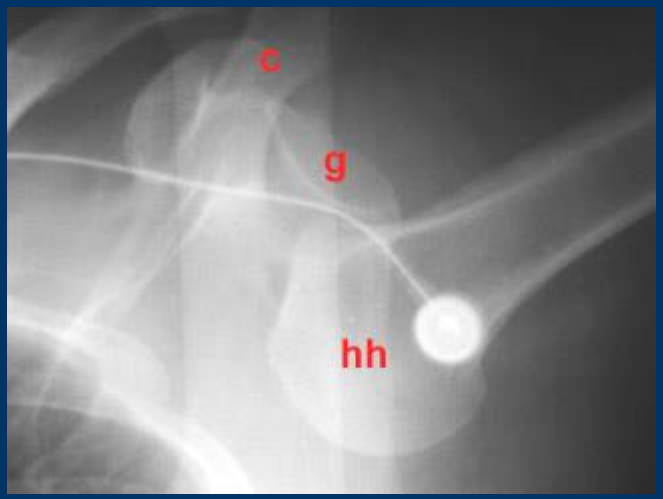
Shoulder Dislocations

- Posterior Dislocation
  - Adduction/Flexion/IR at time of injury
  - Electrocution and Seizures cause overpull of subscapularis and latissimus dorsi
  - Look for “lightbulb sign” and “vacant glenoid” sign
  - Reduce with traction and gentle anterior translation (Avoid ER arm → Fx)



Shoulder Dislocations

- Inferior Dislocations
- Luxatio Erecta
  - Hyperabduction injury
  - Arm presents in a flexed “asking a question” posture
  - High rate of nerve and vascular injury
  - Reduce with in-line traction and gentle adduction



Shoulder Dislocation

- Treatment
  - Nonoperative treatment
    - Closed reduction should be performed after adequate clinical evaluation and appropriate sedation
  - Reduction Techniques
    - Traction/countertraction- Generally used with a sheet wrapped around the patient and one wrapped around the reducer.
    - **Hippocratic technique-** Effective for one person. One foot placed across the axillary folds and onto the chest wall then using gentle internal and external rotation with axial traction
    - **Stimson technique-** Patient placed prone with the affected extremity allowed to hang free. Gentle traction may be used
    - **Milch Technique-** Arm is abducted and externally rotated with thumb pressure applied to the humeral head
    - **Scapular manipulation, Kocher technique,...**

    - https://www.shoulderdoc.co.uk/article/1267

Shoulder Dislocations

- Postreduction
  - Post reduction films are a must to confirm the position of the humeral head
  - Pain control
  - Immobilization for 2-3 weeks then begin progressive ROM
- Operative Indications
  - Irreducible shoulder (soft tissue interposition)
  - Displaced greater tuberosity fractures
  - Glenoid rim fractures bigger than 5 mm
  - Elective repair for younger patients

Proximal Humerus Fractures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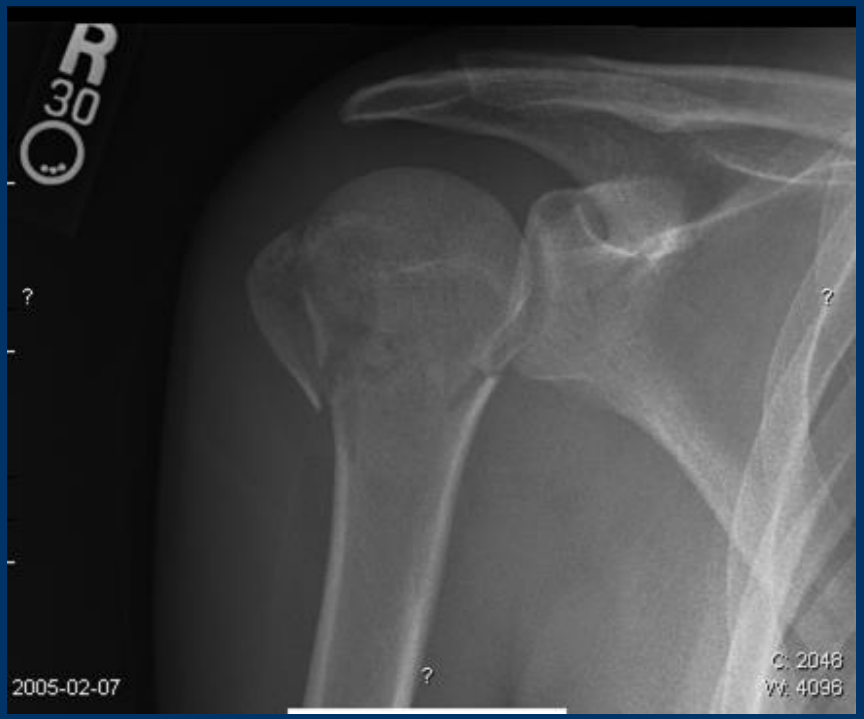
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Proximal Humerus Fractures

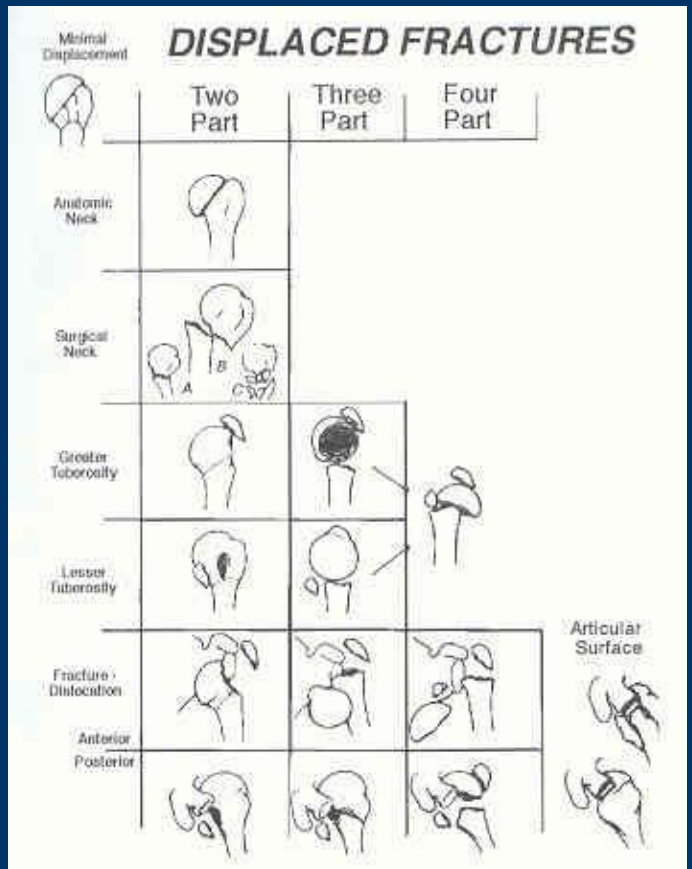
- Epidemiology
  - Most common fracture of the humerus
  - Higher incidence in the elderly, thought to be related to osteoporosis
  - Females 2:1 greater incidence than males
- Mechanism of Injury
  - Most commonly a fall onto an outstretched arm from standing height
  - Younger patient typically present after high energy trauma such as MVA

Proximal Humerus Fractures

- Clinical Evaluation
  - Patients typically present with arm held close to chest by contralateral hand. Pain and crepitus detected on palpation
  - Careful NV exam is essential, particularly with regards to the axillary nerve. Test sensation over the deltoid. Deltoid atony does not necessarily confirm an axillary nerve injury

Proximal Humerus Fractures

- Neer Classification
  - Four parts
    - Greater and lesser tuberosities,
    - Humeral shaft
    - Humeral head
  - A part is displaced if >1 cm displacement or >45 degrees of angulation is seen



Neer classification of proximal humerus fractures.

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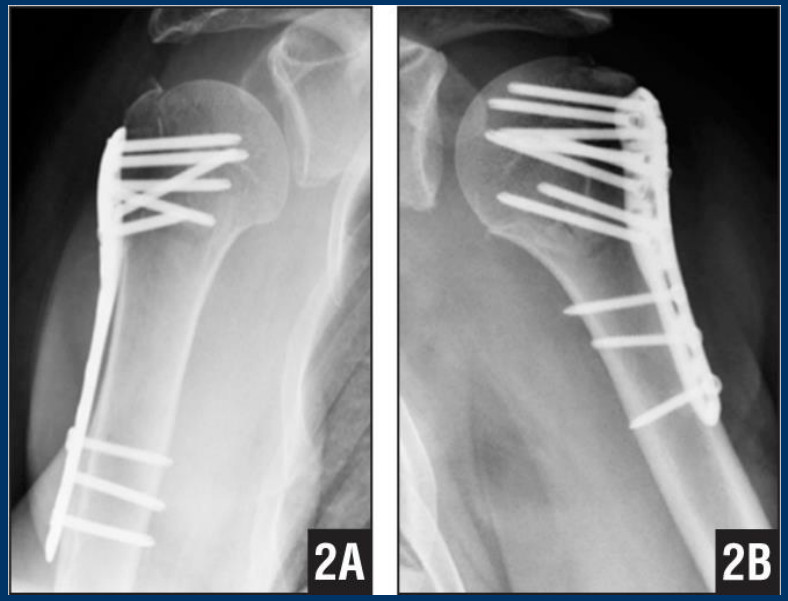
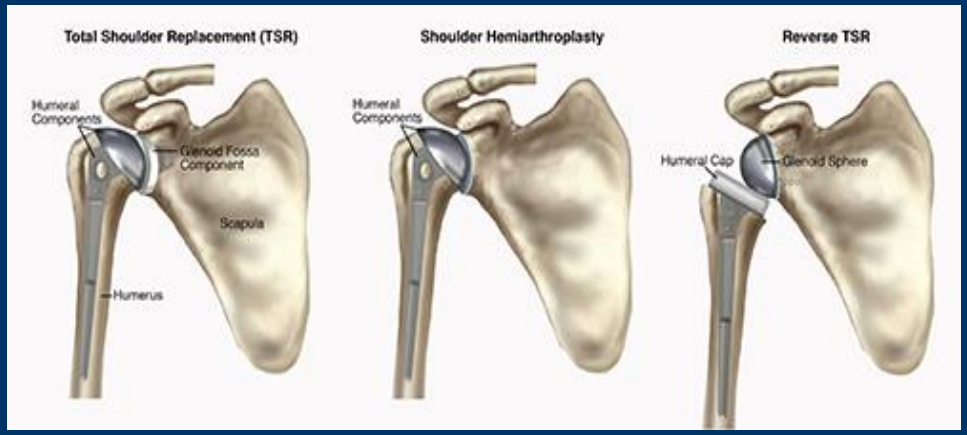
Proximal Humerus Fractures

- Treatment
  - Minimally displaced fractures- Sling immobilization, early motion
  - **Two-part fractures-**
    - Anatomic neck fractures likely require ORIF. High incidence of osteonecrosis
    - Surgical neck fractures that are minimally displaced can be treated conservatively. Displacement usually requires ORIF
  - **Three-part fractures**
    - Due to disruption of opposing muscle forces, these are unstable so closed treatment is difficult. Displacement requires ORIF.
  - **Four-part fractures**
    - In general for displacement or unstable injuries ORIF in the young and hemiarthroplasty in the elderly and those with severe comminution. High rate of AVN (13-34%)

Proximal Humerus Fractures





Humeral Shaft Fractures

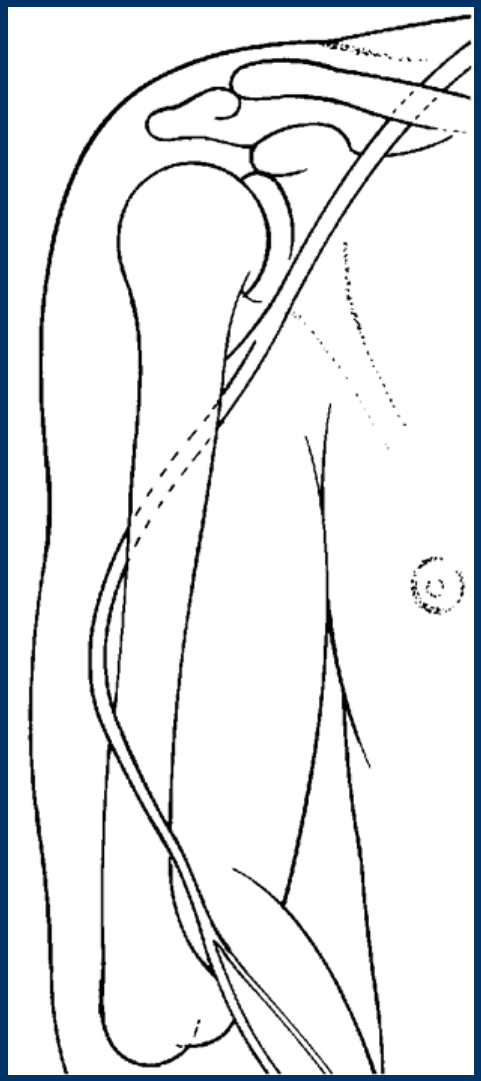
Humeral Shaft Fractures

- Mechanism of Injury
  - Direct trauma is the most common especially MVA
  - Indirect trauma such as fall on an outstretched hand
  - Fracture pattern depends on stress applied

- Compressive- proximal or distal humerus
- Bending- transverse fracture of the shaft
- Torsional- spiral fracture of the shaft
- Torsion and bending- oblique fracture usually associated with a butterfly fragment

Humeral Shaft Fractures

- Clinical evaluation
  - Thorough history and physical
  - Patients typically present with pain, swelling, and deformity of the upper arm
  - Careful NV exam important as the radial nerve is in close proximity to the humerus and can be injured

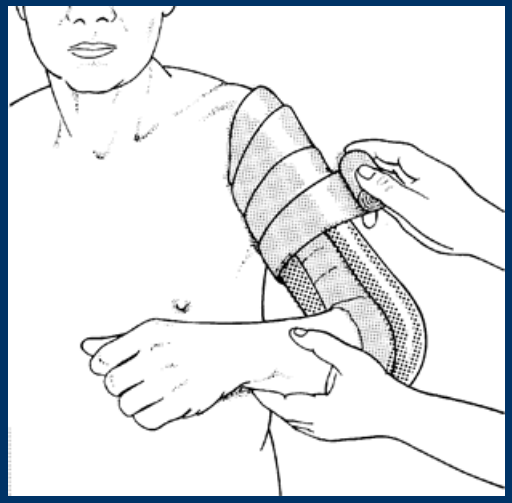


Humeral Shaft Fractures

- Radiographic evaluation
  - AP and lateral views of the humerus
  - Radiographs after traction reposition attempt may be indicated for hard to classify secondary to severe displacement or a lot of comminution

Humeral Shaft Fractures

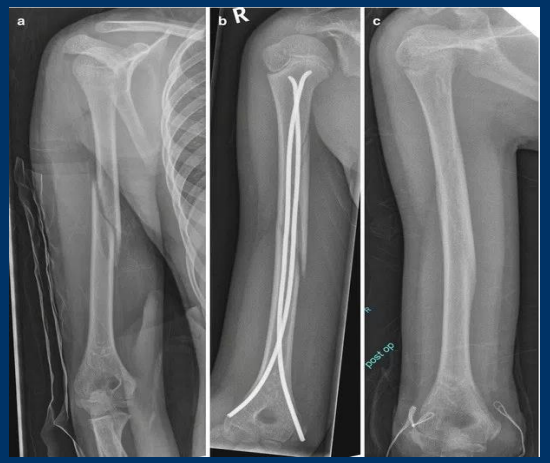
- Conservative Treatment
  - Goal of treatment is to establish union with acceptable alignment
  - >90% of humeral shaft fractures heal with nonsurgical management

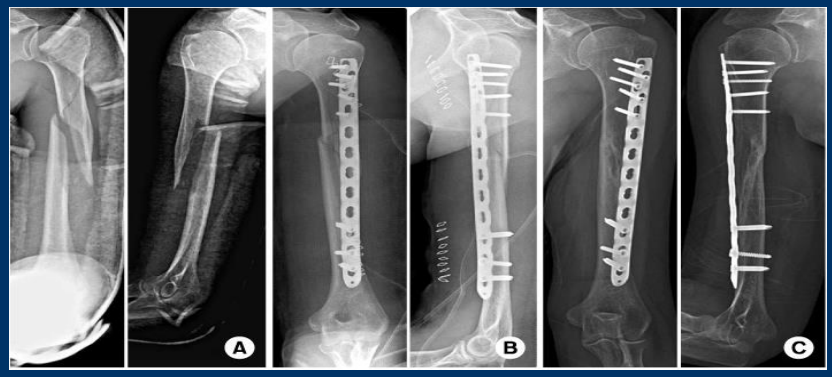


- 20 degrees of anterior angulation, 30 degrees of varus angulation and up to 3 cm of shortening are acceptable
- Most treatment begins with application of a coaptation splint or a hanging arm cast followed by placement of a fracture brace

Humeral Shaft Fractures

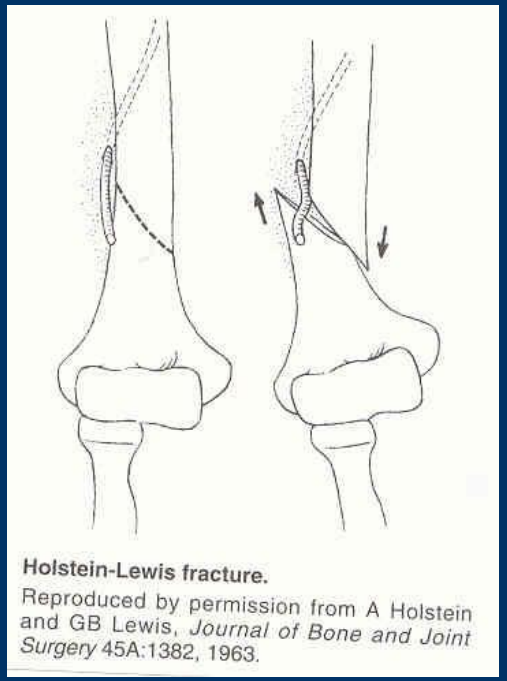
- Treatment
  - Operative Treatment
    - Indications for operative treatment include inadequate reduction, nonunion, associated injuries, open fractures, segmental fract., associated vascular or nerve injuries
    - Most commonly treated with plates and screws or IM nails





Humeral Shaft Fractures

- Holstein-Lewis Fractures
  - Distal 1/3 fractures
  - May entrap or lacerate radial nerve as the fracture passes through the intermuscular septum



Holstein-Lewis fracture.
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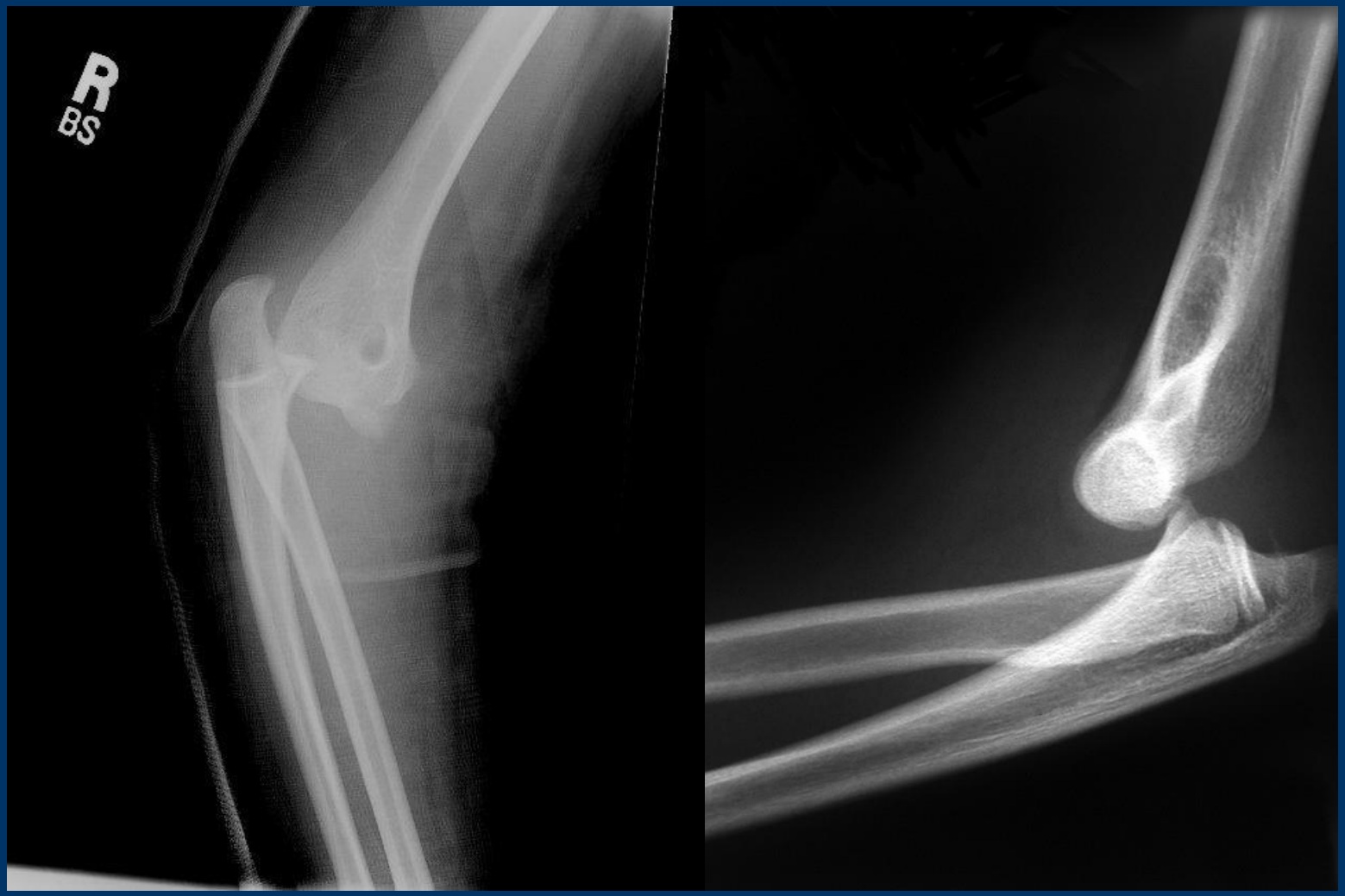
Elbow Fracture/Dislocations



Elbow Dislocations

- Epidemiology
  - Accounts for 11-28% of injuries to the elbow
  - Posterior dislocations most common
  - Highest incidence in the young 10-20 years and usually sports injuries
- Mechanism of injury
  - Most commonly due to fall on outstretched hand or elbow resulting in force to unlock the olecranon from the trochlea
  - Posterior dislocation following hyperextension, valgus stress, arm abduction and forearm supination
  - Anterior dislocation ensuing from direct force to the posterior forearm with elbow flexed

Elbow Dislocations

- Clinical Evaluation
  - Patients typically present guarding the injured extremity
  - Usually has gross deformity and swelling
  - Careful NV exam in important and should be done prior to radiographs or manipulation
  - Repeat after reduction
- Radiographic Evaluation
  - AP and lateral elbow films should be obtained both pre and post reduction
  - Careful examination for associated fractures

Elbow Fracture/Dislocations

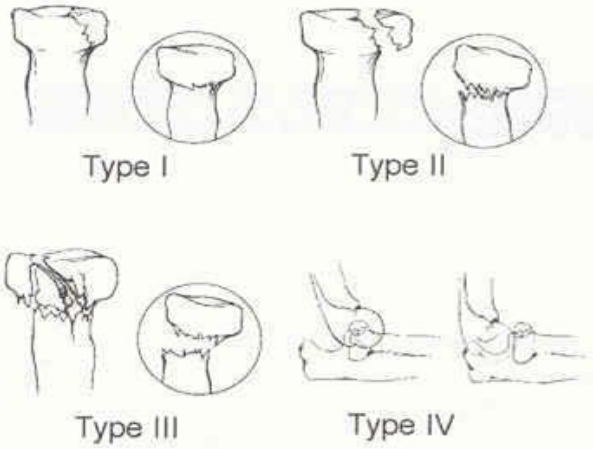
- Treatment
  - Posterior Dislocation
    - Closed reduction under sedation
    - Reduction should be performed with the elbow flexed while providing distal traction
    - Post reduction management includes a posterior splint with the elbow at 90 degrees
    - Open reduciton for severe soft tissue injuries or bony entrapment
  - Anterior Dislocation
    - Closed reduction under sedation
    - Distal traction to the flexed forearm followed by dorsally direct pressure on the volar forearm with anterior pressure on the humerus

Elbow Dislocations

- Associated injuries
  - Radial head fx (5-11%)
  - Treatment
    - Type I- Conservative
    - Type II/III- Attempt ORIF vs. radial head replacement
    - No role for solely excision of radial head.

Mason

Type I:	Undisplaced fractures
Type II:	Marginal fractures with displacement (impaction, depression, angulation)
Type III:	Comminuted fractures involving the entire head
Type IV:	Associated with dislocation of the elbow (added by Johnston)



Mason classification of radial head and neck fractures.

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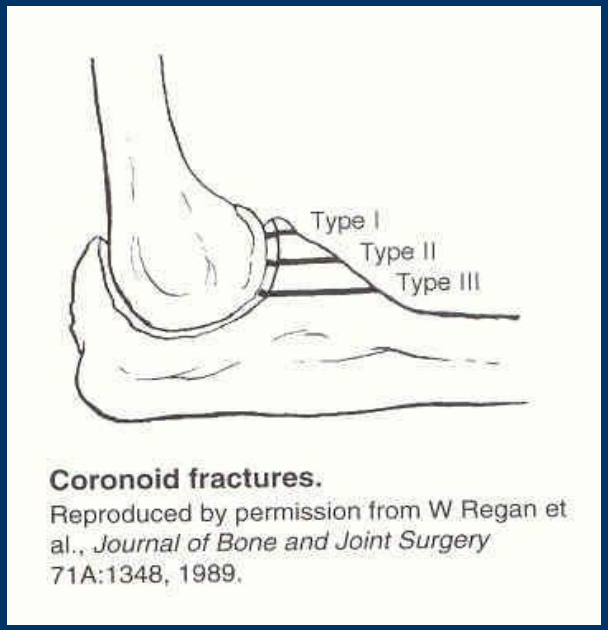
Elbow Dislocations

- Associated injuries
  - Coronoid process fractures (5-10%)



Coronoid fractures.
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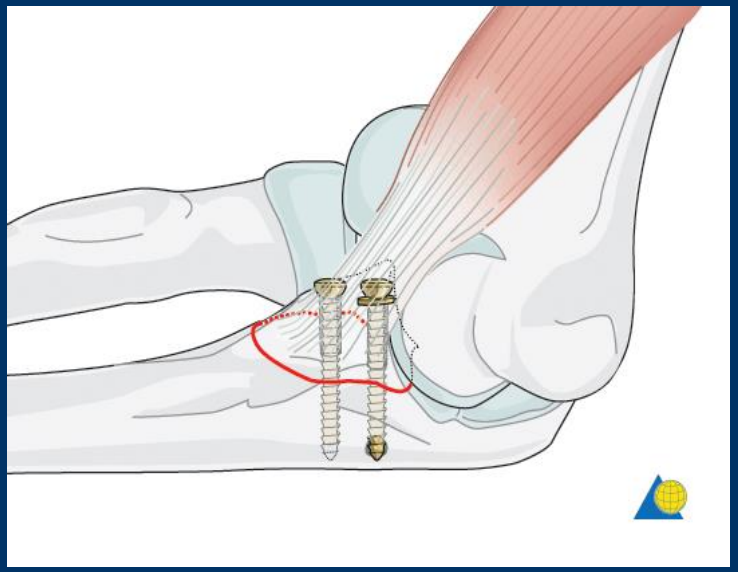
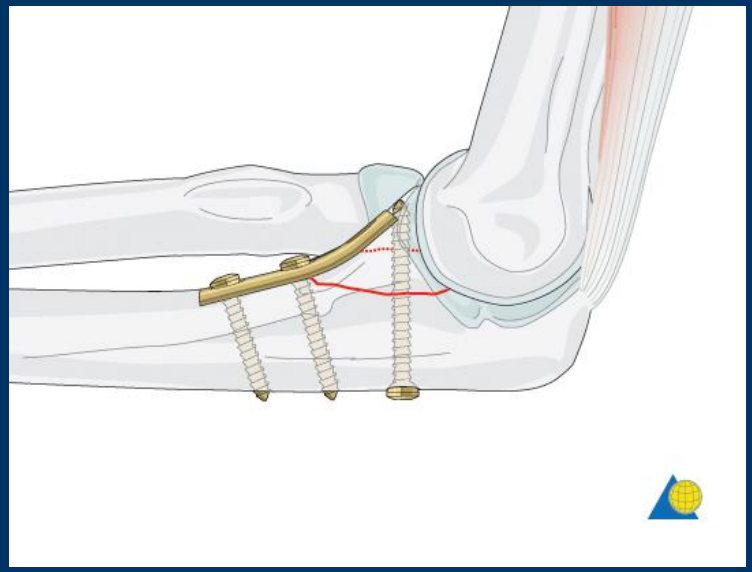
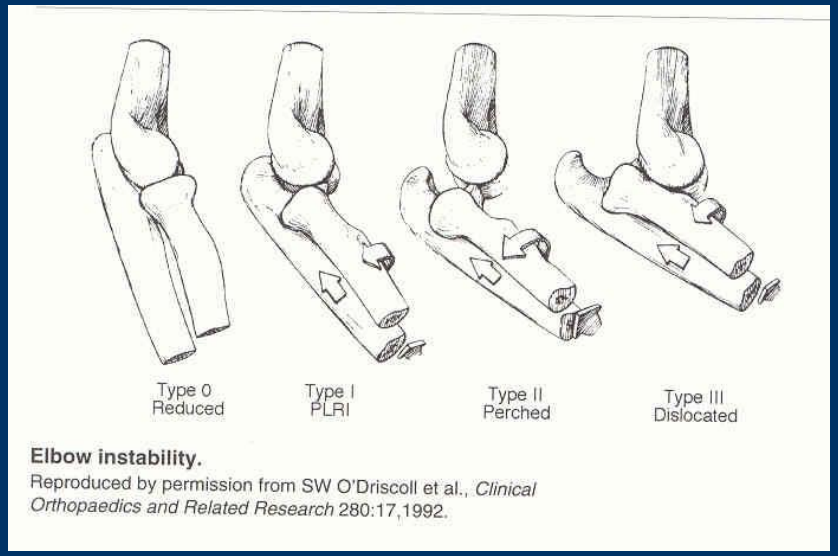




Elbow Dislocations

- Associated injuries
  - Medial or lateral epicondylar fx (12-34%)

Elbow Dislocations



Elbow instability.
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- Instability Scale
  - Type I
    - Posterolateral rotary instability, lateral ulnar collateral ligament disrupted
  - Type II
    - Perched condyles, varus instability, ant and post capsule disrupted
  - Type III
    - A: posterior dislocation with valgus instability, medial collateral ligament disruption
    - B: posterior dislocation, grossly unstable, lateral, medial, anterior, and posterior disruption

Olecranon fractures

Olecranon fractures

- Presentation
  - Symptoms
    - pain well localized to posterior elbow
  - Physical exam
    - palpable defect
  - indicates displaced fracture or severe comminution
    - inability to extend elbow
  - indicates discontinuity of triceps (extensor) mechanism

- Imaging
  - AP/lateral radiographs
    - true lateral essential for determination of fracture pattern

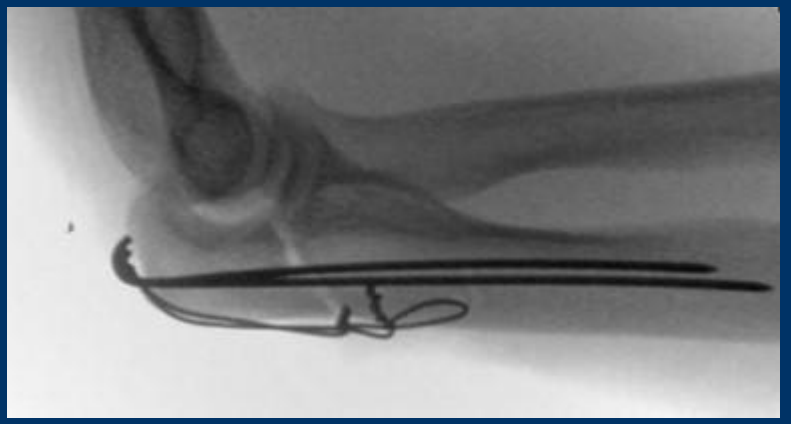
Olecranon fractures

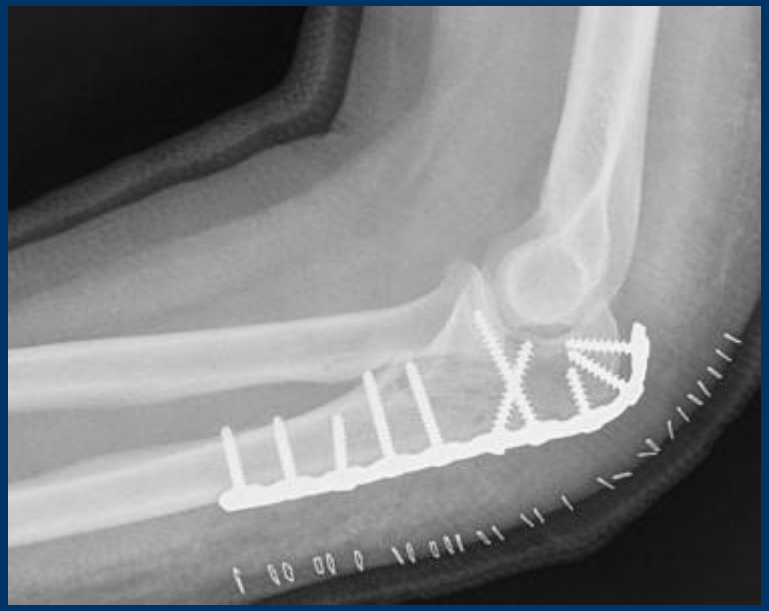
- Treatment
- **Nonoperative -** immobilization
  indications
- nondisplaced fractures
- displaced fracture in low demand, elderly individuals
- immobilization in 45-90 degrees of flexion initially
- begin motion at 1 week

- **Operative**
  -tension band technique
- indications: transverse fracture with no comminution
- outcomes: excellent results with appropriate indication
  - plate and screw fixation
  - excision and triceps advancement
  - intramedullary fixation

Olecranon fractures

- Treatment





Olecranon fractures

- Complications
  - Symptomatic hardware
    - most frequent reported complication
  - Stiffness
    - occurs in ~50% of patients
    - usually doesn't alter functional capabilities
  - Heterotopic ossification
    - more common with associated head injury
  - Posttraumatic arthritis
  - Nonunion
    - rare
  - Ulnar nerve symptoms
  - Anterior interosseous nerve injury
  - Loss of extension strength

Forearm Fractures

Forearm Fractures

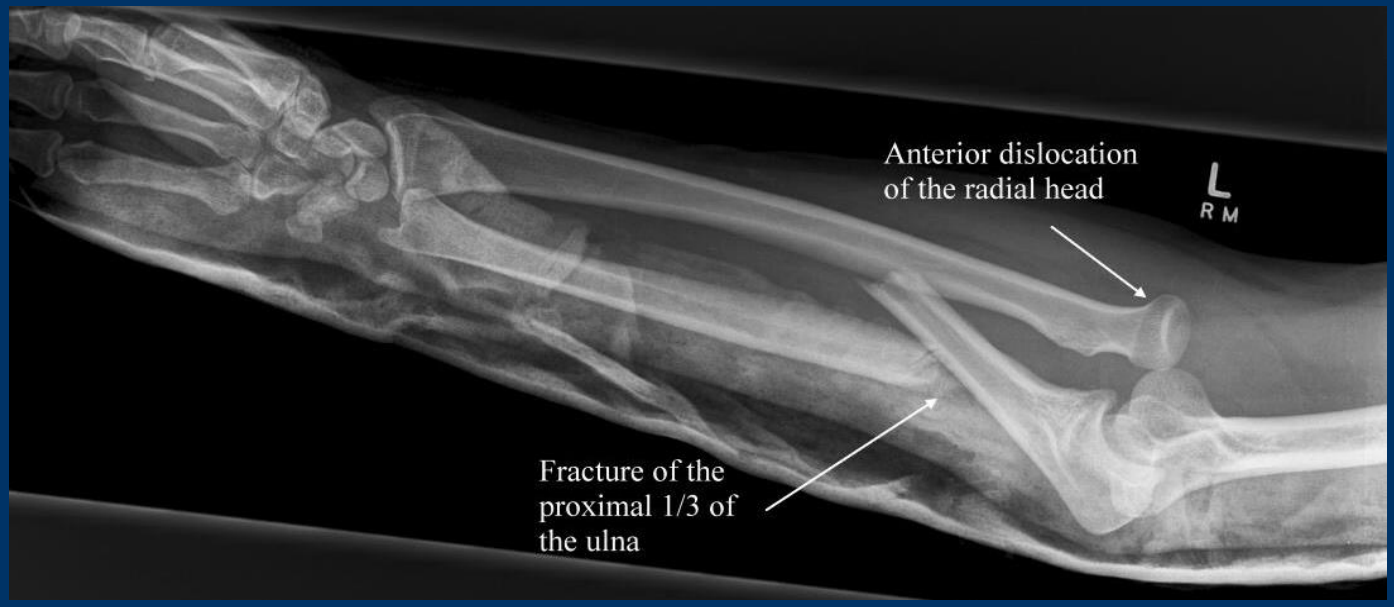
- Epidemiology
  - Highest ratio of open to closed than any other fracture except the tibia
  - More common in males than females, most likely secondary MVA, contact sports and falls
- Mechanism of Injury
  - Commonly associated with MVA, direct trauma and falls

Forearm Fractures

- Clinical Evaluation
  - Patients typically present with gross deformity of the forearm and with pain, swelling, and loss of function at the hand
  - Careful exam is essential, with specific assessment of radial, ulnar, and median nerves and radial and ulnar pulses
  - Tense compartments, unremitting pain, and pain with passive motion should raise suspicion for compartment syndrome
- Radiographic Evaluation
  - AP and lateral radiographs of the forearm
  - Don’t forget to examine and x-ray the elbow and wrist

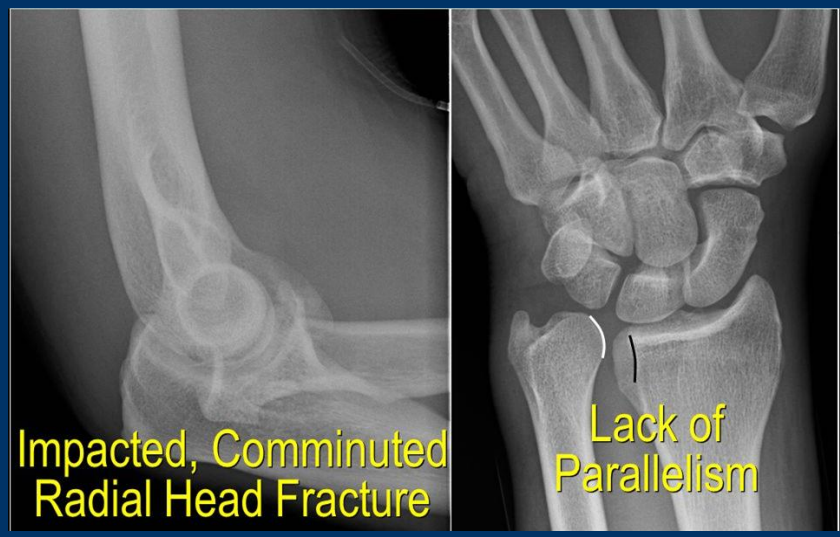
Forearm Fractures

- Ulna Fractures
  - These include nightstick and Monteggia fractures
  - Monteggia denotes a fracture of the proximal ulna with an associated radial head dislocation
    - Monteggia fractures classification- Bado



Forearm Fractures

- Radial Diaphysis Fractures
  - Galeazzi or Piedmont fractures refer to fracture of the radius with disruption of the distal radial ulnar joint
  - A reverse Galeazzi denotes a fracture of the distal ulna with disruption of radioulnar joint
  - Essex-Lopresti



Distal Radius Fractures

Distal Radius Fractures

- Introduction
  - Most common orthopaedic injury with a bimodal distribution
- younger patients - high energy
- older patients - low energy / falls
  - 50% intra-articular
  - Associated injuries
- DRUJ injuries must be evaluated
- radial styloid fx - indication of higher energy
- soft tissue injuries in 70%
  - TFCC injury 40%
  - scapholunate ligament injury 30%
  - lunotriquetral ligament injury 15%

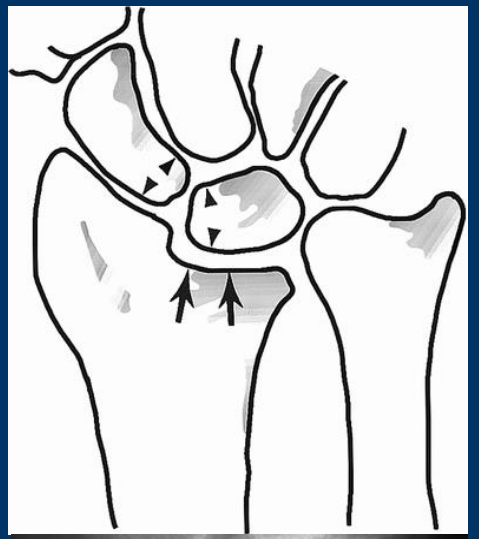
Distal Radius Fractures

- Osteoporosis
  - high incidence of distal radius fractures in women >50
  - distal radius fractures are a predictor of subsequent fractures
  - DEXA scan is recommended in woman with a distal radius fracture

Distal Radius Fractures

Eponyms

- Die-punch



- Barton's fx

- Chauffeur's fx

- Colles' fx

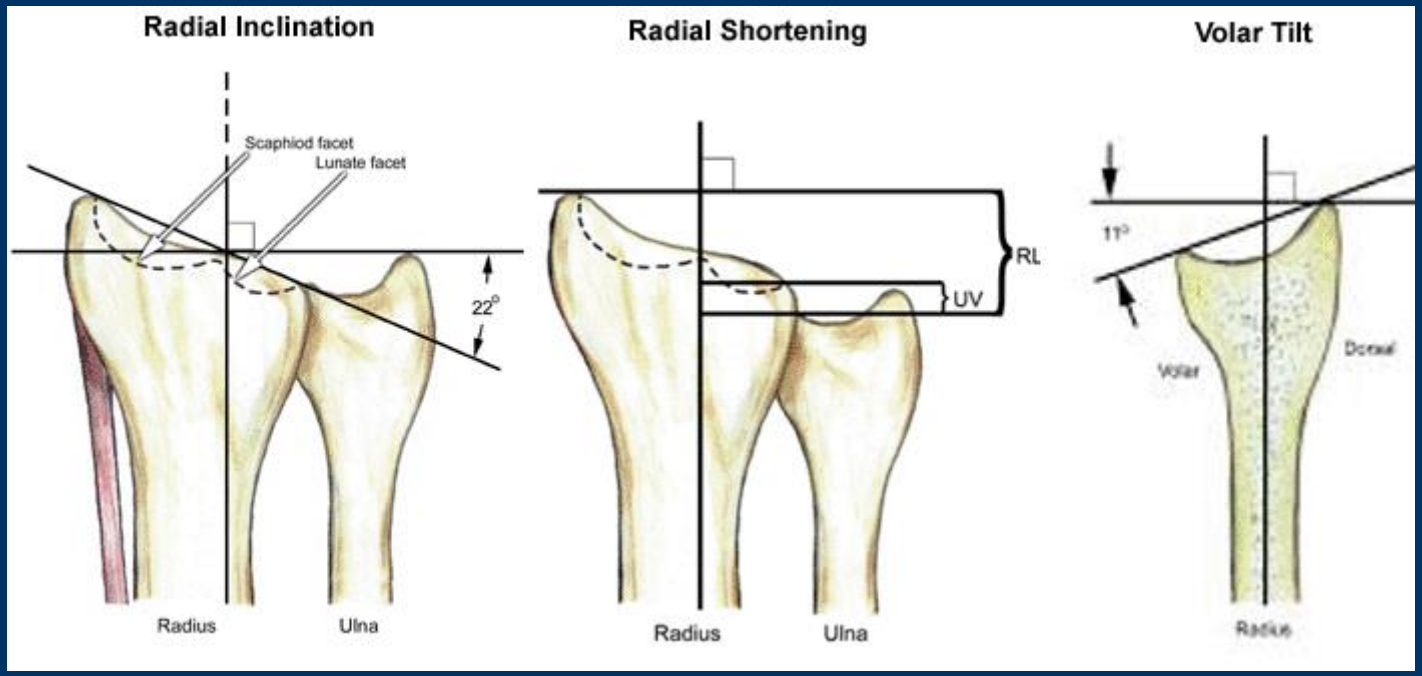
- Smith's fx

Distal Radius Fractures

- Eponyms
  - Colles Fracture
    - Combination of intra and extra articular fractures of the distal radius with dorsal angulation (apex volar), dorsal displacement, radial shift, and radial shortenting
    - Most common distal radius fracture caused by fall on outstretched hand
  - Smith Fracture (Reverse Colles)
    - Fracture with volar angulation (apex dorsal) from a fall on a flexed wrist
  - Barton Fracture
    - Fracture with dorsal or volar rim displaced with the hand and carpus
  - Radial Styloid Fracture (Chauffeur Fracture)
    - Avulsion fracture with extrinsic ligaments attached to the fragment
    - Mechanism of injury is compression of the scaphoid against the styloid

Radiographic Evaluation

- 3 view of the wrist including AP, Lat, and Oblique



Distal Radius Fractures

- Treatment

– Displaced fractures require and attempt at reduction.

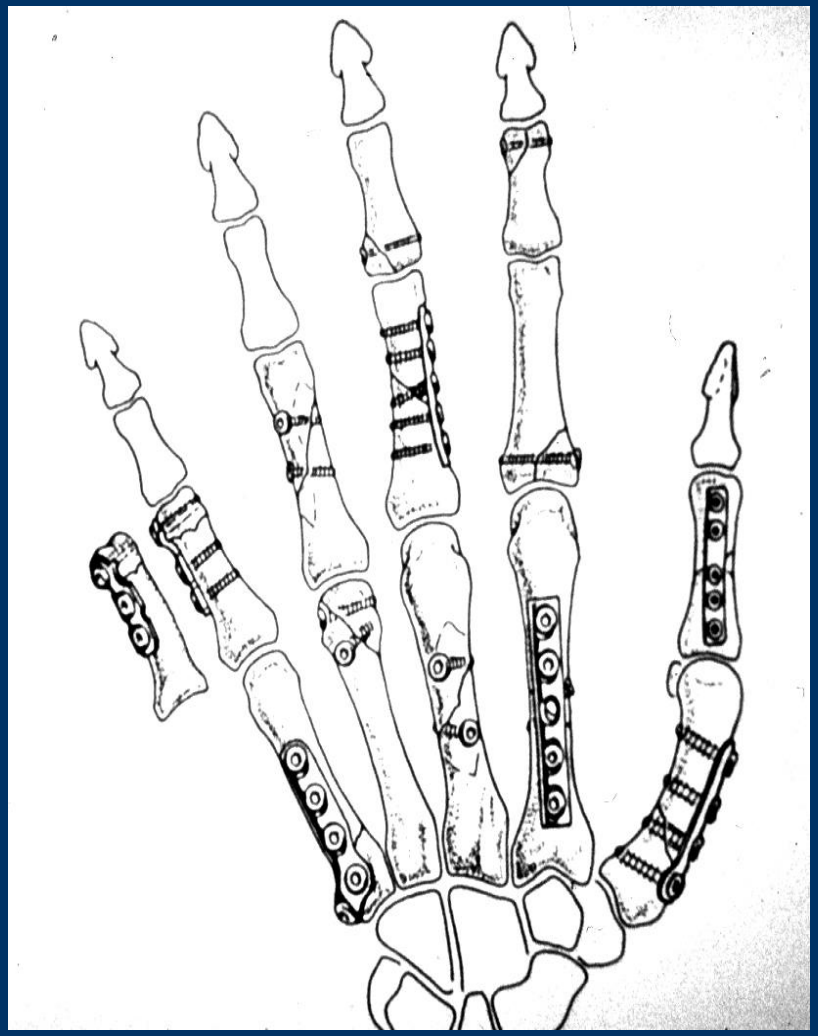
- Hematoma block-10ccs of Mesocaine
- Hang the wrist in fingertraps with a traction weight
- Reproduce the fracture mechanism and reduce the fracture
- Place in a splint

– Operative Management

- For the treatment of intraarticular, unstable, malreduced fractures.
- As always, open fractures are emmergency indication for the operation

FIGURE 2. A type C1 fracture of the distal radius. Postero-anterior and lateral radiographs of the fracture (patient V.H.) A) after injury; B) at 3 months after Aptus radius locking plate fixation.

Hand

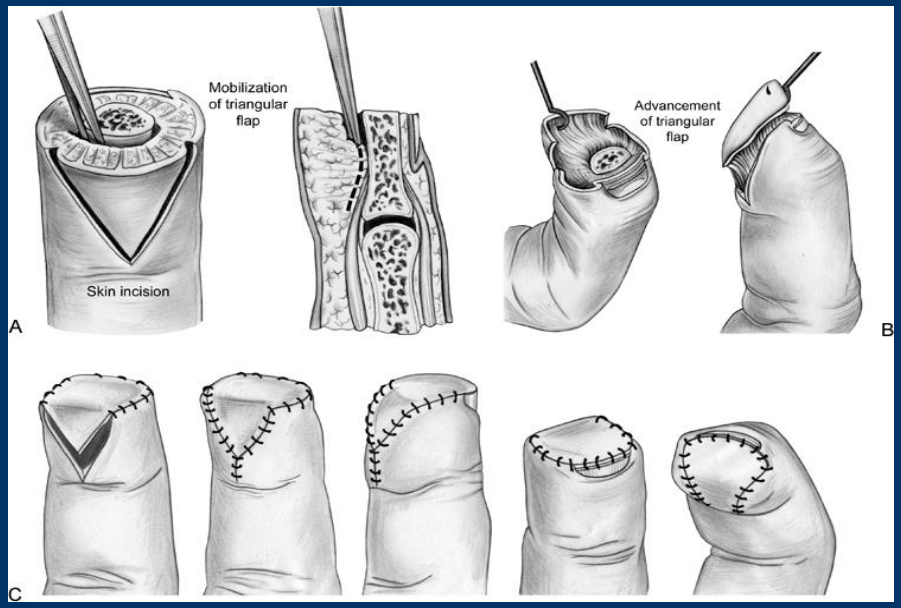


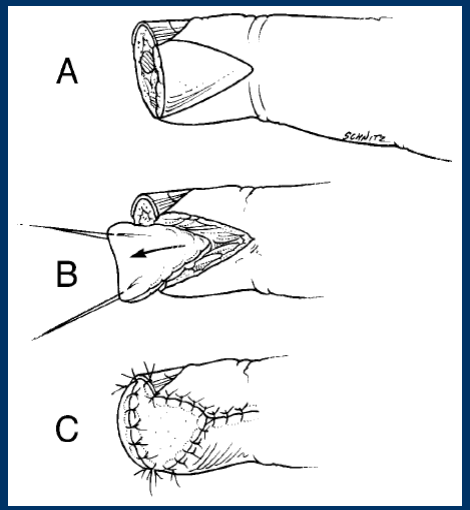
Hand

- Introduction
  - The hand is a very vital part of the human body
  - 4 requirements for a functioning hand:
    - Supple, Sensate, Painfree, Coordinate
  - Account for 5-10 % of hospital ER visits.
  - Great potential for serious handicap

Hand

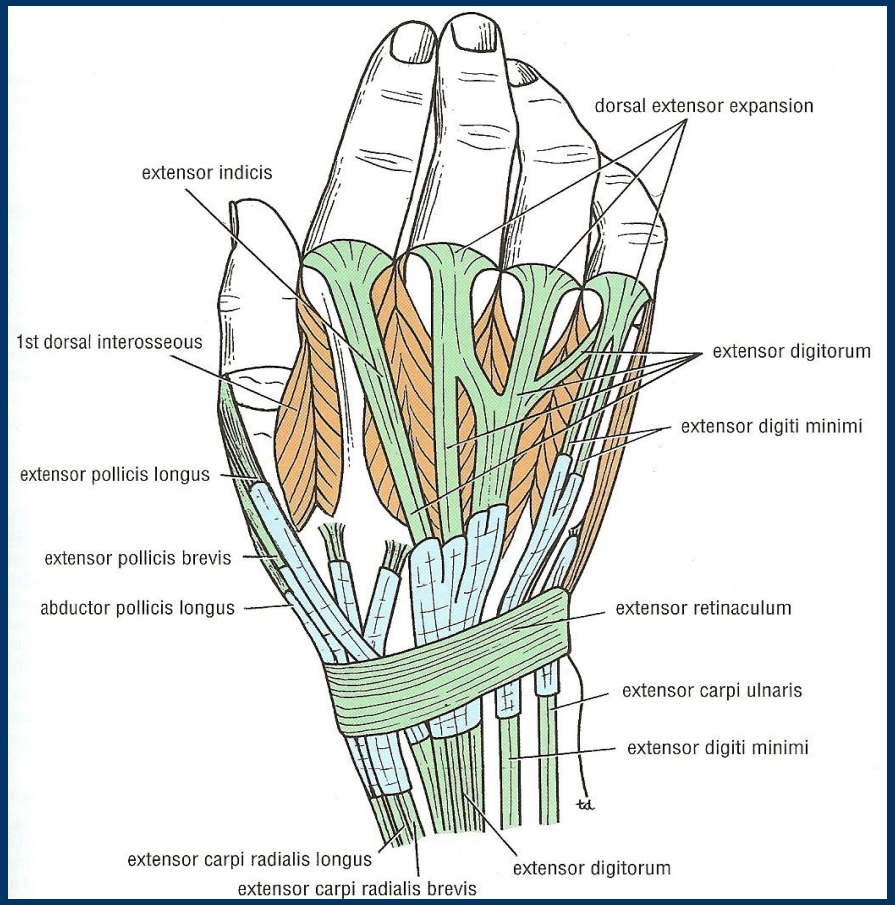
- Soft tissues
  - Wounds **older than 6-8** hours or **primarily infected** (bites) **should not** be closed primarily because of an increased likelihood of infections.
  - If skin cover insuficient – egalization or flap

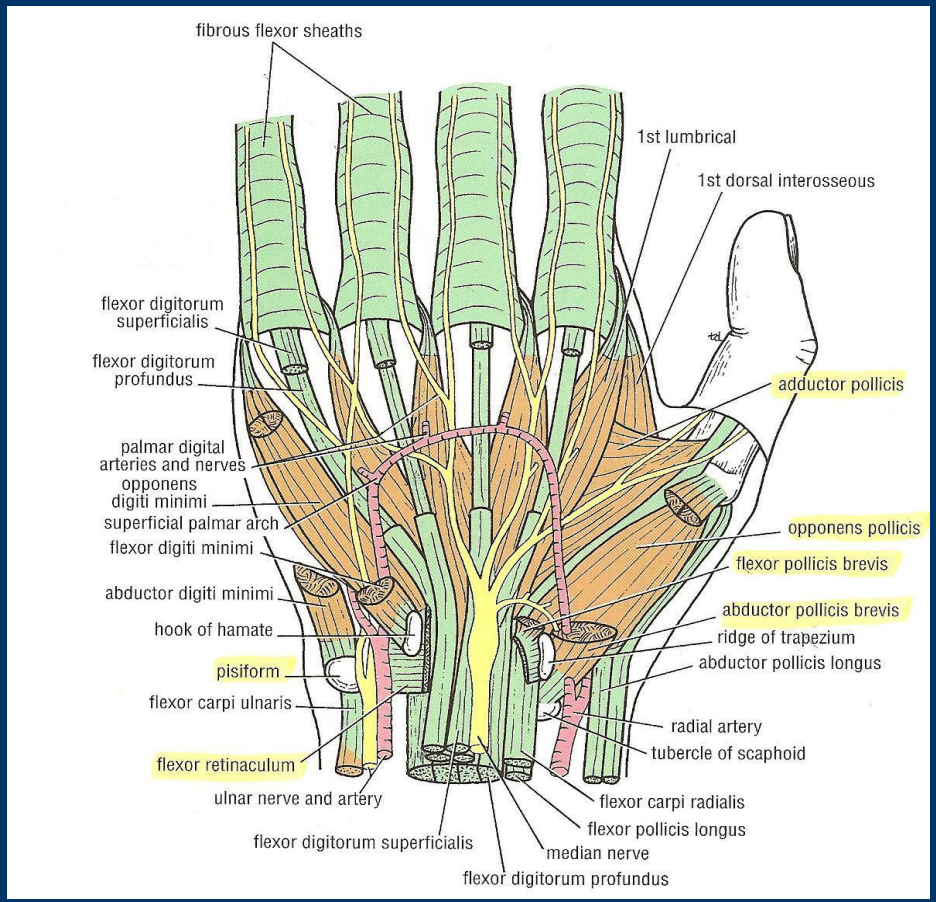




Hand

- Tendons





Hand

- Tendons

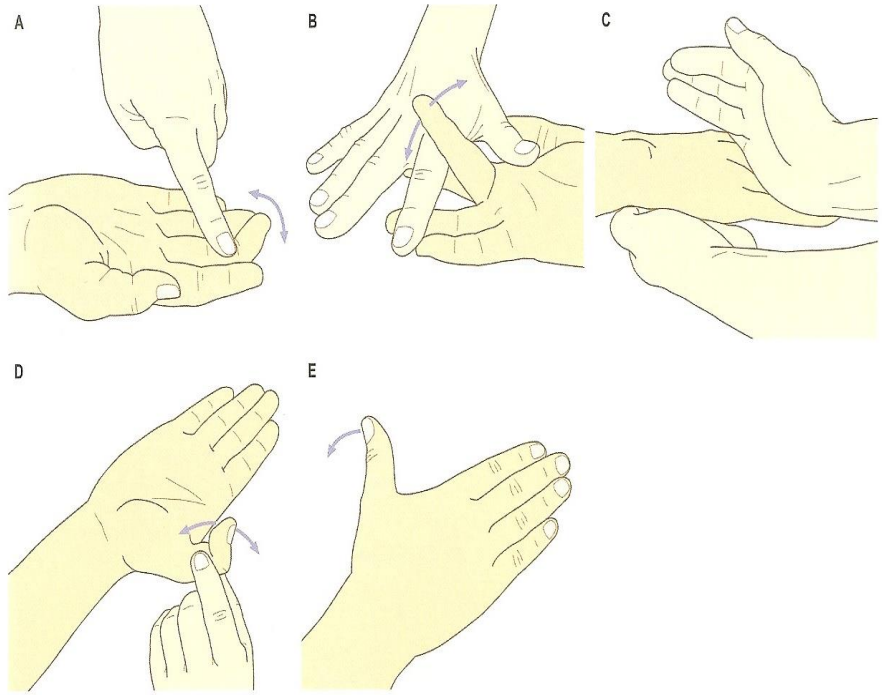
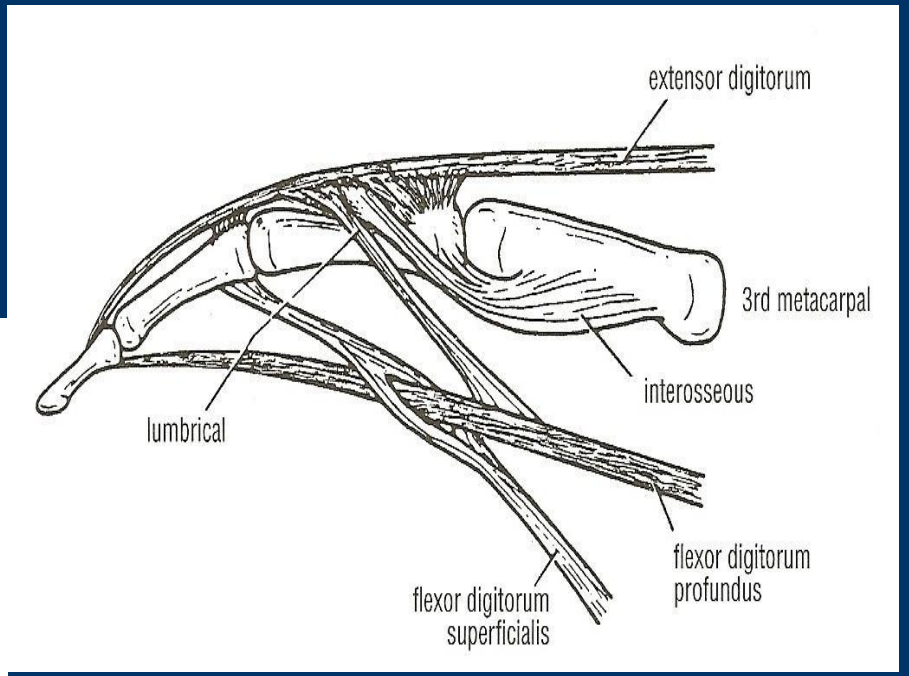


Fig. 10.39 Testing the flexors and extensors of the fingers and thumb. (A) Flexor digitorum profundus. (B) Flexor digitorum superficialis. (C) Extensor digitorum. (D) Flexor pollicis longus. (E) Extensor pollicis longus.



Tendon injury occording to zones

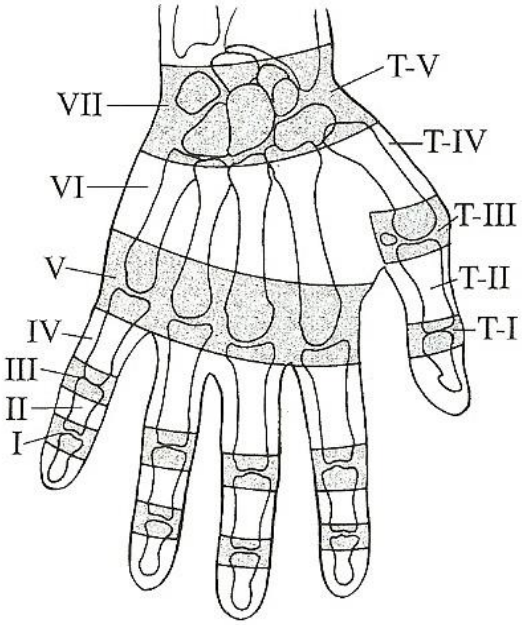
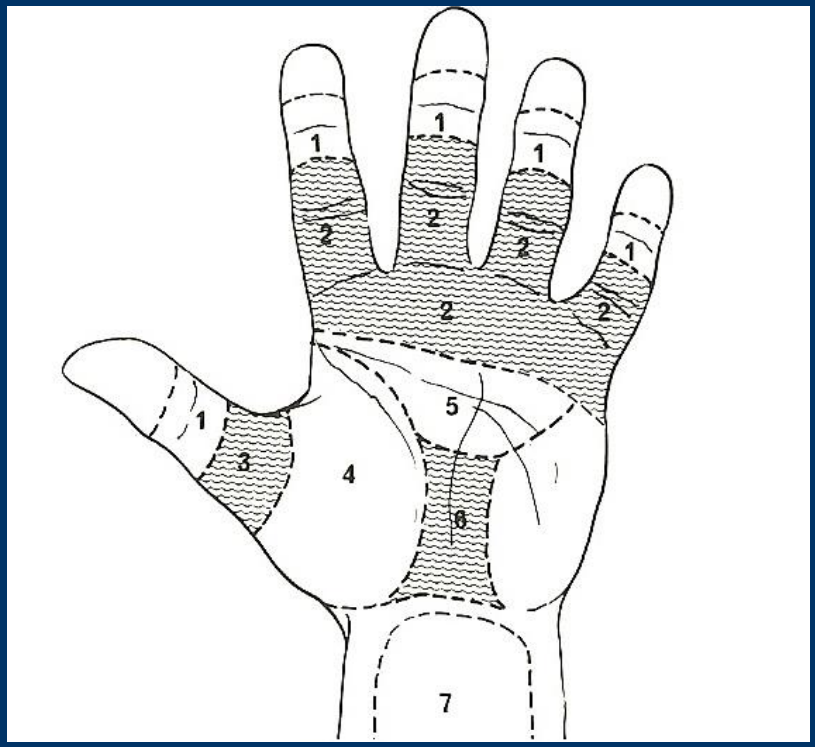


FIGURE 45-3. Zones of extensor tendon injury.



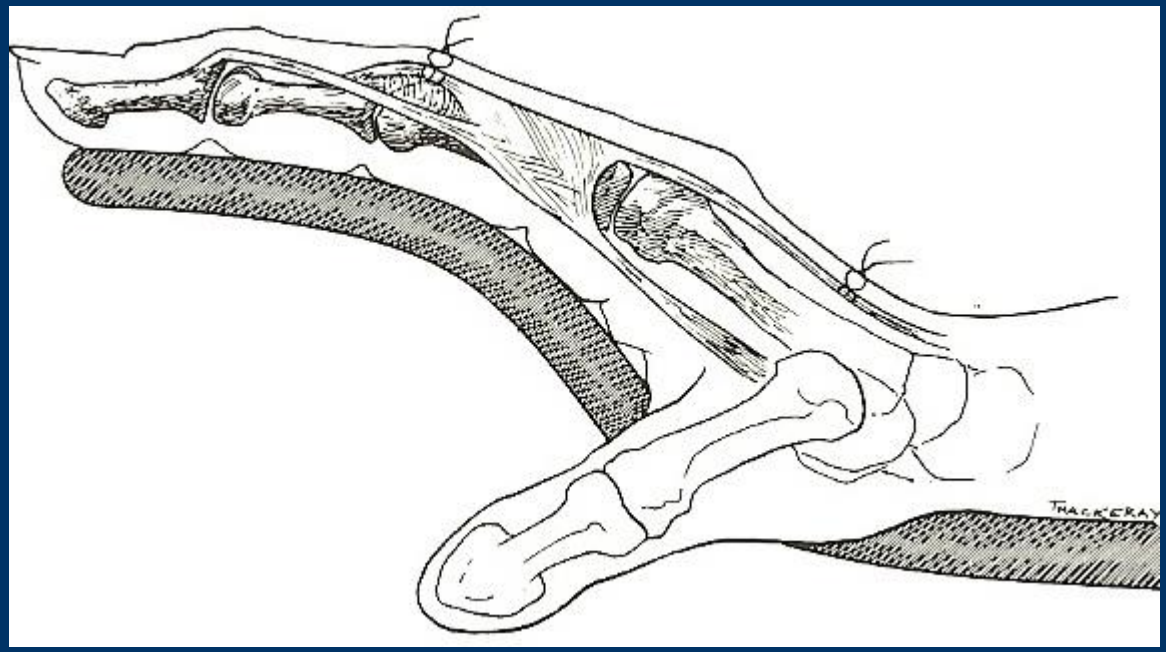

Mallet finger
Zone 1

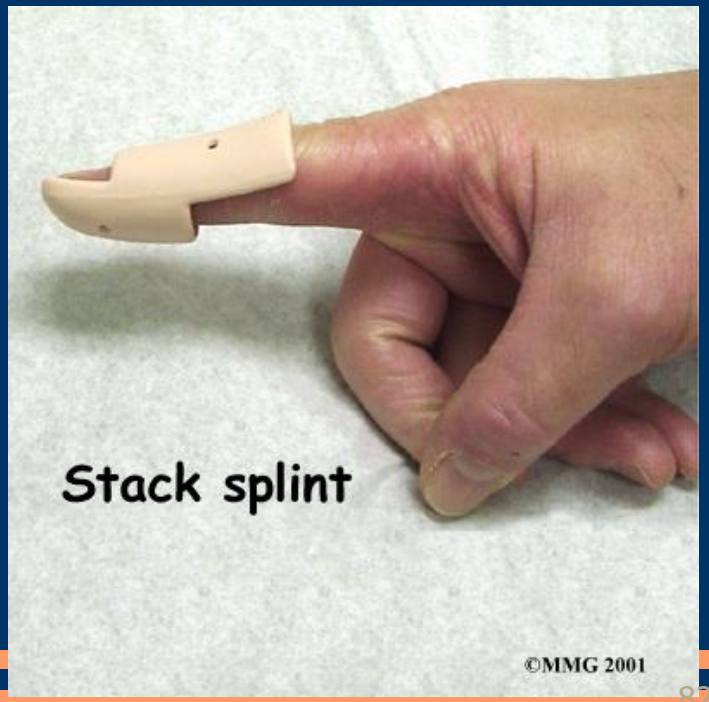

Zone 5


Boutonniere's
Deformity
Zone 3

MANAGEMENT

Zone	Presentation	Management
I	Mallet's Deformity	•Closed: splinting 6-8 weeks •Open: suture repair for fixation. •Soft tissue reconstruction
III	Boutonniere's Deformity	•Closed: splinting MCP and PIP in hyperextension for 6 weeks •Open: suture repair (figure of 8 suture)
V	Fixed flexion of MCP	•Closed: splinting ,45 extension at wrist and 20 flexion at MCP •Open: suture repair.




Stack splint
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CARPAL FRACTURES

Scaphoid fractures:

- Most common carpal fracture (15% of wrst inj)
- Results from force applied on distal end with wrist hyper extended (fall on outstretched hand).
- Unless treated effectively it would result in mal-union and permanent weakness and pain in the wrist.
- Blood supply retrograde so proximal fragment at risk of AVN
- Deep tenderness in ***anatomical snuffbox*** is felt.
- **Treatment:**
  - **Stable:** Cast for 12 weeks
  - **Unstable or non-union**: ORIF


Thumb Spica Cast
FPnotebook.com

CARPAL FRACTURES

Triquetral fracture:

- 2nd most common carpal fracture
- Direct blow to the dorsum of the hand or extreme dorsiflexion.
- Palpation of the triquetrum is facilitated by radial deviation of the hand.
- Point directly over the triquetrum.

Metacarpal Fractures

- Relatively common. 30-40% of hand fractures
- Result from direct or indirect trauma.
- Direct trauma commonly results in transverse fracture, usually midshaft.
- Most fractures are easily reducible, stable and managed non-operatively.
- Indications of surgical intervention:
  - Intra-articular fractures,
  - Displaced and angulated fractures,
  - Unstable fracture patterns,
  - Combined or open injuries,
  - Irreducible and unstable dislocations

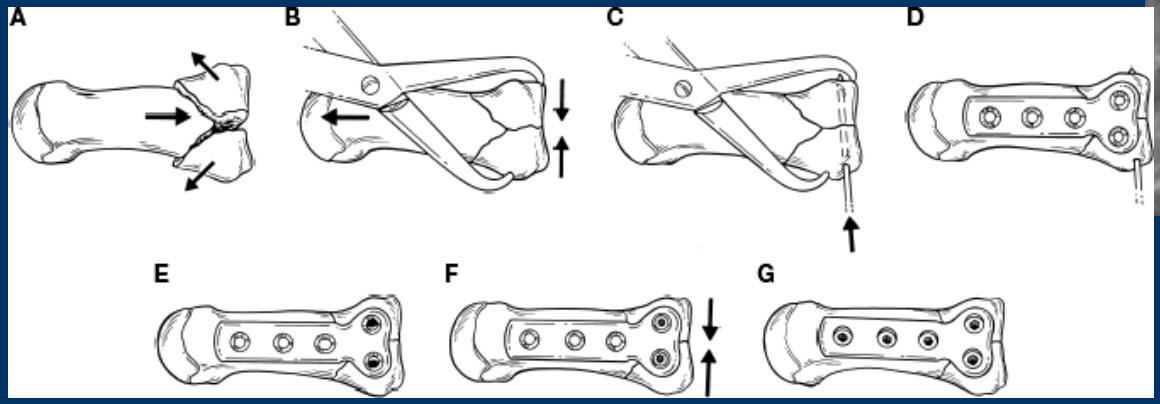
Thumb Fractures

- Bennett's fracture:
  - Fracture at the base of the1st Metacarpal.
  - Intra-articular fracture subluxation
  - Swelling and pain at the thumb base
  - Closed reduction and immobilization with thumb spica splint
  - ORIF

- Rolando's fracture:
  - Comminuted (displaced) thumb base fracture.
  - Improper healing restriction of motion around CMJ
  - Swollen, tender thumb base. If significant varus has developed, a clinically visible deformity may be present.
  - ORIF

Bennett’s

Rolando’s


A
B
C
D
E
F
G

Phalangeal Fractures

Distal Phalanx:

- Extra-articular fractures are common, associated with significant soft tissue injury.
- Crush injuries from a perpendicular force (injuries from a car door or hammer)
- Intra-articular fractures are associated with extensor tendon avulsion (Mallet's finger), FDP tendon avulsion (Jersey finger).
- Examination:
  - Inspection:.
  - Neurovascular status should be examined.
  - Palpation is done for tenderness.
- Closed treatment is recommended with splinting and if necessary closed reduction

Phalangeal Fractures

Middle Phalanx:

- Blunt or crush force perpendicular to the long axis of the bone.
- Angulation and rotation are two features of instability that must be examined.
- Rotational deformities are serious injuries and are detected clinically.
- Examination:
  - Inspection: for dislocations and sublaxations. Ask patient to fully flex the phalanx to examine alignment of digits.
  - Palpation: swelling and tenderness
- Treatment:
  - Nondisplaced without impaction: require only dynamic splinting for 2-3 weeks.

Phalangeal Fractures

- Proximal Phalanx:

–More common than middle phalanx fractures.

–May result in a great deal of disability.

–Dorsal or palmar angulation may occur with these fractures.

–Examination:

- Inspection:
- Neurovascular status
- Palpation is done for tenderness.

–Treatment:

- Nondisplaced fractures: usually stable and treated by closed reduction and dynamic splinting.
- Angulated or unstable fractures may require internal or external fixation.

K-Wire Fixation

Plates for ORIF


ÚRAZOVÁ
NEMOCNICE