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Common adult fractures

Objectives:

- CLAVICLE FRACTURE
- Humerus (proximal and distal)
- Both bone and foramen fractures
- Distal radius fracture
- Hip fracture
- Femur shaft fracture
- Tibial shaft fracture
- Ankle fracture

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Before you study this lecture we suggest to read how to manage open fracture

How to do physical examination for any fracture?

1st step: Expose the area and check for any deformity or skin changes

2nd step: N/V examination: ask the patient to move distal parts from fracture and check sensation then check temperature, color, pulses and capillary refill distally to fracture

3rd step: Examine the joint above and joint below

4th step: Check for other complications

In fractures, we don't examine range of motions passively because of pain.

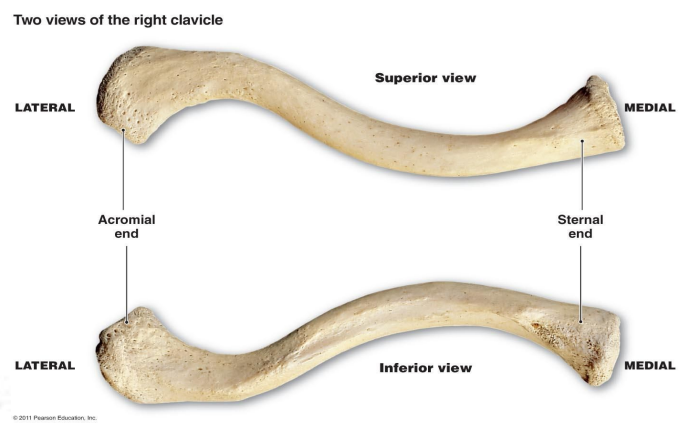
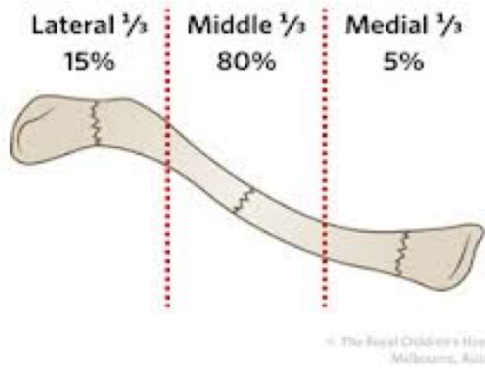
Mind map



Clavicular fracture

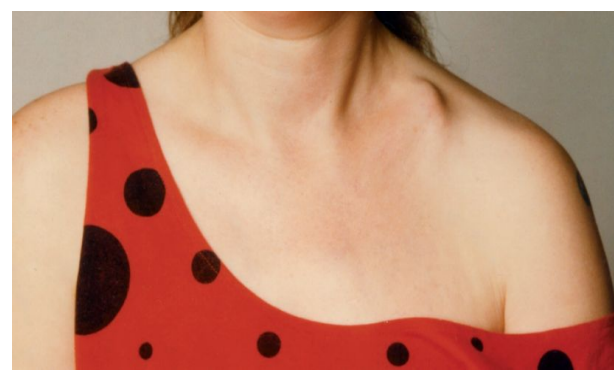
- **Normal Anatomy and Facts:**

- Clavicle is S shaped bone.
- It is anchored to scapula via ACJ (acromioclavicular joint).
- It is anchored to trunk via SCJ (sternoclavicular joint).
- Most of fracture occurs as result from **Fall on Outstretched Hand (FOOSH), fall on shoulder.**
- Fractures are classified into: proximal, middle and lateral third fractures.
- Most of fractures are of **middle third**. The medial half is pulled by SCM¹, while lateral half gets pulled down by gravity and limb weight.
- Majority of brachial plexus injuries are associated with proximal third fracture. pneumothorax, damage to the subclavian vessels and brachial plexus injuries are all very rare.



- **Physical examination:**

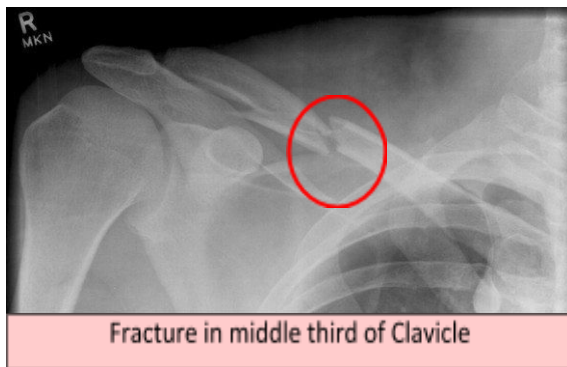
- **1st Step:** Expose the area and check the skin.
- **Tenting of skin:** A very common finding due to sharp spike of bone. it's called 'impending open fracture' because if left untreated, bone may break through skin.
- **2nd Step:** Check **brachial plexus** and **subclavian artery/vein**. because these structures are at risk in this type of fracture.
- Rarely, pneumothorax occurs.



¹ Sternocleidomastoid muscle.

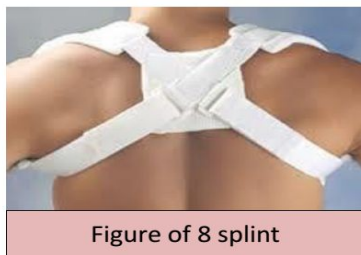
- **Investigation:**

X-ray: AP view and Clavicle special view (30° cephalic tilt).



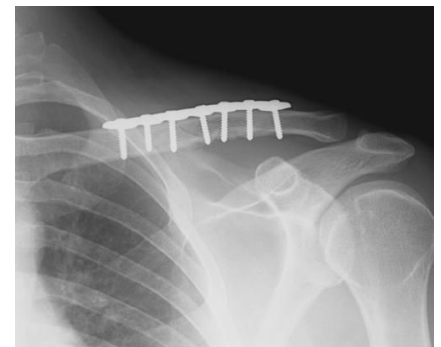
- **Treatment:**

- **Usually conservatively** with a sling or by figure of eight splint.²



- **Few fractures should be treated surgically** with open reduction and internal fixation, as if:

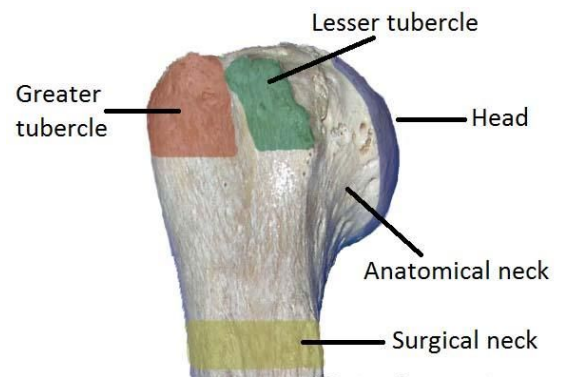
- Skin tenting
- Severe displacement (**100% displaced or > 2cm overlap**)
- Flail joint. (**Minimum you have to fix one side**).
- Profession of the patient. (**e.g.; baseball player**)
- **Why don't we do closed reduction instead of open reduction? because patient can't immobilize it.**



² no evidence that the traditional figure-of-eight bandage confers any advantage and it carries the risk of increasing the incidence of pressures sores over the fracture site and causing harm to neurological structures; it may even increase the risk of non-union.

Humerus fractures

Proximal humerus fracture



• Normal Anatomy and Facts:

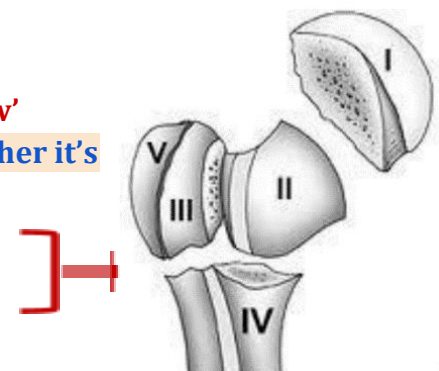
- It has four anatomic parts:
 - a. Head
 - b. Greater tuberosity
 - c. Lesser tuberosity
 - d. Shaft.
- Fractures occur in **Surgical neck** are more common and have better outcomes, while fractures in **anatomical neck** are generally rare and carries bad outcomes due to blood supply injury and its association with avascular necrosis (AVN).
- In younger patients: **violent trauma** (high energy “car accident”).
- In older patients: **minor trauma**. (Osteoporosis)
- Most fractures are minimally displaced.

• Physical examination:

- **1st Step:** Expose the shoulder very well and look for fracture signs (**ecchymosis, swelling, deformity...**) and Check the skin.
- **2nd Step:** Check for **Axillary nerve** (deltoid atrophy and upper lateral side of arm).
- **3rd Step:** Ask the patient to move his **head and elbow**

• Investigations:

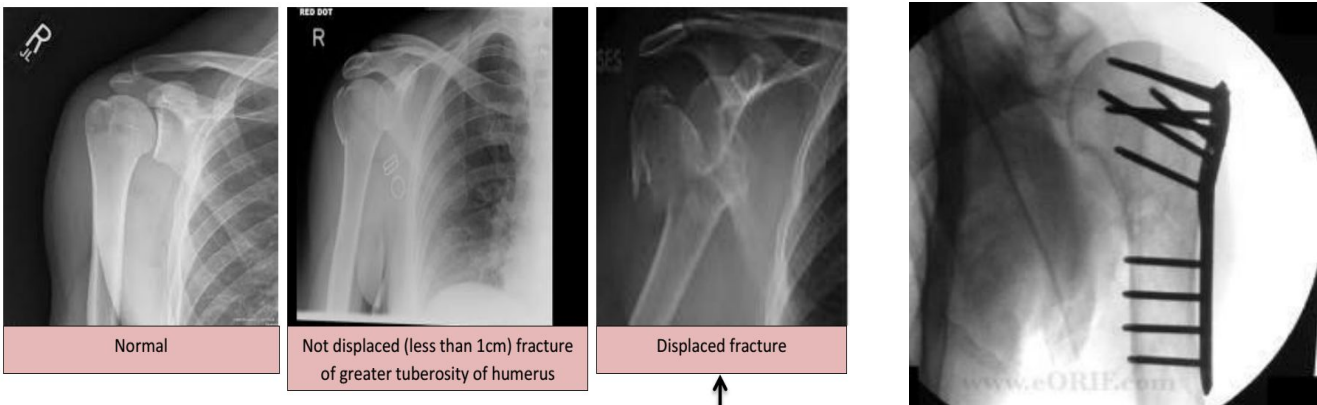
- **X-ray:** AP, lateral and a **special view ‘axillary view’** (**it shows the glenohumeral joint and tells whether it’s dislocated or not**).
 - Fracture is defined by **fragment displaced**.
 - Displacement: **more than 1 cm**.
- **CT scan:** for displaced fractures **if X-ray isn’t clear**.



Axillary view, to see if there is any dislocation

○ Treatment:

- **Vast majority of patients are treated non-operatively.**
- **If fracture is not displaced**(impacted), **Treat it Conservatively:**
 - Treatment with **sling** and **Non-weight bearing "NWB"** for 6-8 weeks.
 - Early ROM exercises after 2-4 weeks. **(To avoid stiffness)**
 - Normal function can be resumed after 3-4 months.
- **If the fracture is displaced, Treat it Surgically:**
 - ORIF (plate and screws): **If the patients is young OR old patient without anatomical neck fracture.**
 - Shoulder hemiarthroplasty: **If the patient is old with anatomical neck fracture complicated with AVN or damaged head of humerus.**



Humerus shaft fracture

● Normal Anatomy and Facts:

- It can be classified based on location of fracture:
 - Proximal, middle and distal.

● Physical Examination:

- **1st Step:** Expose the area very well and look for fracture signs Check the skin.
- **2nd Step:** Watch for **radial nerve** palsy (**wrist drop**) and vascular examination
- **3rd Step:** Ask the patient to move his **shoulder and elbow**
- **4th Step:** Check for Compartment syndrome (**Patient will complain from continuous aggravating pain even without movement and woody skin**)

● Investigations:

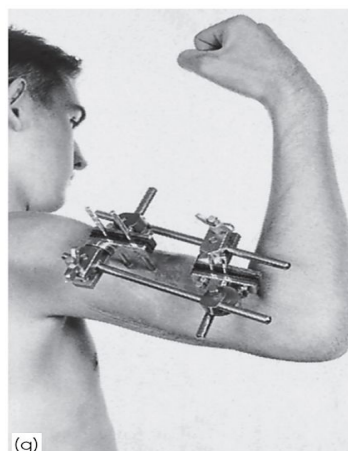
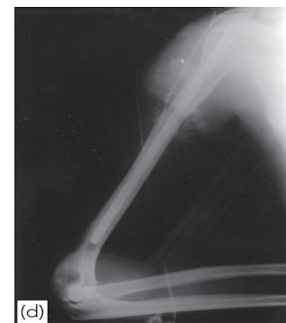
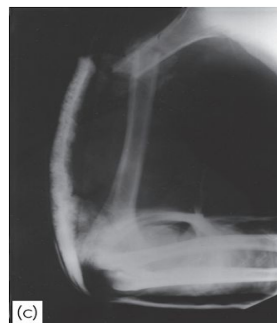
- **X-ray:** AP and lateral views

Spiral fracture in middle third of the humerus.



● **Treatment:**

- **Usually conservatively** in almost all humerus shaft fracture:
 - Close reduction by **Functional Brace** for 4-6 weeks + NWB
 - Early ROM of elbow and shoulder.
 - if there is an open fracture w/ nerve injury we repair the nerve in the surgery.
 - if it is a closed fracture w/ nerve injury: we wait and follow the patient up with the nerve conduction study looking for the nerve spontaneous
- **Surgically by ORIF (plate and screws) if:**
 - Segmental fracture
 - Open fracture
 - Obese patient. because you can't fit the brace.
 - Bilateral fracture (both humerus). because the patient can't function with braces on both arms.
 - Floating elbow (forearm and humerus)



26.13 Fractured shaft of humerus


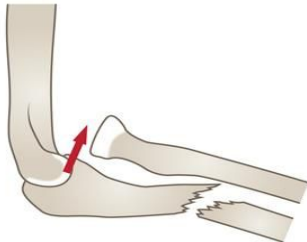
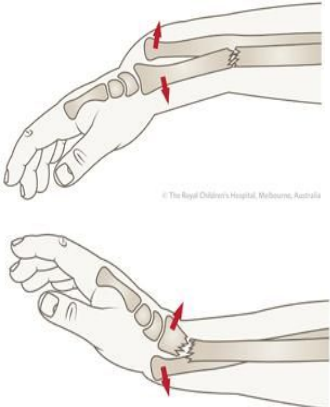
(a) Bruising is always extensive. Closed transverse fractures with moderate displacement can often be treated by using a sling or a plaster U-slab hanging cast (or ready-made brace). These methods demand careful supervision if excessive angulation and malunion are to be prevented. Beware the upper third fracture (b) which tends to angulate at the proximal border of the splint (c). This particular fracture would have been better managed by (d) intramedullary nailing (and better still with a locking nail). Other methods of fixation – especially for lower-third fractures (e) or open fractures – are compression plating (f) or external fixation (g).

Both bone forearm fractures

- **Normal Anatomy and Facts:**

- Forearm is complex with two mobile parallel bones.
- Radius and ulna articulate proximally and distally.
- Fractures are often from **fall or direct blow**.

It's very unlikely to fracture only one bone without disruption of their articulation

fracture Both bone	Monteggia fracture	Galeazzi fracture
<p>radius and ulna are broken.</p> 	<p>Proximal or middle third ulna shaft fracture with dislocation of radius proximally (at elbow). if the fractured third of ulna is angulated anteriorly, the radius will dislocate anteriorly and so on.</p>  <p style="font-size: small; text-align: center;">© The Royal Children's Hospital, Melbourne, Australia</p>	<p>Means distal third shaft radius fracture with disruption of DRUJ (distal radio-ulnar joint).</p>  <p style="font-size: small; text-align: center;">© The Royal Children's Hospital, Melbourne, Australia</p>

- **Physical Examination:**

- **1st Step:** Expose the area, look for fracture signs and check the skin
- **2nd Step:** examine **median, ulnar and radial nerve** and vascular examination
- **3rd Step:** Ask the patient to move his **wrist and elbow**
- **4th Step:** Check for Compartment syndrome

- **Investigations:**

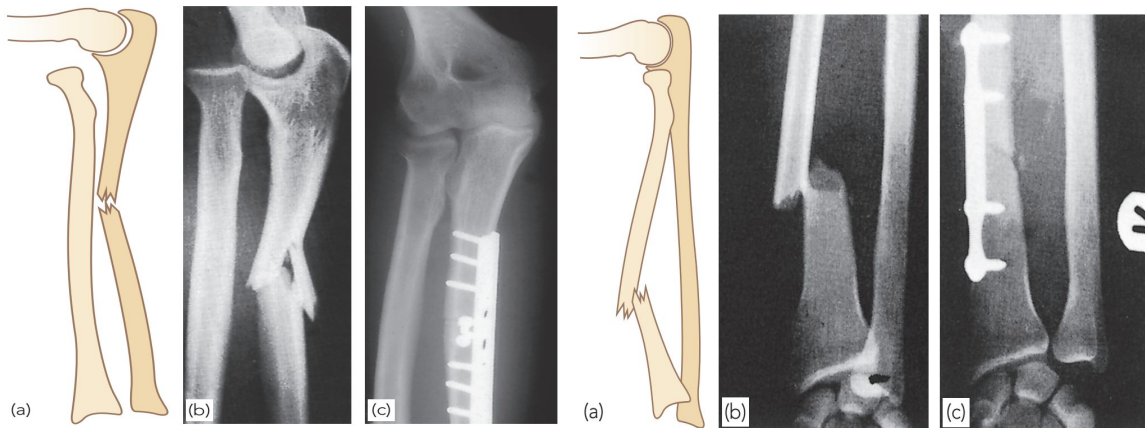
- **X-ray:** 2 orthogonal views (AP and lateral views)
- **CT scan:** if fracture extends into joint. (If the fracture extends to the joint, there is a risk of osteoarthritis).



- **Treatment:**

- Both bone fracture:
 - Reduce and splint at ER/clinic (temporary to relief pain).
 - Are treated **almost always with ORIF: (plate and screws).**
- Monteggia fracture: **ORIF ulna and close reduction of radial head.**
- Galeazzi fracture: **ORIF radius and closed reduction of DRUJ.**

Monteggia		Galeazzi
Anterior dislocation of the radial head with a fracture of the ulna, usually angulated dorsally	Description	Fracture of the radius with shortening and dislocation of the distal ulna
Dislocation at the head	Radius	Isolated fracture at the junction of the distal and middle third
Fracture of the proximal third	Ulna	Subluxation or dislocation of the distal radio-ulnar joint
Fall on an outstretched hand with the forearm in excessive pronation	Mechanism	Fall on an outstretched arm with elbow flexed
Direct blow on back of upper forearm in self-defense (night-stick injury)	Management	Open reduction in adults Closed reduction in children
ORIF	Complications	Malunion/Nonunion Limitation of pronation or supination Anterior interosseous nerve palsy
Nonunion	Credit goes to...	Ricardo Galeazzi
Limitation of motion at elbow		
Giovanni Battista Monteggia		






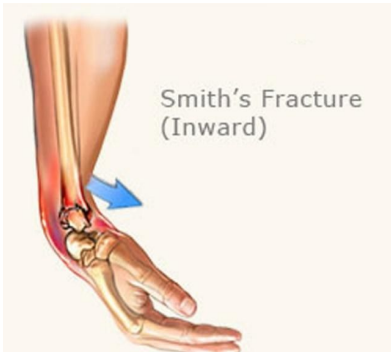


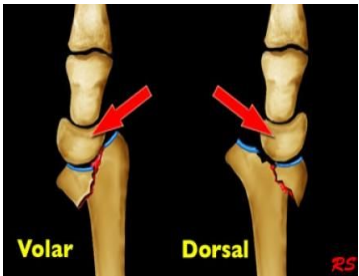
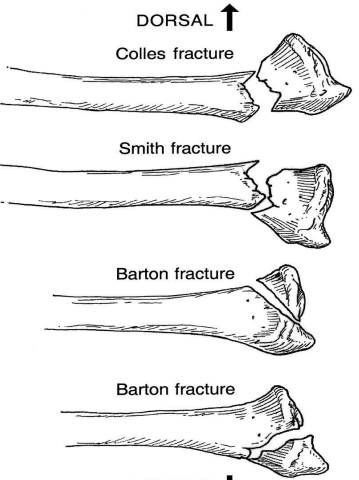
27.4 Monteggia fracture–dislocation of the radius and ulna (a–c) The Monteggia injury is a fracture of the ulna and dislocation of the proximal end of the radius. X-rays that include the elbow joint will show that the head of the radius no longer points to the capitulum. In a child, closed reduction and plaster is usually satisfactory; in the adult (b,c), the crucial step is to restore the ulna to its full length by reducing the fracture and holding it with internal fixation; in most cases the radial head will then reduce by itself but if it does not then open reduction is required.

27.5 Galeazzi fracture–dislocation (a) In the Galeazzi fracture–dislocation it is the radius that is fractured and thereby ‘shortened’, causing the head of the ulna to dislocate. (b,c) X-rays before and after reduction and plating.

Distal radius fracture

- **Most common fracture of upper extremity.**
- Most frequently are seen in older women. (osteoporosis)
- Young adults are most commonly secondary to high energy trauma.

Extra-articular fracture

Extra-articular		Intra-articular
Colle's fracture	Smith's fracture	Barton's fracture
<p>Dorsal displacement, shortening and radial deviation.</p> <p>common presentation: an older woman who gives a history of falling on her outstretched hand. (high incidence being related to the onset of postmenopausal osteoporosis.)</p>  <p>Colle's Fracture (Outward)</p>   <p>Colle's "dinner fork"</p>	<p>shortening and volar displacement. (reverse Colle's)</p>  <p>Smith's Fracture (Inward)</p>   <p>Smith's "garden spade"</p>	<p>volar or dorsal.</p>  <p>Volar Dorsal</p>  <p>DORSAL ↑ Colles fracture Smith fracture Barton fracture Barton fracture VENTRAL ↓</p>

- **Investigations:**

- AP and lateral X-ray views
- CT scan because it extends to joint “Barton’s”

- **Treatment:**

- **For Extra-articular fractures:**
 - If stable, do close reduction under conscious sedation and cast application (below elbow cast). If reduction is successful, send patient home. Then wait for 1 week if the swelling decreased and not painful. Continue Immobilization for 6-8 weeks. If not make split to decrease the pressure and wait for 15 minutes, if pain continues remove it completely.
 - Why Below elbow cast? In adults below elbow cast used to prevent stiffness but we can use above elbow cast in children
 - ROM exercises after cast removal.
 - If not stable, treat it surgically
- **For Intra-articular fracture:**
 - A step more than 2 mm is an indicator for surgery.
 - **almost always treated surgically** (ORIF with plate and screws).



Lower extremity fractures

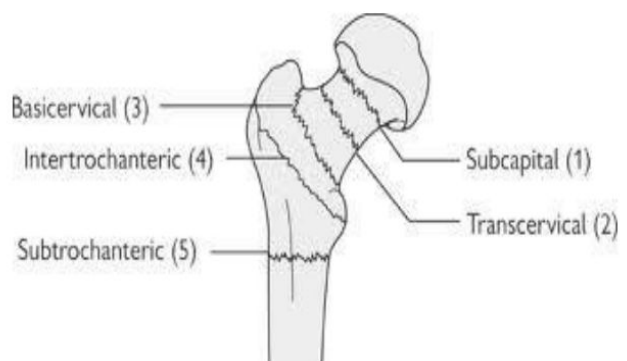
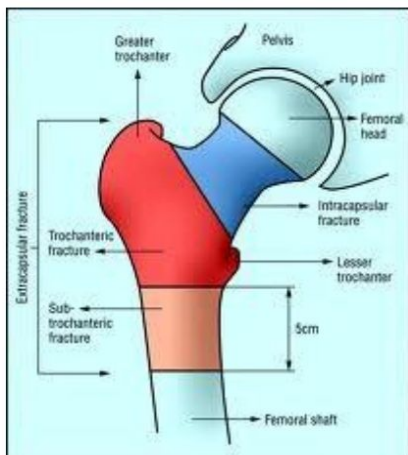
Hip fracture

• Normal Anatomy and Facts:

- It is the **most common** fracture in lower limb.
- It is associated with osteoporosis.
- Most common mechanism is a fall from standing height (**mechanical**).
- Other causes of fall (**stroke, MI, hypoglycemic attack**) should be rolled out during clinical evaluation.
- Common associated injuries (fragility fractures):
 - Distal radius fracture
 - Proximal humerus fracture
 - Subdural hematoma.

These fractures can be classified into

Intra-capsular fracture	Extra-capsular fracture	Displaced vs Non displaced
Subcapital Transcervical AVN (avascular necrosis) risk is higher with intra-capsular fracture because blood supply comes through the neck.	Basicervical Intertrochanteric	-



- **Physical Examination:**

- Full detailed history of mechanism of injury.
- R/O syncope, chest pain, weakness etc.
- A detailed systematic review.
- Deformity: **Abduction, External rotation and shortening.**
- Assess distal N/V status.
- Avoid ROM if fracture is expected.

- **Investigations:**

- **X-ray:** AP and lateral Hip – AP Pelvis – AP Femur
- **MRI:** is sensitive for occult fracture (rarely done only if you can't decide whether a fracture is present or not).

- **Treatment: (IMPORTANT)**

- No close reduction is needed.
- No traction is needed.
- Patient needs **surgery** ideally within 48 hrs.
- The goal is to ambulate patient as soon as possible.
- Be sure that **DVT prophylaxis is started.**
- Be sure that patient will be evaluated for osteoporosis after discharge.

If fracture is Intra-capsular	If fracture is Extra-capsular
<ul style="list-style-type: none"> ● Displaced: <ul style="list-style-type: none"> ○ <u>Old patient:</u> we do hip replacement (hemiarthroplasty) because part of the bone would be dead due to disrupted blood supply. ○ <u>Young patient:</u> internal fixation/intramedullary nailing (Urgent, should be done within 6 hrs.) ● Non-displaced: <ul style="list-style-type: none"> ○ We do percutaneous in situ fixation (Urgent for all patients old and young). 	<ul style="list-style-type: none"> ● Stable: Close reduction and DHS (direct hip screw). ● Unstable: Intramedullary device (IM).



DHS



Intramedullary Nail



Hemiarthroplasty



Percutaneous in situ fixation

- **Complications:**

- Nonunion: 30% (most common complication in young patient).

Femoral shaft fracture

- **Normal Anatomy and Facts:**

- **Most common:** high energy mechanisms - Young patients (male < 30 years).
- **Less common:** low energy mechanism (torsional forces) - Old patients.
- **R/O pathological fracture in Young + low energy mechanisms.**
- **Associated musculoskeletal injuries:**
 - Ipsilateral femoral neck fracture (10%. Missed in 30%-50%)
 - Knee ligaments injuries: 50%
 - Meniscal tear 30%
 - **Floating knee injury:** less common "fracture of shaft of femur+tibial fracture".
 - Vascular/nerve injuries: rare
 - Contralateral femur shaft fracture. (worse prognosis among above)
- **Associated non-MS injuries:**
 - **Fat embolism.** (sudden dyspnea + sudden drop in BP)
 - **ARDS**
 - Head injuries.
 - Abdominal injuries.

- **Physical Examination:**

- **1st Step:** Expose the area, look for fracture signs and check the skin
- **2nd Step:** N/V exam.
- **3rd Step:** Knee swelling or ecchymosis
- **4th Step:** Check for Compartment syndrome.

- **Investigations:**

- AP and lateral views femur
- 15° internal rotation AP view ipsilateral hip.
- Knee AP and lateral views
- **If femoral neck fracture is suspected CT scan hip.**

- **Treatment:**

- ATLS: ABC resuscitation.
- Skeletal traction (proximal tibial pin) or skin traction
- **Early surgical fixation:**
 - Proven to reduce pulmonary complications.
 - Must be within 24 hrs (ideally < 6 hrs).
 - **If patient is unstable: External fixation. Takes 15 mins (because he can't tolerate surgery).**
 - **If Patient is stable: IM nailing. Take 2 hours.**

Tibial shaft fracture

- **Normal Anatomy and Facts:**

- It is a subcutaneous bone (high suspicion for Skin injury).
- Most common large long bone fracture.
- It can be secondary to low or high energy mechanism.
- **It carries the highest risk of compartment syndrome.**
- 20 % of tibial fracture can be associated with **ankle intra-articular fracture.**
- It can be classified based on location and morphology:
 - Proximal third
 - Middle third
 - Distal third
 - Displaced vs. Non-displaced.

- **Physical examination:**

- **1st Step:** Expose the area, look for fracture signs and check the skin.
- **2nd Step:** N/V exam & Check for Compartment syndrome (need serial exam)

- **Investigations:**

- **X-rays:** “join above and below”
 - AP and lateral tib/fib.
 - AP/lateral knee
 - AP/Lateral ankle
- **CT scan:** if fracture extends to joint above or below.



- **Treatment:**

- **Surgically:** most of the time and treatment by **IM nail fixation**.
- **Conservatively only if:** NO displacement: < 10° angulation on AP/lateral

Ankle fracture

- **Normal Anatomy and Facts:**

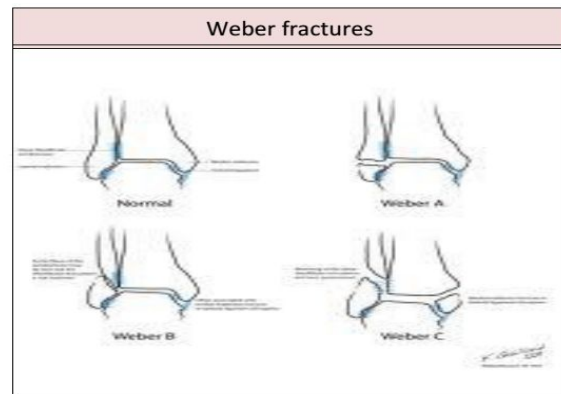
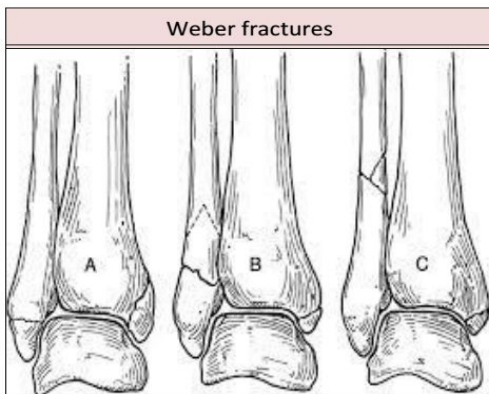
- Ankle anatomy: Medial and lateral malleoli, distal Tibia and talus.
- Highly congruent joint
- Fibula is held to distal tibia by **syndesmosis ligament**.
- Medial malleolus is held to talus by **deltoid ligament**.
- Lateral malleolus is held to talus by **lateral collateral ligament “LCL”**.
- Low energy (torsional): malleoli fracture.

- **Classification:**

- Stable v.s Unstable fracture (lateral displacement of talus).
- Medial, lateral or bi-malleolar fracture.
- **Lateral malleolus: Weber A, B, C.**

Weber classification

Weber A	Weber B	Weber C
<ul style="list-style-type: none"> ● below level of the ankle joint. ● Tibiofibular syndesmosis intact. (deltoid ligament intact). ● No displacement ● No tenderness of the medial side ● No destruction of the joint line (no talas shift) 	<ul style="list-style-type: none"> ● at the level of the ankle joint, extending superiorly and laterally up the fibula. ● tibiofibular syndesmosis intact or only partially torn, but no widening of the distal tibiofibular articulation. ● medial malleolus may be fractured or deltoid ligament may be torn. 	<ul style="list-style-type: none"> ● Above the level of the ankle joint. ● Tibiofibular syndesmosis disrupted with widening of the distal tibiofibular articulation. ● Medial malleolus fracture or deltoid ligament injury present.



● Physical examination:

- Look for Fracture symptoms and signs.
- Assess medial joint ecchymosis or tenderness To assess medial malleolus and deltoid ligament integrity.
- Assess N/V status (before and after reduction).
-

● Investigations:

- X-rays:
 - AP/Lateral
 - **Mortise view:** is done with the leg internally rotated 15°-20°
 - **Long leg x-rays if only medial malleolus is broken**



- **CT scan** if fracture extends to articular distal Tibia articulation.

- **Management:**

- If the fracture in medial malleolus or both malleoli: **Always surgically**
- If the fracture in lateral malleolus:
 - **Weber A:**
 - ✓ Splint + NWB X 6 weeks.
 - ✓ Early ROM.
 - **Weber B/C:**
 - ✓ If medial joint line widen (unstable): ORIF.
 - ✓ If not: Call Orthopedic for stress film x-rays (usually conservative).

Summary:

Weber A: no need to operate.

Weber B: most of the time needs surgery.

Weber C: always surgery.



Clavicle Fracture

- incidence: proximal (5%), middle (80%), or distal (15%) third of clavicle.
- common in children (unites rapidly without complications).

- **Mechanism**
 - fall on shoulder (87%), direct trauma to clavicle (7%), FOOSH (6%).

- **Clinical Features**
 - pain and tenting of skin.
 - arm is clasped to chest to splint shoulder and prevent movement.

- **Investigations**
 - evaluate NVS of entire upper limb.
 - x-ray: AP, 45° cephalic tilt (superior/inferior displacement), 45° caudal tilt (AP displacement).
 - CT: useful for medial physeal fractures and sternoclavicular injury.

- **Specific Complications**
 - cosmetic bump usually only complication.
 - shoulder stiffness, weakness with repetitive activity.
 - pneumothorax, brachial plexus injuries, and subclavian vessel (all very rare).

Proximal Humeral Fracture

- **Mechanism**
 - young: high energy trauma (MVC).
 - elderly: FOOSH from standing height in osteoporotic individuals.
- **Clinical Features**
 - proximal humeral tenderness, deformity with severe fracture, swelling, painful ROM, bruising extends down arm and chest.
- **Classification**
 - Neer classification is based on 4 fracture fragments.
 - displaced: displacement >1 cm and/or angulation >45°.
 - the Neer system regards displacement, not the fracture line, as meeting criteria for a 'part' in the classification scheme.
 - ± dislocated/subluxed: humeral head dislocated/subluxed from glenoid.
- **Specific Complications**
 - AVN, nerve palsy (45% _ typically axillary nerve), malunion, post-traumatic arthritis.

Humeral Shaft Fracture

- **Mechanism**
 - high energy: direct blows/MVC (especially young); low energy: FOOSH, twisting injuries, metastases (in elderly).
- **Clinical Features**
 - pain, swelling, weakness ± shortening, motion/crepitus at fracture site.
 - must test radial nerve function before and after treatment: look for drop wrist, sensory impairment dorsum of hand.
- **Specific Complications**
 - radial nerve palsy: expect spontaneous recovery in 3-4 mo, otherwise send for EMG .
 - non-union: most frequently seen in middle 1/3.

- decreased ROM.
- compartment syndrome.

Distal Humeral Fracture

- **Mechanism**

- young: high energy trauma (MVC).
- elderly: FOOSH.

- **Clinical Features**

- elbow pain and swelling.
- assess brachial artery.

- **Investigations**

- x-ray: AP and lateral of humerus and elbow.
- CT scan: helpful when suspect shear fracture of capitulum or trochlea.

- **Classification**

- supracondylar, distal single column, distal bicolunar and coronal shear fractures.

- **Treatment**

- goal is to restore ROM 30-130° flexion (unsatisfactory outcomes in 25%).
- non-operative.
 - cast immobilization (in supination for lateral condyle fracture; pronation for medial condyle fractures).
- operative
 - indications: displaced, supracondylar, bicolunar.
 - closed reduction and percutaneous pinning; ORIF; total elbow arthroplasty (bicolunar in elderly).

Hip fracture

Overview of Hip Fractures

Fracture Type	Definition	Mechanism	Special Clinical Features	Investigations	Treatment	Complications
Femoral Neck (Subcapital)	Intracapsular (See <i>Garden Classification</i> , Table 20)	Young: MVC, fall from height Elderly: fall from standing, rotational force	Same as general	X-Ray: AP hip, AP pelvis, cross table lateral hip		DVT, non-union, AVN, dislocation
Intertrochanteric Stable: intact posteromedial cortex Unstable: non-intact posteromedial cortex	Extracapsular fracture including the greater and lesser trochanters and transitional bone between the neck and shaft	Same as femoral neck fracture Direct or indirect force transmitted to the intertrochanteric area	Ecchymosis at back of upper thigh	X-Ray: AP pelvis, AP/lateral hip	Closed reduction under fluoroscopy then dynamic hip screw or IM nail	DVT, varus displacement of proximal fragment, malrotation, non-union, failure of fixation device
Subtrochanteric	Fracture begins at or below the lesser trochanter and involves the proximal femoral shaft	Young: high energy trauma Elderly: osteopenic bone + fall, pathological fracture	Ecchymosis at back of upper thigh	X-Ray: AP pelvis, AP/lateral hip and femur	Closed/open under fluoroscopy then plate fixation or IM nail	Malalignment, non-union, wound infection

Garden Classification of Femoral Neck Fractures

Type	Displacement	Extent	Alignment	Trabeculae	Treatment
I	None	"Incomplete"	Valgus or neutral	Malaligned	Internal fixation to prevent displacement (valgus impacted fracture)
II	None	Complete	Neutral	Aligned	Internal fixation to prevent displacement
III	Some	Complete	Varus	Malaligned	Young: ORIF Elderly: hemi-/total hip arthroplasty
IV	Complete	Complete	Varus	Aligned	Young: ORIF Elderly: hemi-/total hip arthroplasty

Femoral Diaphysis Fracture

- **Clinical Features**
 - shortened, externally rotated leg (if fracture displaced).
 - inability to weight-bear.
 - often open injury, always a Gustilo III .
 - Winquist and Hansen classification.

- **Complications**
 - hemorrhage requiring transfusion.
 - fat embolism leading to ARDS.
 - extensive soft tissue damage.

- ipsilateral hip dislocation/fracture (2-6%) • nerve injury.