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Orthopedic 441 Team

MED441 KING SAUD UNIVERSITY

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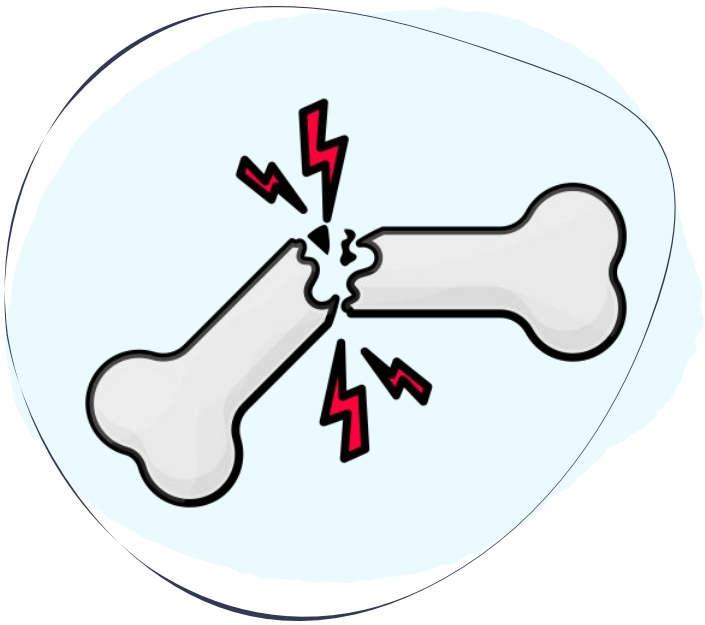

Common Adult Fractures

Dr. Wassim AlDebeyan

Color Index:

- Main Text
- Important
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Objectives

- Clavicle fracture.
- Humerus (proximal & shaft).
- Both bone 'forearm' fractures.
- Distal radius fracture.
- Hip fracture.
- Femur shaft fracture.
- Tibial shaft fracture.
- Ankle fracture.

Important Note:
The indications of surgical fixation could come as simple MCQ like (which of the following is an indication), **OR** it could come as **X-ray with an indication** and you need to interpret it

Resources

- Clavicle fracture
- Proximal humerus fracture
- Humerus shaft fracture
- Monteggia & Galeazzi fractures
- Distal radius fractures
- Hip fractures
- Femoral shaft fracture
- Tibial shaft fracture
- Ankle fractures

Orthobullets
Search for the topics

Upper Extremities

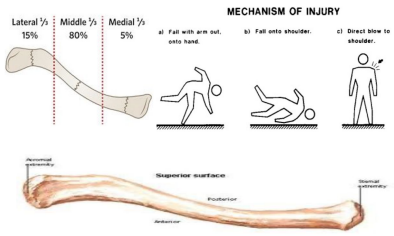
1- Clavicle Fracture

Anatomy

- Clavicle is S shape bone.
- It is anchored to scapula (laterally) via ACJ (Acromioclavicular joint).
- It is anchored to trunk (medially) via SCJ (Sternoclavicular Joint).

General Notes

- Most fractures occurs as result of a direct blow to the shoulder such as fall onto the shoulder "FOOSH" (Fall On Out-Stretched Hand).
- Fractures are classified into: proximal "medial" (5%), middle (80%) and lateral third (15%) fractures.
- Most of fractures are of middle third (the lateral fragment is pulled down by the weight of the arm, and the inner medial half is held up by the sternomastoid muscle).
- When a patient comes in with a clavicular fracture, take history then do a physical exam, you should check if the skin is intact or if there is tenting in the skin (is it an open fracture?), and do a NV exam (brachial plexus, subclavian artery and vein) it's a rare but a serious complication.



Clinical findings

- Injury to brachial plexus and subclavian artery/vein may be present.
- Rarely, pneumothorax can occur, when the bone go inferiorly and cause a lung injury "so, must be assessed for pulmonary injury".

Imaging

X-Ray:

- AP chest, to check there is no pneumothorax.
- Clavicle special view (focused on clavicle, 30° cephalic tilt), this X-ray shows a short oblique middle third fracture with minimal displacement[1].

Treatment

Will you reduce clavicle fracture? No, we use the gravity to reduce it, then use a sling for immobilization.

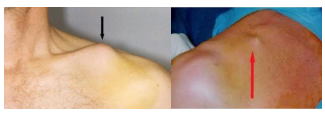
- Most of clavicle fractures are treated conservatively with a sling (usually heals within 6-8 weeks)[2].
- Few fractures should be treated **surgically** with open reduction and internal fixation (ORIF) with plate and screws.

Sling

ORIF

When do we perform surgery? *(SOS)* (Not necessarily all the 3, one is enough)

- Skin is tented[3] "open fracture".
- Overlap of 2 cm or more, causing shortening of the clavicle, which in turn cause all rotator cuff muscles to shorten and weaken.
- Severe displacement (100% displacement, i.e there is no contact between the fragments).

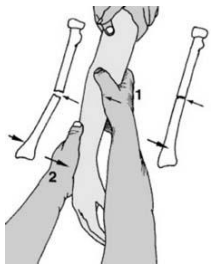


Skin Tenting

1- We have wedge or butterfly fragments here.
2- Joint stiffness usually develops in 1-2 weeks, physiotherapy is started early to prevent elbow stiffness, but shoulder motion is restricted during the treatment period.
3- **Why?** because it might affect blood supply and cause skin necrosis and ulcer and become an open fracture.

What is the difference between open and closed reduction?

- ➔ Closed reduction: is a procedure to reduce a broken bone (put it back in its normal position) without cutting the skin open, see the picture.
- ➔ Open reduction: is reducing the bone surgically, if the fractured bone is exposed and you can see the bone fragments by your eyes and manipulate it by your hands and you reduce the fragments.

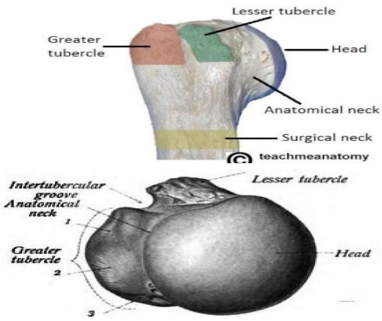


2- Proximal Humerus Fracture

Anatomy

Proximal humerus has 4 anatomic parts:

1. Head (articular surface), the anatomical neck separates the head from the tuberosities.
2. Greater tuberosity ***GT*** → Muscles attached *(SIT)*:
   - ➢ Supraspinatus (initiate abduction 0-15°)
   - ➢ Infraspinatus (external rotation and aid in abduction)
   - ➢ Teres minor (external rotation and aid in abduction)
3. Lesser tuberosity ***LT*** → Muscle attached:
   - ➢ Subscapularis (internal rotation).
4. Shaft.



- Anatomical neck v.s. Surgical neck: The surgical neck is located between the tuberosities and the shaft. **Why is it called surgical neck?** Because this is the location of many fractures that require surgery.

- Bicipital groove runs between GT & LT Attaches Biceps Brachii and Latissimus Dorsi.

- The short head of biceps (with coracobrachialis) goes more medially and attaches to the coracoid process.

Description

Causes of proximal fractures:

- Younger patients: violent (high energy) trauma such as RTA.
- Older patients: minor (low energy) trauma such as falling (osteoporotic or postmenopausal women).
- **Most fractures are minimally displaced** and can be treated with a sling.

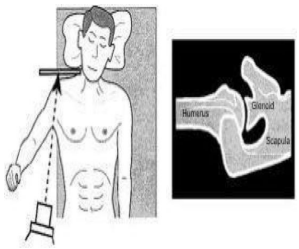
Physical exam:

1. **Expose** the shoulder very well.
2. **Look** for fracture signs (ecchymosis, erythema, swelling, tenderness, inability to move).
3. **Check** the skin, to know if it is an open or closed fracture (although open fractures are unlikely).
   - Examine the **axilla**, most of times they forget to examine it because patient has a lot of pain or they forget.
4. **Peripheral N/V** exam, to make sure there is no neurovascular injury.
5. **Axillary nerve**: the most commonly affected nerve, it innervates the lateral skin patch (area shown in the pic).
   - Patient will lose sensation over the deltoid and will have difficulty in abducting his shoulder.
6. **Examine** cervical spine: (the axillary nerve originates from C5 and C6)
   - You always have to examine the joint above and the joint below of any injury. In case of this fracture, the above is the cervical spine and below is elbow joint.

Imaging

X-Ray (3 views)**:** to make sure proximal humerus is not displaced

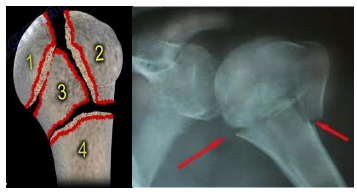
- AP and lateral views: 2 perpendicular (Orthogonal) views, to have 3D image of the fracture.
- Axillary view (special X-ray): the patient is laying down, and the beam will go through the axilla showing the whole joint. It can show you if there is a fracture-dislocation (it has different management).



CT scan: for displaced/dislocated fractures (to categorize the fracture and count the fragments), and intra-articular fractures and to plan surgery if needed.

Neer's Classification:

- As discussed in the previous slide, proximal humerus is divided into 4 pieces: head (articular surface), LT, GT and a shaft (figure 1).
- Fracture is defined by the fragments displaced, this classification describes the number of fragments in the fracture with a maximum of 4 pieces, but it only considers the fragment as a separate piece if it was displaced by >1cm and/or angulated by >45°.
- So there are 4 types:
  - **One-part fracture (non-displaced humerus fracture):** No fragment satisfies the displacement criteria (figure 3), although there are many fracture lines, if the fragments are undisplaced, it's regarded as a one-part fracture.
  - **Two-part fracture:** If 1 segment (can be the head, LT, GT or the shaft) is displaced from the main bone by >1cm (figure 4).
  - **Three-part fracture:** If 2 fragments are displaced from the main bone (figures 2&5).
  - **Four-part fracture:** all 4 major parts (both tuberosities, articular surface, and shaft) are separated from each other (figure 6).



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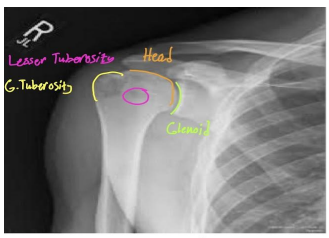
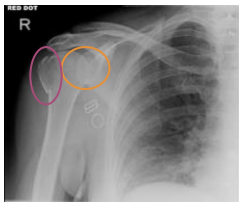
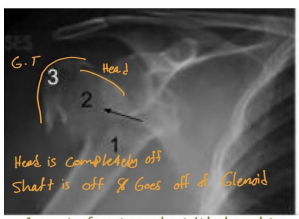
Fun Fact from Apley:
It has always been difficult to apply Neer's classification when based on plain X-rays, and not surprisingly there is a relatively high level of both inter- and intra-observer disagreement. Neer himself later noted that, when this classification was developed, the criteria for displacement (distance >1 cm, angulation >45 degrees) were set arbitrarily. The classification was not intended to dictate treatment, but simply to help clarify the pathoanatomy of the different fracture patterns.



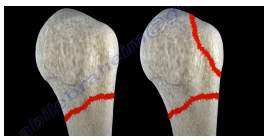
Normal



Three-part fracture
Displaced head: head is tilted back and faces up more than medially.
Fractured & minimally displaced G.T



4 parts fracture but it's hard to tell due to overlap.



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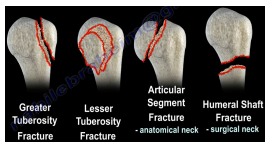

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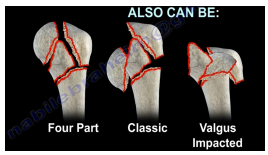

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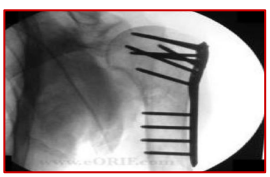
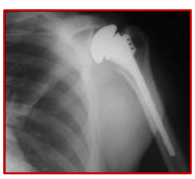
Treatment

- If fracture is not displaced or minimally displaced:
  - Treatment with sling and NWB (non-weight bearing) of UP (upper extremity) for 6-8 weeks.
    Why? based on the healing process of the fracture.
  - Early ROM exercises (pedaling exercise) after 2-4 weeks to prevent stiffness.
  - Normal function can be resumed after 3-4 months. (After 6-8 weeks we remove the sling, but the patient might still complain of pain and stiffness up to 3-4 months)
- If the fracture is displaced or intra-articular:
  - Surgery (ORIF with screws and plate) is indicated.
  - Shoulder **Hemiarthroplasty**[1] is indicated in some cases as in severely comminuted fractures.



ORIF with plate and screws



Hemiarthroplasty

1- In hemiarthroplasty, the ball (head of humerus) is changes, while in total arthroplasty, both the ball and socket are changed.

3- Humerus Shaft Fracture

Shaft fractures of the humerus, femur and tibia are classified according to which third was fractured.

General Description

It can be classified based on location of fracture: 1-Proximal. 2-Middle (most common location). 3-Distal.

Clinical Features

Symptoms: Pain, swelling, weakness ± shortening, motion/crepitus at fracture site, bruising.

Physical exam:

- Check the Skin to rule out open fractures.
- Compartment syndrome: Passively stretch distally to check for severe pain.
- Neurovascular (N/V): watch for **radial nerve palsy**. **How to examine the radial nerve?**
  - **Motor:** Extension of the metacarpophalangeal joints "posterior interosseous nerve" (extension of the wrist can be misleading because sometimes supplied by another branch).
  - **Sensory:** over the dorsum of the first webspace.
  - Check if the patient can raise their thumb and wrist "wrist drop & paralysis of the MCP extensors".

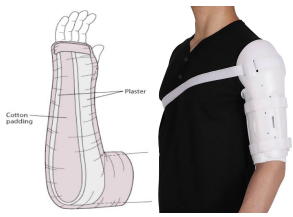
Imaging

X-Ray[1]:

- Left pic: AP and lateral of the right humerus showing long spiral shaft fracture at the junction of the middle and distal thirds of the humerus with lateral displacement, has good alignment with no angulation.

Treatment

Almost all humerus shaft fracture can be treated non-surgically by:



- Closed reduction at the ER under conscious sedation or analgesics.
- Functional brace for 4-6 weeks + NWB. (**Why called functional?** because they can still move their elbow and, to a lesser extent, their shoulders).
- Early ROM of elbow and shoulder to avoid stiffness, but arm abduction is postponed until the fracture has united.

What is the difference between brace and cast? the brace is removable, plastic with velcro tape, clamshell. There is no significant difference compared to the cast but it's easier to the patient.

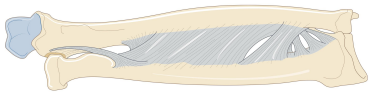
Surgery is indicated[2] (ORIF with plate and screws) for specific conditions like:

- Segmental fracture, (because it is considered unstable).
- Open fracture.
- Obese patient, **why?** Because of body built which will push the humerus and displace it, and also, they have a lot of fat which push the arm into varus, you can't control the fracture with a brace.
- Bilateral fracture, **why?** Patient can't function with 2 casts (inhumane).
- Floating elbow (Fractures of forearm and humerus) difficult to control, so basically like segmental, the elbow being the free segment.
- Multiple trauma: If he will undergoing for surgery, do it surgically because the patient already in OR.

1- Holstein-Lewis fracture is a spiral fracture of the distal one-third of the humeral shaft commonly associated with neuropraxia of the radial nerve (22% incidence).
2- Displacement is not indication.

4- Both Bones Forearm Fracture

Anatomy



- Forearm is complex with two mobile parallel bones; we consider the forearm as a ring or one joint (quadrilateral joint), usually if you break a ring at one side it breaks in another side so if the patient has a fracture in one bone, you should check the other bone or check the joint for disruption, it's rare to see an isolated ulnar or radial injury.

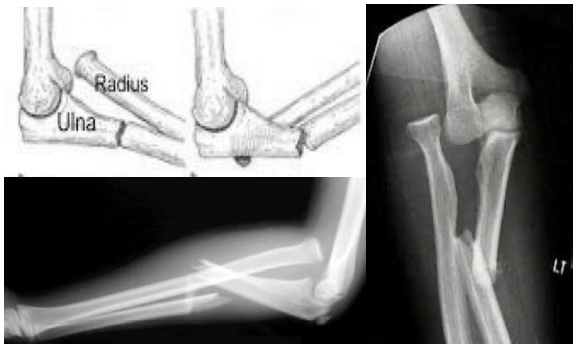
- Radius and ulna articulate proximally and distally, by the proximal and distal radioulnar joint (RUJ) to allow forearm rotation (supination and pronation).

General Description

Fractures are often from fall or direct blow. It's very unlikely to fracture only one bone without disrupting of their articulation.

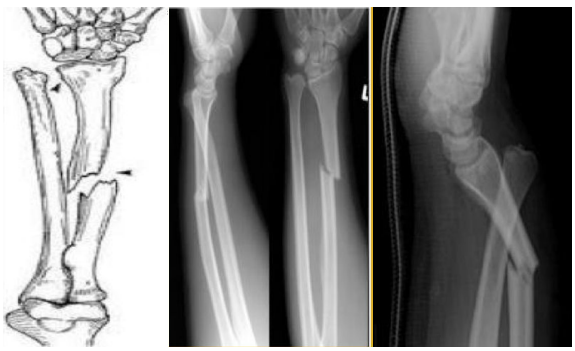
Types:

1. **Both bones fracture:** Both the radius and ulna are broken.
2. **Monteggia fracture:** Proximal or middle third ulnar shaft fracture with dislocation of radius (head) proximally (at elbow).
   - Mechanism: direct blow on the posterior aspect of the forearm, hyper-pronation or fall on a hyperextended elbow.
   - Clinical features: decreased rotation of forearm ± palpable lump at the radial head (dislocation).
3. **Galeazzi fracture:** Distal or middle third shaft radius fracture with disruption of DRUJ.
   - Mechanism: hand FOOSH (Fall on An Outer Stretched Hand) with axial loading of pronated forearm or wrist trauma.



Monteggia Fracture

Radial head can be dislocated to lateral or posterior side



Galeazzi Fracture

Radial fracture with ulnar dislocation dorsally

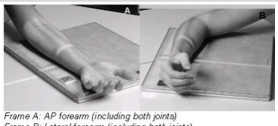
Both Bone Fracture

Clinical Findings

- Symptoms and signs of fracture: Deformity, pain, swelling loss of function in hand and forearm.
- Check the skin: To make sure it is not an open fracture.
- Check the compartments of forearm.
- Check ulnar, median and radial nerve, it bifurcates at the level of wrist into (**PIN**, **AIN**) "Posterior(radial) & anterior(median) interosseous nerves", so examine it separately.
- Check vascularity of the hands: color, temperature, capillary refill and pulse.

Imaging

- **2 Orthogonal views** perpendicular on each other usually AP + lateral with joint above and joint below.
- CT scan if fracture extends into joint "intra-articular to asses the displacement".



Frame A: AP forearm (including both joints)
Frame B: Lateral forearm (including both joints)
Image courtesy of Dr. Naveed Ahmad

Treatment

- **Both bone fracture:** We treat these fractures as a joint
  - Reduce and splint at ER/clinic (this is a temporary solution for pain control).
  - Definitive treatment: Almost always with surgery ORIF with plate and screws even if it didn't displace because we worry that it will later if we left it.
- **Monteggia fracture:**
  - ORIF of the fractured ulna and close reduction of radial head, if closed failed go for open "The key to successful treatment is to restore the length of the fractured ulna".
- **Galeazzi fracture:** Opposite to monteggia
  - ORIF of fractured radius with plate & screws and closed reduction of DRUJ.


Galeazzi managed with ORIF of radius

5- Distal Radius Fracture

General Description

- It is the Most common fracture of upper extremity.
- Most frequently are seen in older women due to osteoporosis.
- Young adults fractures are most commonly secondary to high energy trauma (FOOSH).
- Types:

1. **Extra-articular fractures**:
   A. Colles' fracture: **dorsal** angulation, shortening and radial "displacement" deviation.
   B. Smith's fracture: shortening and **volar** (anterior) angulation (reverse colles').
2. **Intra-articular fractures**:
   A. Barton's fracture: Partial articular (i.e. half of the articular surface is fractured and lost contact with the shaft while the other half is intact and in contact with shaft (fig 1), if no part of the articular surface is in contact with shaft then this is not barton's), could be volar or dorsal (Fig 2), needs lateral view.
   B. Others: Due to a fall on extended pronated wrist (Chauffeur fracture aka Hutchinson or Backfire fracture, which is radial styloid fracture).

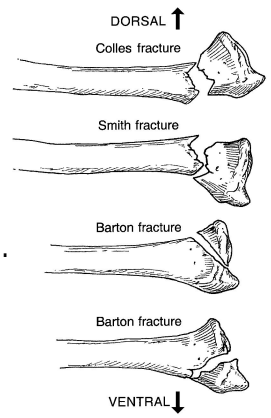


Fig 1

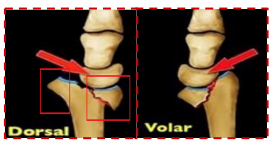
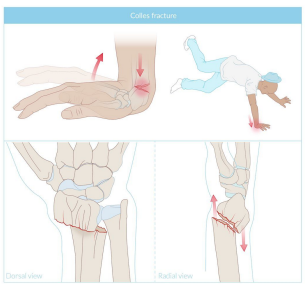
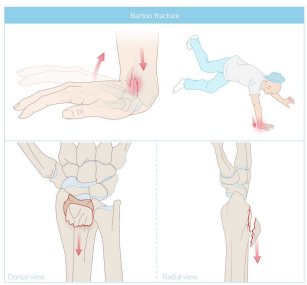
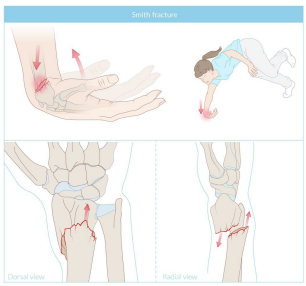
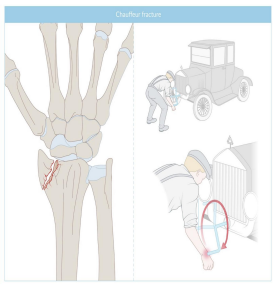


Fig 2

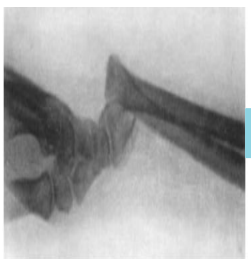






Clinical Features

Colles' Fracture	Mnemonic: Colle's restaurant Smith's farm	Smith's Fracture
Can present clinically with a "Dinner Fork" deformity		Can present clinically with a "Shovel" deformity

Imaging

- X-ray: PA not AP → it's hard to ask the patient to supinate his arm.
- In Barton's fracture you have to see it in lateral x-ray because on AP/PA there will be overlap.
- **CT Scan:** if fracture extends into joint (intra-articular).



Smith's fracture

Colles' fracture

Barton's fracture

Treatment

Extra-articular fractures (Colles' and Smith's): you have to know the specific steps, it always comes in OSCE

1. Start with analgesia or preferably, conscious sedation and N/V exam.
2. Closed reduction (traction and countertraction), check N/V again, then apply a splint or below elbow cast (to avoid elbow stiffness, and don't include metacarpophalangeal joint also to avoid finger stiffness), then send the patient to X-ray to check if reduction is acceptable.
    a. If reduction is acceptable:
        - Send the patient home with acute compartment syndrome checklist (tell them if they have pain not responding to analgesia "called pain out of proportion" to immediately come to ER to be checked for compartment syndrome).
        - Patient should be checked once a week for 2 weeks for secondary displacement. If X-ray was good at the 2nd week, continue the cast for 4 more weeks (immobilization for 6-8 weeks in total), then bring them back for out-of-cast X-ray to make sure it is healed.
        - ROM exercises after cast removal.
    b. If closed reduction is unacceptable (failed):
        - Try again if you think you may get it.
        - If very unstable or you think you won't get it, then surgery (ORIF with plate and screws).

ORIF with the plate and screws

Intra-articular fracture (Barton's and Chauffeur's):

- The treatment is the same as extra-articular unless there is an indication for surgery which is:
    - Displacement (also called step or gap)[1] of intra-articular fracture ≥2 mm[2].
    - If Surgery Indication is present → ORIF with plate and screws.

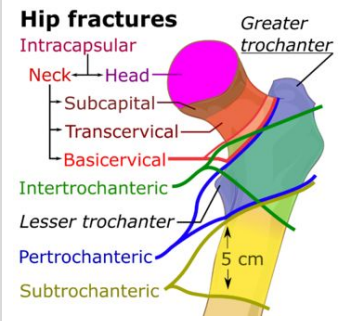
1- The 2 fragments at the articular surface are not at the same level, if it heals like that it will lead to arthritis.
2- If it was less than 2mm (no step or gap), then let them stay in the cast and check them every week for 2 weeks, if stable then we continue to a total of 6 weeks, but most of barton's fractures are unstable "have a step or gap".

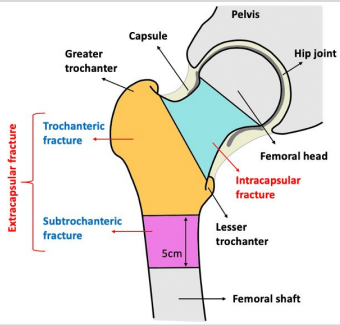
Lower Extremities

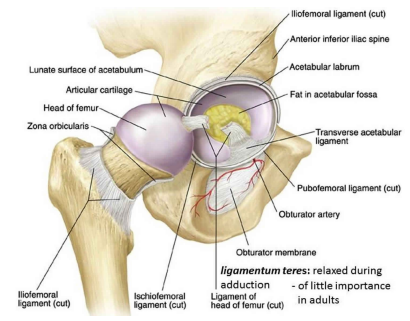
1- Hip Fractures in Elderly (>60 years)

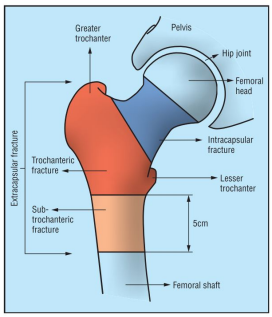
- The physiological age is what matters not the exact age, because you can have a 60 y\o male but he is completely fit and healthy with no issues (in the exam stick to 60 as a cutoff).

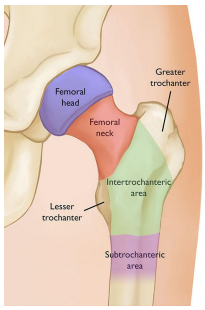
Anatomy









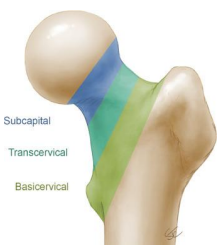


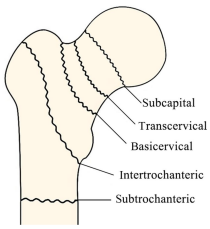
General Description

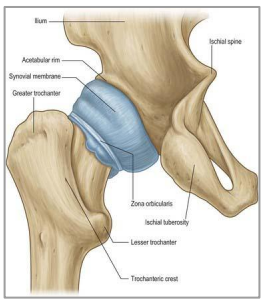
- Hip fractures are defined as fractures that occur between the articular margin of the femoral head to 5 cm below the lesser trochanter.
- The usual story of this fracture: A geriatric patient falls down in the bathroom and it is usually managed by surgery.
- It is the most common fracture of lower limb.
- **It is associated with osteoporosis** (Like colles in old women).
- Most common mechanism is **a fall from standing height**.
- In young people it is usually caused by high energy trauma and is considered a separate entity of fractures that affects elderly.
- **BEWARE** → you have to ask **what caused the fall?** it might be a manifestation of a much more serious medical condition that you first have to deal with or **rule out during clinical evaluation** before managing the fracture such as an **MI or a stroke.**
- Hip fracture is a life changing event, it's not about the fracture itself, but it's about the systemic failure; "The patient starts to be senile". Most people will walk but they will not be the same. Mortality: 20% of these people will die 1 year after the fracture but not because of the fracture, but due to the complications that follow, it just tells you how it's linked to systemic failure.

Fractures can be classified into: intra/extra-capsular (important for prognosis and treatment) **or displaced and non-displaced.**

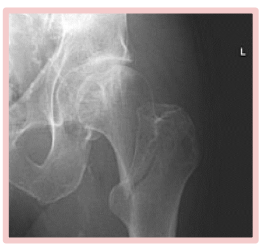
- **Intracapsular** (also called femoral neck fracture) **:**
  - Subcapital: Directly below the femoral head.
  - Transcervical: Mid portion of femoral neck.
  - ❖ Avascular necrosis (AVN) risk is higher with **intracapsular fracture**.
- **Extracapsular :**
  - Basicervical: Base of femoral neck, the end of the capsule.
  - Intertrochanteric.
  - Subtrochanteric: not a hip fracture, rather, a femoral shaft fracture.







Hip capsule



Intertrochanteric fracture

Common associated injuries "at time of fall"**:**

1. **Distal radius fracture.**
2. **Proximal humerus fracture.**
3. **Subdural hematoma.**

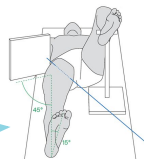
Clinical

- Full detailed history of mechanism of injury.
- Rule out syncope, chest pain, weakness, MI, stroke, etc.
- A detailed systematic review.
- Look for Hip fracture deformity: Abduction, external rotation and shortening "typical but not always".
- **Assess distal N/V status:** The most commonly injured nerve is **the sciatic nerve**.
- **Avoid ROM if fracture is expected**, if patent can not do active, don't try passive ROM.

Imaging

X-Ray:

- 3 views are needed:
  1. AP pelvis.
  2. AP hip.
  3. Lateral hip. (Cross-table view)

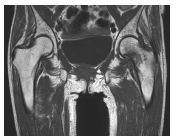


MRI is sensitive for occult (stress) fractures, they don't appear on an X-ray, they happen in people who stress their hip like military or trumps.

The X-ray shows either subcapital or transcervical intracapsular fracture

AP of pelvis

Lateral of hip

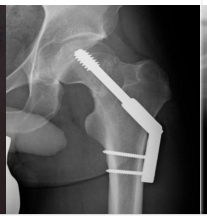


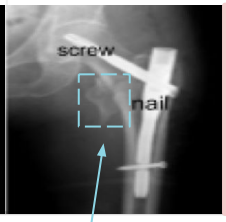
Occult femoral neck fracture

AP of hip

Treatment (includes elderly and young)

Intracapsular			Extracapsular (age is irrelevant)	
Non-displaced So no need for reduction	**Displaced**		**Stable**	**Unstable**
Internal fixation in situ with 3 percutaneous cannulated screws (PCS)	Elderly	Young	Closed reduction and internal fixation with Dynamic hip screws (DHS)	Closed reduction with internal fixation using a cephalomedullary nail (CMN)
	Hemiarthroplasty	ORIF With cannulated screws		





- **Signs of fracture instability:** Need only 1 to be considered unstable
  1- Four-parts fracture. **2-** Extension to subtrochanteric region. **3-** Large lesser-trochanteric fragment.
- In the ER, no close reduction is needed, **why?** it will displace again anyway. a study showed that there is no difference if you put a traction or not, not cost effective, and no benefit for the patient.
- No traction is needed.
- Patient needs surgery ideally within 48 hours, even less, as studies show it decreases the rate of mortality by more than 40% due to post surgery complications (e.g. atrophy, DVTs, infection, etc)
- The goal is to ambulate patient as soon as possible.
- For all hip fractures, be sure that **DVT prophylaxis is started**.
- Be sure the patient will be evaluated for osteoporosis after discharge, to avoid more fractures.

Why do we do hemiarthroplasty in elderly when they have displaced intracapsular hip fractures, while in young we do ORIF with cannulated screws?

- Patients who undergo hemiarthroplasty can start walking at the same day, ORIF mandates NWB the limb for at least 6 weeks. When elderly are told not to bear weight, they will just lay down in bed all day and be prone to all the complications mentioned below, In the other hand, younger people will stay perform their daily life using crutches.

Complications

1. Nonunion (most common complication in young people):
   - ➔ 2% in IT (intertrochanteric) fractures very rare.
   - ➔ 5% in non-displaced neck fracture.
   - ➔ 30% in displaced neck fracture and among young people.
2. AVN in femoral neck fracture:
   - ➔ 10% in non-displaced.
   - ➔ 30% in displaced.
3. Death:
   - ➔ Early 4%. i.e within the first few weeks of a hip fracture.
   - ➔ At 1 year post-fracture, 20-40% of the patients will be dead, because of some complication like pneumonia, delayed surgery, delayed amputation, bed sores, immobility, and post surgery complication.
4. VTE (venous thromboembolism).

2-Femoral Neck Fractures (young patients)

General

- It is a completely different entity from similar fractures in elderly (>60 years).
- Commonly caused by high energy mechanism (e.g. High-impact trauma such as motor vehicle accidents), start with ATLS protocol.
- 2.5% associated femoral shaft fracture, (needs long femur X-ray), in young people because fractures are caused by high energy.
- Complications:
  - Nonunion: 30% (most common)
  - AVN: 25-30%

Clinical Features (EXTRA)

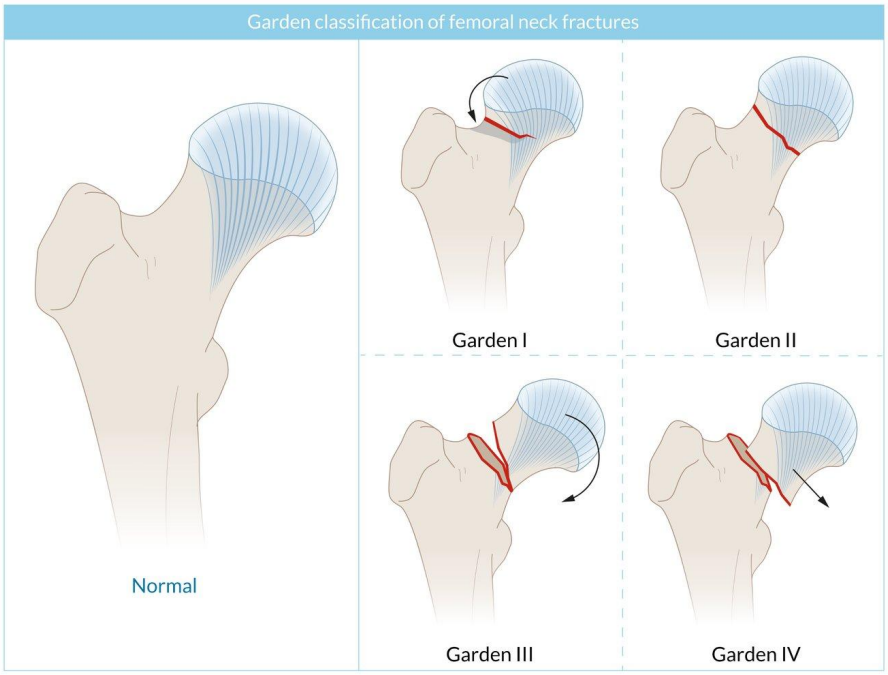
- Groin pain
- Shortened and externally rotated leg
- Minimal bruising

Diagnostic (EXTRA)

- X-ray (AP and lateral view of the pelvis with internal rotation of the affected limb).
- Full femur X-ray of the affected limb should be done to avoid unseen fractures in shaft.
- MRI or bone scan if clinical suspicion is high despite absent findings on x-ray.

Classification (EXTRA)

Garden Classification	
Garden I	Nondisplaced, incomplete, impaction fracture
Garden II	Complete, but nondisplaced fracture
Garden III	Complete and partially displaced fracture
Garden IV	Complete, fully displaced fracture



Treatment (EXTRA)

- Conservative management:
  - Indication: stable, nondisplaced fractures, especially abduction fractures , mostly in debilitated patients.
  - Methods:
    - Temporary bed rest or use of crutches followed by mobilization with physical therapy.
    - Venous thromboembolism prophylaxis.
- Surgical therapy (usually within 72 hours is indicated for unstable fractures, typically adduction fractures, and fragment dislocation:
  - For children and young adults:
    - Attempt preservation of the femoral head.
    - Early (within 6 hours) ORIF.
  - For older adults: total hip replacement (THR) or hip hemiarthroplasty.

3- Femoral Shaft Fractures

If you have femoral shaft fracture look for hip injuries as well

Etiology

More common	Less common
• High energy mechanisms. - Car accidents, fall from a height, gunshot wound. • Young patients "adolescents" (male, < 30 years). • Start with ATLS protocol.	• Low energy mechanism (torsional forces). • Old patients. • Spiral type fracture (twisting).

Clinical Associations

IMPORTANT

MSK injuries	Non-MSK Injuries

1. Ipsilateral femoral neck fracture in 10% (missed in 30-50%, so always check the femoral neck and if you highly suspect it do a CT scan).
2. Knee ligaments injuries in 50%.
3. Meniscal tear in 30%.
4. Floating knee injury: Less common
  - Ipsilateral tibial and femoral shaft fractures.
5. Vascular/nerve injuries: Rare.
6. Contralateral femoral shaft fracture, bilateral:
  - Worse prognosis among above.
	1. Fat embolism, from medullary canal usually to the lung causing shortness of breath "most common associated injury".
	2. ARDS (Acute respiratory distress syndrome).
	3. Head injuries.
	4. Abdominal injuries.

Clinical Examination

- Start with ATLS.
- Look for fracture signs and symptoms.
- Check skin integrity, to rule out open fracture.
- Do N/V exam.
- Do compartment assessment.
- Check for knee swelling or ecchymosis, Indicates ligament Injury.

Investigations

- AP and lateral views of femur:
  - Joint above (spine, looking for bamboo spine) and joint below.
- 15° Internal rotation AP view of ipsilateral hip:
  - To get a good profile of the femoral neck.
- Lateral view ipsilateral view.
- Hip CT if femoral neck fracture is suspected.
- Knee AP and lateral views.

Management

- ATLS: ABC resuscitation, if surgery will be delayed, we can use:
  - Skeletal traction (proximal tibial pin)[1] for pain control and preventing motion which reduces fat embolism risk.
- Early surgical fixation: Is the key
  - ➔ Proven to reduce pulmonary complications: PE, fat embolism, ARDS.
  - ➔ Must be within 24 hours (ideally < 6 hours) "as soon as feasible".
  - ➔ If patient is unstable → External fixation "temporary".
  - ➔ If patient is **stable** → Closed reduction & IM nailing.

Complications

- Malunion:
  A. **Most common**.
  B. More common with proximal fracture (**subtrochanteric fracture**) because of muscles attachments.
  C. Rotational, angulation or shortening (or combination of those).
- Nonunion: Rare.
- Infection: In case of open fracture the skin condition and contamination will change the fixation method from IM to external fixation as temporary and this will worsen the outcome of femur fracture.
- VTE: Always give prophylaxis.

4- Tibial Shaft Fractures

If you have tibial shaft fracture look for ankle injuries as well

General Description

- It is a subcutaneous bone (high suspicion for skin injury), not a lot of muscles are covering it.
- Most common large long bone fracture, and has higher incidence of **open bone fractures** than femur.
- It can be secondary to low or high energy mechanism.
- It carries the highest risk of compartment syndrome, because it is small space and less distal muscles.
- 20% of tibial fractures can be associated with ankle intra-articular fracture.

Classified based on:

A. Location and morphology:
   - ➔ Proximal third.
   - ➔ Middle third.
   - ➔ Distal third.

B. Displaced v.s. Non-displaced.

Clinical Examination

- Check skin integrity to rule out open fracture.
- Assess compartments of leg: Needs serial exam.
- Serial N/V exam.

1- Pins are put proximal and distal to fracture, the pins go through the skin and bone and then out from the other side, the patient would be at the end of the bed with a robe and weight attached to the pins. Benefits: Immobilization of the bone and decrease the risk for fat embolism.

Investigations

X-ray:

- **AP and lateral tib/fib**.
- AP and lateral knee.
- AP and lateral ankle.

CT scan if fracture extends into joints above or below.

- Left pic: AP X-ray of the right lower leg showing comminuted fractures of both tibia and fibula in the middle third + ankle fracture.
- Right pic: AP and lateral X-ray of right leg showing nondisplaced fracture of the tibial shaft in the middle third.

Management

Non-surgical Treatment

Indications:

- No displacement: < 10° angulation on AP/lateral X-rays.
- <1cm shortening.
- Not comminuted.

Procedure: Closed reduction and cast immobilization:

- **Definitive treatment: Above knee full cast, it must be bi-valved** to minimize the risk of compartment syndrome.
  - A bivalve (Anteroposterior or mediolaterally) for 8 weeks, why? If there's any swelling the bivalve gives an area for expansion and this will prevent compartment syndrome.
- In all fractures, if patient is discharged home with cast always provide them with Compartment Syndrome checklist, (pain out of proportion: not responding to analgesia or requiring more analgesia).
- NWB for 8 weeks with cast immobilization.

Surgical Management (most common modality)

Indications: These are also considered "contraindications of non-surgical management".

- Displacement (> 10° angulation).
- Open fracture.
- Compartment syndrome.
- Floating knee.

Procedure:

- **In the ER:** Temporary reduction + Above knee backslab and U-shape slab (3-sided slab) until surgery.
- Most commonly **IM** nail fixation.

IM nail of the tibia with proximal and distal interlocking screws

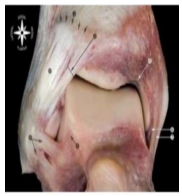
Complications

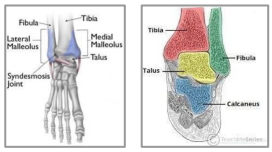
- **Non-union:** Most common complication, while in femoral shaft it's malunion.
- Delayed union.
- Infection: Open fracture.
- DVT/PE.

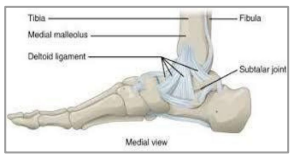
5- Ankle Fractures

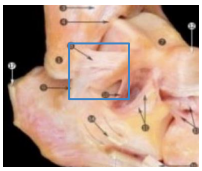
Anatomy

- Medial (distal tibial extension) and lateral (distal tibial extension) malleoli, **distal tibia**[1] and **talus**.
- Highly **congruent joint** (stable).
- Fibula is held to distal tibia by syndesmotic ligament.
- Medial malleolus is held to talus by deltoid ligament.
- Lateral malleolus is held to talus by LCL (lateral collateral ligament)
- Lateral ligament complex of the ankle is composed of three ligaments:
  - Anterior & Posterior talofibular ligament (ATFL-PTFL).
  - Calcaneofibular ligament (CFL).







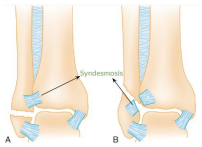


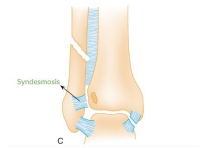
General Description

- Most of them are low energy "torsional" injuries that cause malleoli fracture.

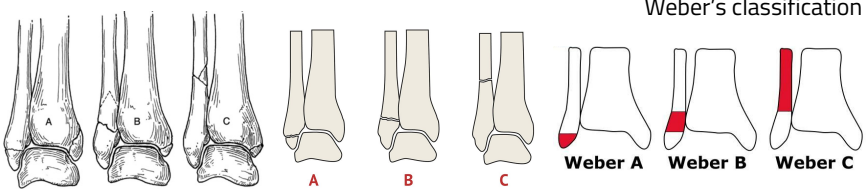
Classifications:

- Stable (non-surgically) v.s. Unstable fracture (surgically):
  - **Causes of instability →** 1- **Lateral displacement of talus**. 2- **Bimalleolar fracture**.
- Medial (usually surgically), lateral (depend on the stability) or bimalleolar fracture (directly unstable and requires surgical fixation).
- For lateral malleolus (and bimalleolar) fractures, we can subdivide them using **Weber's classification**[2]:
  A. Below the level of syndesmosis.
  B. At the level of syndesmosis.
  C. Above the level of syndesmosis.





Weber's classification



Clinical Findings

- Look for fracture signs and symptoms.
- Assess medial joint ecchymosis or tenderness to assess medial malleolus and deltoid ligament integrity.
- Assess N/V status (before and after reduction).
- A valgus deformity is present in medial malleolus fractures.

Imaging

X-ray:

- AP.
- Lateral.
- Mortise view: AP +15° internal rotation (special view).
- Long leg X-rays: If only medial malleolus is broken.

CT scan if fracture extends to articular distal tibia surface.

Unstable: Weber B + very wide medial clear space, so needs surgical fixation with plate & screws

1- The distal articular surface of the tibia is called 'Plafond', so the ankle joint is the articulation between the 'Plafond' and talus.
2- In X-ray we can't see the ligaments, so how to know where is the syndesmosis level? the syndesmosis is present in the area where the distal tibia and fibula overlap on x-ray, look at the AP picture in the imaging part.

Treatment

Medial malleolar fracture:

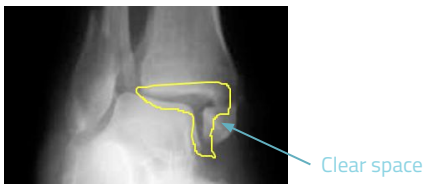
- If non displaced we splint or apply a below knee cast and treat conservatively.

Lateral malleolar fracture "intact medial malleolus":

1. **Weber A:** Stable, No surgery
   - Splint (cast) + NWB for 6-8 weeks.
   - Early ROM.
2. **Weber B:** Plate & screws
   - **We check the clear space on the medial side, if it's wider than 4 mm the fracture is considered to be laterally displaced** making the fracture unstable:
     - ORIF, if the tibia and fibula are displaced we will put a syndesmotic screw between them, it is called **syndesmotic screw** because it acts as a syndesmotic ligament (hold the bones together until syndesmosis heal).
   - If stable "< 4 mm": Cast + NWB for 6 weeks.
   - If not: Call orthopedic for stress film X-rays to see if it's open or not.
3. **Weber C:** Unstable, needs surgical fixation (plate & screws).

Stable: Weber B

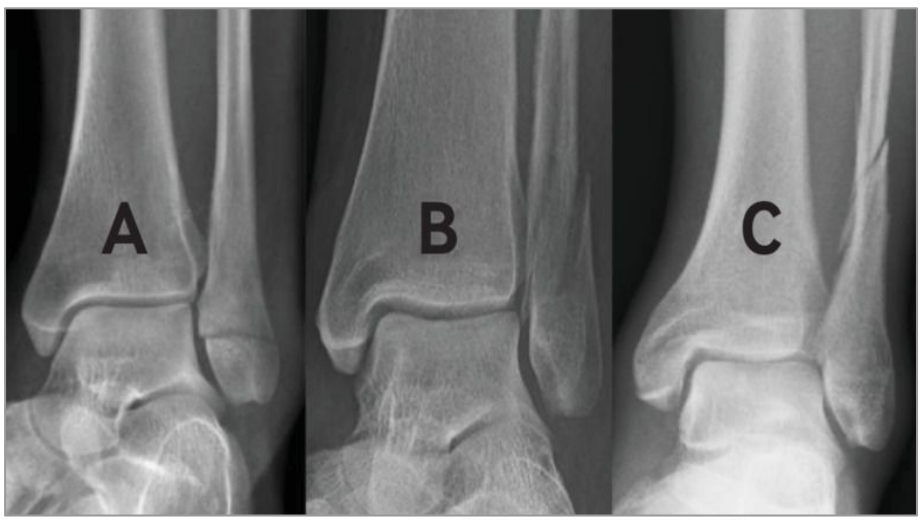
Unstable: > 4 mm lateral translation

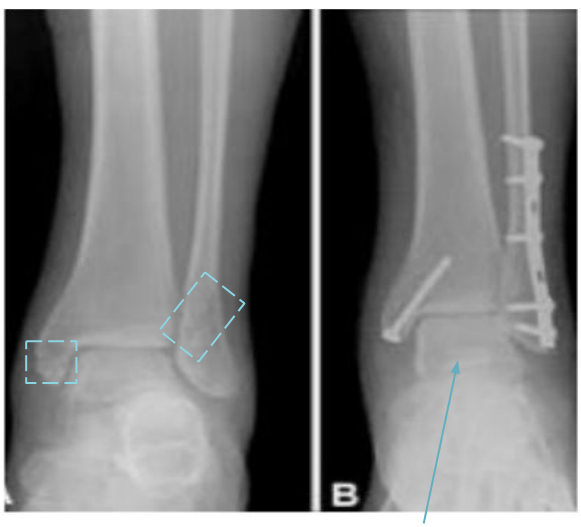


If both malleoli are broken "Bimalleolar fractures": Directly unstable & need surgical fixation

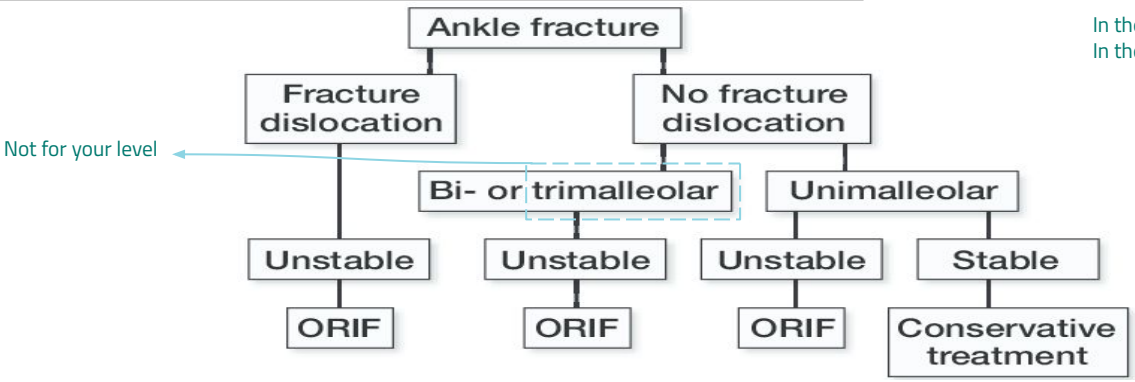
- ORIF with plate & screws (ORIF both bones -/+ syndesmotic screw).

Bimalleolar fracture





In the lateral malleolus: Plate & screws
In the medial malleolus: Screws only



EXTRA

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

Treatment
- medial and middle-third clavicle fractures
  - for nondisplaced fractures, simple sling for 1-2 wk prn
  - early ROM and strengthening once pain subsides
  - if fracture is shortened >2 cm, consider ORIF
- distal-third clavicle fractures
  - undisplaced (with ligaments intact): sling for 1-2 wk
  - displaced (CC ligament injury): ORIF

Specific Complications (see *General Fracture Complications*, OR7)
- cosmetic bump (most common complication)
- shoulder stiffness, weakness with repetitive activity
- pneumothorax, brachial plexus injuries, and subclavian vessel (all very rare)

Open Reduction and Internal Fixation vs. Nonsurgical Treatment in Displaced Midshaft Clavicle Fractures: A Meta-Analysis
J Orthop Trauma 2018;32(7):e276-e283
Purpose: Compare outcomes from ORIF and non-operative treatments in displaced mid-shaft clavicular fractures.
Methods: Meta-analysis with 9 RCTs reporting nonunion, functional outcomes, and subsequent surgeries in patients older than 16 yr.
Results: 9 randomized clinical trials with 1027 total patients were included. ORIF was associated with significantly lower nonunion rate of 1.7% compared to 14.5% for the non-operative treatment groups (RR 0.15, 95% CI, 0.08-0.31). Functional outcomes, rated by either DASH or Constant scores, were significantly better in ORIF up to 6 mo. When excluding elective plate removal, the rate of subsequent surgeries was significantly lower in the ORIF cohort (4.7% vs. 14%, RR 0.36, 95% CI 0.24-0.56).
Conclusions: ORIF is associated with significant reductions in nonunions and earlier functional outcomes in displaced midshaft clavicular fractures.

Associated Injuries with Clavicle Fractures
- Up to 9% of clavicle fractures are associated with other fractures (most commonly rib fractures)
- Majority of brachial plexus injuries are associated with proximal third fractures

EXTRA

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
- physical exam usually reveals diminished forward elevation, with or without disuse atrophy of deltoid and periscapular musculature

Investigations
- test axillary nerve function (deltoid contraction and skin over deltoid)
- x-rays: AP, trans-scapular, and axillary views of the shoulder are essential
- CT scan: to evaluate for tuberosity or articular involvement and fracture displacement, and if the diagnosis of non-union is unclear

Classification
- Neer classification is based on 4 fracture locations or 'parts'
- displaced: displacement >1 cm and/or angulation >45°
- the Neer system regards the number of displaced fractures, not the fracture line, in determining classification
- ± dislocated/subluxed: humeral head dislocated/subluxed from glenoid

Treatment
- assess for and treat osteoporosis if needed
- non-operative
  - nondisplaced and minimally displaced (85% of patients): broad arm sling immobilization, begin ROM within 14 d to prevent stiffness
  - most displaced fractures in low-demand elderly patients
- operative
  - ORIF (anatomic neck fractures, displaced, associated irreducible glenohumeral joint dislocation) or IM nail (surgical neck)
  - hemiarthroplasty or reverse TSA may be necessary, especially in elderly
  - minimally invasive percutaneous pinning and intramedullary nail fixation are indicated in rare instances

Specific Complications (see *General Fracture Complications*, OR7)
- AVN, nerve palsy (45%; typically axillary nerve), malunion, post-traumatic arthritis, persistent pain and weakness, frozen shoulder

Neer Classification
Based on 4 parts of humerus
- Greater tuberosity
- Lesser tuberosity
- Humeral head
- Shaft

One-part fracture: any of the 4 parts with none displaced
Two-part fracture: any of the 4 parts with 1 displaced
Three-part fracture: displaced fracture of surgical neck + displaced greater tuberosity or lesser tuberosity
Four-part fracture: displaced fracture of surgical neck + both tuberosities

EXTRA

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 in dorsum of hand

Investigations
- x-ray: AP and lateral views of the humerus, including the shoulder and elbow joints

Treatment
- in general, humeral shaft fractures are treated non-operatively
- non-operative
  - ± reduction; can accept deformity due to compensatory ROM of shoulder
  - hanging cast (weight of arm in cast provides traction across fracture site) with collar and cuff sling immobilization until swelling subsides, then Sarmiento functional brace, followed by ROM
- operative
  - indications: see *NO CAST* sidebar, OR6, pathological fracture, "floating elbow" (simultaneous unstable humeral and forearm fractures)
  - ORIF: plating (most common), IM rod insertion, external fixation (rare)

Specific Complications (see *General Fracture Complications*, OR7)
- failure of functional bracing (seen in up to 30% of patients)
- 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

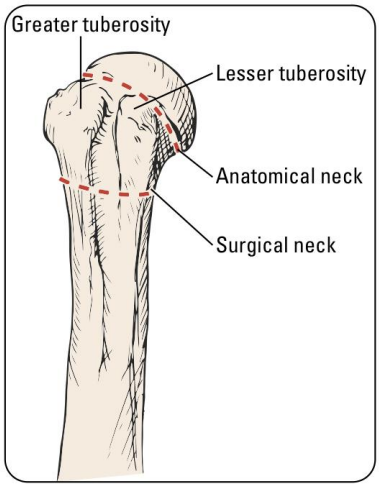


Figure 15. Fractures of the proximal humerus

Acceptable Humeral Shaft Deformities for Non-Operative Treatment
- <20° anterior angulation
- <30° varus angulation
- <3 cm of shortening

Risk of radial nerve and brachial artery injury

EXTRA

Radius and Ulna Shaft Fractures

Mechanism
- high-energy direct or indirect (MVA, fall from height, sports) trauma
- fractures usually accompanied by displacement due to high force

Clinical Features
- deformity, pain, swelling
- loss of function in hand and forearm

Investigations
- x-ray: AP and lateral of forearm ± oblique of elbow and wrist
- CT if fracture is close to joint

Treatment
- goal is anatomic reduction since imperfect alignment significantly limits forearm pronation and supination
- ORIF with plates and screws; closed reduction with immobilization usually yields poor results for displaced forearm fractures (except in children)

Specific Complications (see *General Fracture Complications*, OR7)
- compartment syndrome
- soft tissue contracture resulting in limited forearm rotation – surgical release of tissue may be warranted

Monteggia Fracture

- fracture of the proximal ulna with radial head dislocation and proximal radioulnar joint injury
- more common and better prognosis in the paediatric age group when compared to adults

Mechanism
- direct blow to the posterior aspect of the forearm
- hyperpronation
- fall on the hyperextended elbow

Clinical Features
- pain, swelling, decreased rotation of forearm ± palpable lump at the radial head
- ulna angled apex anterior and radial head dislocated anteriorly (rarely the reverse deformity occurs)

Investigations
- x-ray: AP and lateral views of the elbow, wrist, and forearm

Treatment
- adults: ORIF of ulna with indirect reduction of radiocapitellar joint in 90% of patients (open reduction of radiocapitellar joint if unsuccessful)
- splint and early postoperative ROM if elbow completely stable, otherwise immobilization in plaster with elbow flexed for 2-3 wk
- paediatrics: attempt closed reduction and immobilization in plaster with elbow flexed for Bado Type I-III, surgery for Type IV

Specific Complications (see *General Fracture Complications*, OR7)
- PIN injury: most common nerve injury; observe for 3 mo as most resolve spontaneously
- radial head instability/redislocation
- radioulnar synostosis

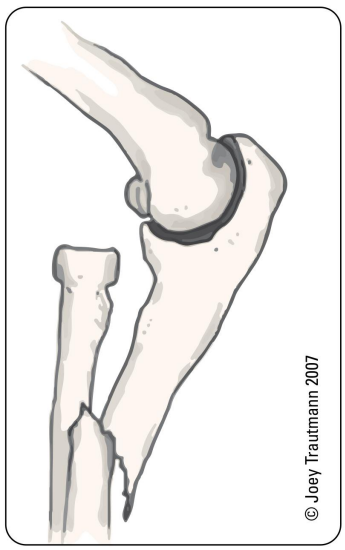


Figure 19. Monteggia fracture

In all isolated ulna fractures, assess proximal radius to rule out a Monteggia fracture

Bado Type Classification of Monteggia Fractures
Based on the direction of displacement of the dislocated radial head, generally the same direction as the apex of the ulnar fracture
Type I: anterior dislocation of radial head and proximal/middle third ulnar fracture (60%)
Type II: posterior dislocation of radial head and proximal/middle third ulnar fracture (15%)
Type III: lateral dislocation of radial head and metaphyseal ulnar fracture (20%)
Type IV – combined: proximal fracture of the ulna and radius, dislocation of the radial head in any direction (<5%)

EXTRA

Galeazzi Fracture

- fracture of the distal radial shaft with disruption of the DRUJ
- most commonly in the distal 1/3 of radius near junction of metaphysis/diaphysis

Mechanism
- FOOSH with axial loading of pronated forearm or direct wrist trauma
- forceful axial loading of radial shaft (e.g. direct trauma to distal 1/3 of radius)

Clinical Features
- pain, swelling, deformity, and point tenderness at fracture site

Investigations
- x-ray: AP, and lateral views of the elbow, wrist, and forearm
  - shortening of distal radius >5 mm relative to the distal ulna
  - widening of the DRUJ space on AP
  - dislocation of radius with respect to ulna on true lateral

Treatment
- all cases are operative ("fracture of necessity")
  - ORIF of radius; afterwards, assess DRUJ stability by balloting distal ulna relative to distal radius
  - if DRUJ is stable and reduced, splint for 10-14 d with early ROM encouraged
  - if DRUJ is unstable, ORIF or percutaneous pinning with long arm cast in supination x 2-3 wk

For all isolated radius fractures assess DRUJ to rule out a Galeazzi fracture

Monteggia vs. Galeazzi Fractures
Remember the mnemonic "**MUGGER**":
Monteggia
Ulnar fracture
Galeazz
Radial fracture

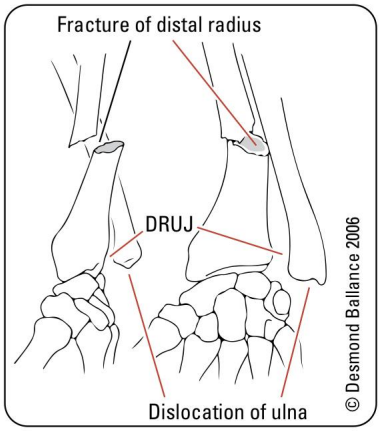


Figure 21. Galeazzi fracture

EXTRA

Colles' Fracture

- extra-articular transverse distal radius fracture (~2 cm proximal to the radiocarpal joint) with dorsal displacement ± ulnar styloid fracture
- most common fracture in those >40 yr, especially in women and those with osteoporotic bone

Mechanism
- FOOSH

Clinical Features
- "dinner fork" deformity
- swelling, ecchymosis, tenderness

Investigations
- x-ray: AP and lateral ± oblique views of wrist

Treatment
- goal is to restore radial height (13 mm), radial inclination (22°), volar tilt (11°), as well as DRUJ stability and useful forearm rotation
- non-operative
  - closed reduction (think opposite of the deformity)
  - hematoma block (sterile prep and drape, local anesthetic injection directly into fracture site) or conscious sedation
  - closed reduction: traction with extension (exaggerate injury); traction with ulnar deviation, pronation, flexion (of distal fragment – not at wrist)
  - dorsal slab/below elbow cast for 5-6 wk
  - obtain post-reduction films immediately; repeat reduction if necessary
  - x-ray at 1 wk, 3 wk, and at cessation of immobilization to ensure reduction is maintained
- operative
  - indication: failed closed reduction, or loss of reduction
  - percutaneous pinning, external fixation, or ORIF

Indications for Direct Surgical Management of Colles' Fracture
- Displaced intra-articular fracture
- Comminuted
- Severe osteoporosis
- Dorsal angulation >5° or volar tilt >20°
- >5 mm radial shortening

Features of Inadequate Closed Reduction that Require ORIF
- Radial shortening >3 mm or
- Dorsal tilt >10° or
- Intra-articular displacement/step-off >2 mm

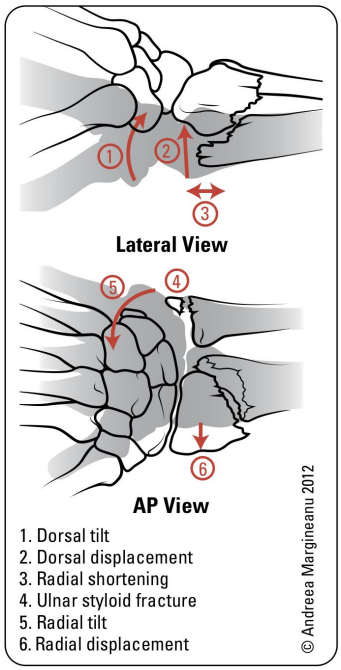


Figure 22. Colles' fracture and associated bony deformity

Smith's Fracture

- volar displacement of the distal radius (i.e. reverse Colles' fracture)

Mechanism
- fall onto the back of the flexed hand

Investigations
- x-ray: AP and lateral ± oblique views of wrist

Treatment
- usually unstable and needs ORIF
- if patient is poor operative candidate, may attempt non-operative treatment
  - closed reduction with hematoma block (reduction opposite of Colles')
  - long-arm cast in supination x 6 wk

Complications of Wrist Fractures

- most common complications are poor grip strength, stiffness, and radial shortening
- distal radius fractures in individuals <40 yr of age are frequently high energy/comminuted and are more likely to require ORIF
- 80% have normal function in 6-12 mo

Table 13. Early and Late Complications of Wrist Fractures

Early	Late
Difficult reduction ± loss of reduction	Malunion, radial shortening
Compartment syndrome	Painful wrist secondary to ulnar prominence
Extensor pollicis longus tendon rupture	Frozen shoulder ("shoulder-hand syndrome")
Acute carpal tunnel syndrome	Post-traumatic arthritis
Finger swelling with venous block	Carpal tunnel syndrome
Complications of a tight cast/splint	CRPS/RSD

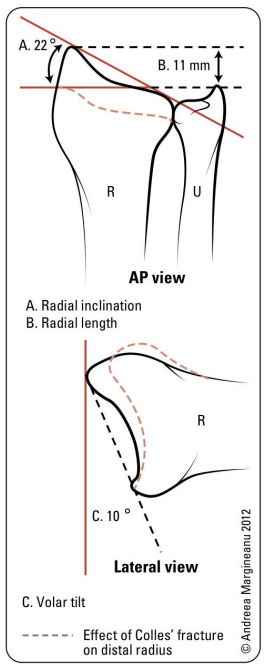


Figure 23. Normal wrist angles+ wrist angles in Colles' fracture
Note the relative shortening of the radius relative to the ulna on AP view in Colles' fracture

Hip Fracture

General Features

- acute onset of hip pain after a fall
- unable to weight-bear
- shortened and externally-rotated leg
- painful ROM

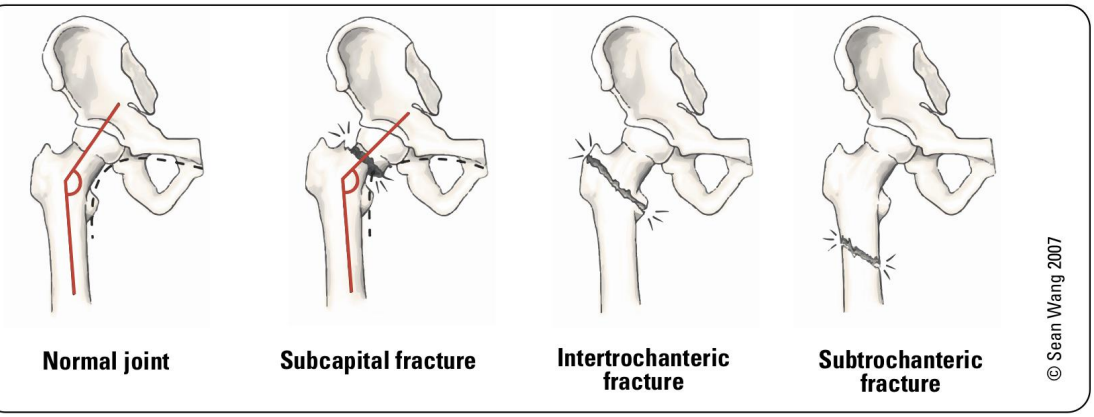


Figure 35. Subcapital, intertrochanteric, and subtrochanteric hip fractures

Table 20. Overview of Hip Fractures

Fracture Type	Definition	Mechanism	Investigations	Treatment	Complications
Femoral Neck (Subcapital)	Intracapsular	Young: MVC, fall from height Elderly: fall from standing, rotational force	X-Ray: AP hip, AP pelvis, cross table lateral hip	See Table 21, OR32	DVT, non-union, AVN, dislocation
Intertrochanteric Stable: intact posteromedial cortex Unstable: non-intact posteromedial cortex	Extracapsular fracture between 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	X-Ray: AP hip, AP pelvis, cross table 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	X-Ray: AP pelvis, AP/ lateral hip and femur	Closed/open reduction under fluoroscopy, then IM nail	Malalignment, non-union, wound infection

Table 21. Garden Classification of Femoral Neck Fractures

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

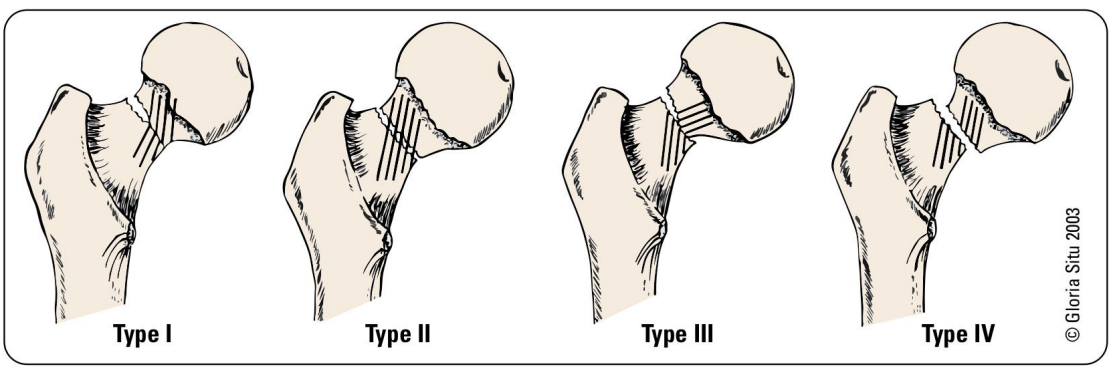


Figure 36. Garden classification of femoral neck fractures

X-Ray Features of Subcapital Hip Fractures

- Disruption of Shenton's line (a radiographic line drawn along the upper margin of the obturator foramen, extending along the inferomedial side of the femoral neck)
- Altered neck-shaft angle (normal is 120-130°)

DVT Prophylaxis in Hip Fractures

LMWH (i.e. enoxaparin 40 mg SC BID), fondaparinux, low dose heparin on admission, do not give <12 h before surgery

AVN of Femoral Head

- Distal to proximal blood supply along femoral neck to head (medial and lateral femoral circumflex arteries)
- Susceptible to AVN if blood supply disrupted
- Etiology: femoral neck fracture, chronic systemic steroid use, SCFE, Legg-Calvé-Perthes, SLE, RA

Comparative Effectiveness of Pain Management Interventions for Hip Fracture: A Systematic Review

Ann Intern Med 2011;155(4):234-245

Study: Randomized controlled trials (RCTs); nonrandomized controlled trials (non-RCTs); and cohort studies of pain management techniques in older adults after acute hip fracture.

Conclusions: Nerve blockade seems to be effective in reducing acute pain after hip fracture. Low-level evidence suggests that preoperative traction does not reduce acute pain. Evidence was insufficient on the benefits and harms of many other interventions.

EXTRA

Femoral Diaphysis Fracture

Mechanism
- high energy trauma (MVC, fall from height, gunshot wound)
  - pathologic as a result of malignancy, osteoporosis, bisphosphonate use
- in children, can result from low energy trauma (spiral fracture)
  - always consider the possibility of non-accidental trauma

Clinical Features
- shortened, externally rotated leg (if fracture displaced)
- inability to weight-bear
- often open injury, always a Gustilo III (see Table 6, OR10)
- Winquist and Hansen classification

Investigations
- x-ray: AP pelvis, AP, and lateral views of the hip, femur, knee

It is important to rule out ipsilateral femoral neck fracture, as they occur in 2-6% of femoral diaphysis fractures and are reportedly missed in 19-31% of cases

Treatment
- non-operative (paediatric, uncommon in adults)
  - possible indication: non-displaced femoral shaft fractures in patients with significant comorbidities who are non-ambulatory
  - most femoral shaft fractures require fixation as this is a life-threatening injury
- operative
  - ORIF with anterograde IM nail (most common) or retrograde IM nail or with plate and screw fixation
  - external fixation may be used initially (e.g. unstable patients or polytrauma patients)
  - early mobilization and strengthening

Complications
- blood loss
- infection
- fat embolism leading to ARDS
- VTE
- malrotation, leg length discrepancy
- malunion/nonunion

Associated Injuries
- extensive soft tissue damage
- ipsilateral hip dislocation/fracture (2-6%)
- nerve injury

EXTRA

Tibial Shaft Fracture

- most common long bone fracture and open fracture

Mechanism
- low energy pattern: torsional injury
- high energy: including MVC, falls, sporting injuries

Clinical Features
- pain, inability to weight bear, deformity
- open vs. closed
- neurovascular compromise

Investigations
- x-ray: full length AP and lateral views
  - AP, lateral, and oblique views of ipsilateral knee and ankle

Treatment
- non-operative
  - indication: closed and minimally displaced or adequate closed reduction
  - long leg cast x 6-8 wk, convert to functional (patellar tendon bearing) brace after
- operative
  - indication: displaced or open
  - if displaced and closed: ORIF with IM nail, plate and screws, or external fixator
  - if open: antibiotics, I&D, external fixation or IM nail, and vascularized coverage of soft tissue defects

Specific Complications (see *General Fracture Complications*, OR7)
- significant incidence of compartment syndrome and neurovascular injury
- knee pain (>50% anterior knee pain with infrapatellar IM nailing)
- malunion, nonunion
- lack of soft tissue coverage secondary to open fracture may require further surgery for muscle flap coverage and can lead to poor outcome

Figure 45. Tibial shaft fracture treated with IM nail and screws

Tibial shaft fractures have high incidence of compartment syndrome and are often associated with soft tissue injuries

EXTRA

Ankle Fracture

Mechanism
- pattern of fracture depends on the position of the ankle when trauma occurs
- classification systems
  - Danis-Weber: based on location of main fibular fracture line relative to the syndesmosis
  - Lauge-Hansen: based on foot position and direction of applied stress/force

Treatment
- non-operative
  - indication: non-displaced, Danis-Weber Type A, and some isolated Danis-Weber Type B
  - NWB in below knee cast, or weight bearing as tolerated in walking boot
- operative
  - indications
    - fracture-dislocation: restore vascularity, minimize articular injury, reduce pain and skin pressure
    - most Danis-Weber Type B, and all Type C
    - any talar displacement
    - displaced isolated medial or lateral malleolar fracture
    - trimalleolar (medial, posterior, lateral) fractures
    - displaced and large posterior malleolar fractures
    - persistent medial clear space widening despite attempt at closed reduction and immobilization
    - open fracture/open joint injury
  - ORIF with plates and screws

Complications
- risk of poor wound healing and deep infections (up to 20%) in patients with DM, particularly if concomitant peripheral neuropathy
- postoperative stiffness
- malunion, nonunion
- post-traumatic arthritis

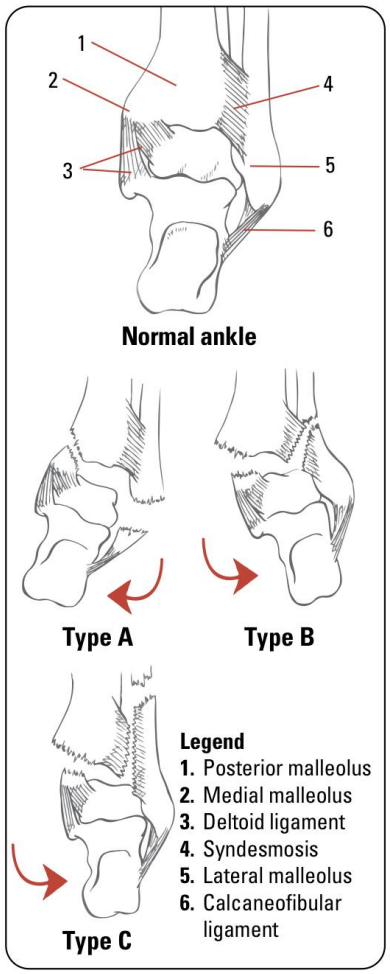


Figure 46. Ring principle of the ankle and Danis-Weber classification

Danis-Weber Classification
- Based on level of fibular fracture relative to syndesmosis
- Type A (infra-syndesmotic)
- Pure inversion injury, tibiofibular syndesmosis remains intact
- Avulsion of lateral malleolus below plafond or torn calcaneofibular ligament
- ± shear fracture of medial malleolus
- Type B (trans-syndesmotic)
- External rotation and eversion (most common)
- ± avulsion of medial malleolus or rupture of deltoid ligament
- Spiral fracture of lateral malleolus starting at plafond
- Type C (supra-syndesmotic)
- Pure external rotation
- Avulsion of medial malleolus or torn deltoid ligament
- ± posterior malleolus avulsion with posterior tibio-fibular ligament
- Fibular fracture is above plafond
- Frequently tears syndesmosis

Extra

Click here
for
Notes from 439 based on (AMBOSS, PubMed & some google researches) for some explanations!

Quiz

Q1: A 22-year-old male had ORIF with plate & screws after a fracture in his humerus, what neurological deficit could happen in his situation?

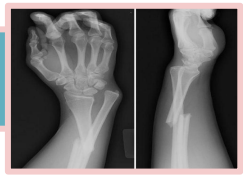
A. Loss of wrist extension

B. Loss of thumb opposition

C. Loss of sensation over the medial 2 fingers

D. Loss of sensation over the medial aspect of the arm

Q2: Which type of fracture is shown on the image?



A. Galeazzi

B. Barton

C. Monteggia

D. Chauffeur

Q3: Which of the following is the best treatment for an elderly with an intracapsular fracture?

A. IM nail

B. Hemiarthroplasty

C. DHS

D. Percutaneous in situ fixation

Q4: A 17-year-old football player had an direct injury to his shoulder, X-ray showed dislocated shoulder anteriorly. What concomitant sign can you see clinically?

A. Deltoid atrophy

B. Claw hand

C. Wrist drop

D. Thenar atrophy

Q5: Which of the following is the best management option for a clavicular fracture with skin tenting?

A. Immobilization with arm sling

B. Immobilization with figure of 8

C. Closed reduction and K-wires

D. ORIF with plate & screws

1:A 2:A 3:B 4:A 5:D

Quiz

SAQs

441 & 439:

1. Name 4 types of distal radius fracture?
   1- Colles' fracture
   2- Smith's fracture
   3- Barton's fracture
   4- Chauffeur's fracture

2. Name 4 indications of operative treatment of humerus fracture?
   1- Segmental fracture
   2- Open fracture
   3- Obese patient
   4- Bilateral fracture

3. What is the treatment for a displaced intracapsular femoral neck fracture in a 75 old lady?
   - Hemiarthroplasty

4. Which nerve might be affected in a proximal humeral fracture?
   - Axillary nerve

Team Leader

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Done by

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Abdulrahman Alroqi
Abdullah Alomran

وفّقكم الله

This work was originally done by team 438 & 439