جـامعـة المعـرفـة
UNIVERSITY of ALMAAREFA

Principles of Fractures

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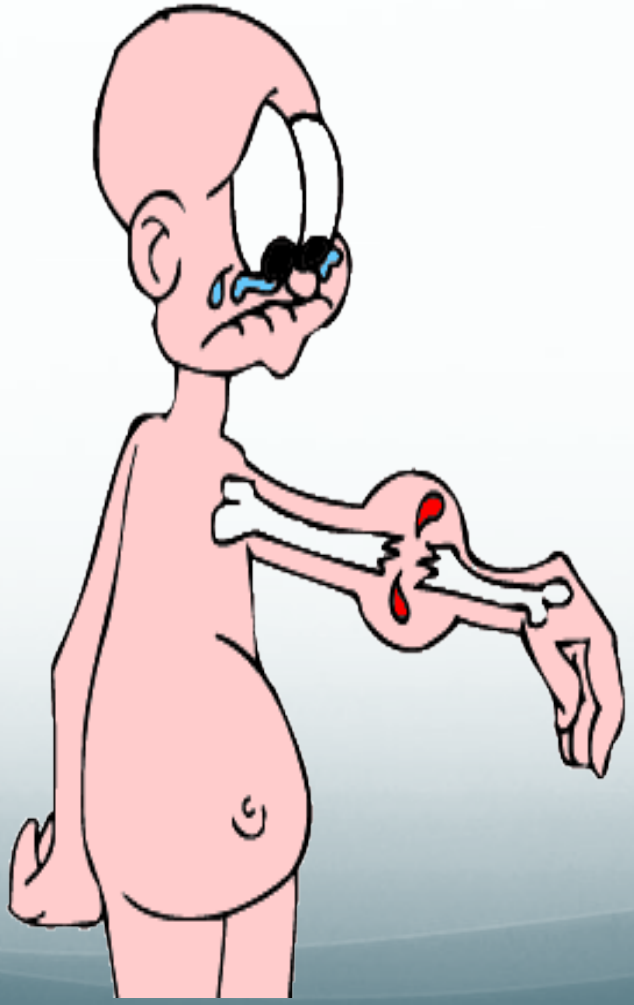
Objectives

- What is a Fracture – the soft tissue part
- Fracture types / classification
- Relation between fracture and force
- History and physical exam. In fractures
- Principles of imaging

What is a fracture?

- A fracture is a break in the structural continuity of bone



What is a fracture?

- A fracture is a break in the structural Discontinuity of bone
  - Always associated with some soft tissue injury Fibuol is always lateral
- A fracture is a soft tissue injury in which the underlying bone is broken!

Type of injury

- Mechanism of injury helps expect the
  - Extent and type of bone injury
    - Simple / comminuted / complex
      More than 2 pice
    - Associated fractures/injuries
      - Fall from height on feet
        - fractured calcaneus and lumbar spine
      - Car dashboard injuries
        - fractured patella and hip dislocation
  - Extent of soft tissue injury
  - Suggested treatment and reduction technique
  - Prognosis

Type of injury

- Fall: height, point of impact, twist

https://nationaltradesmen.co.uk/

Type of injury

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- Sport: type, direction of force

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- Road traffic accident (RTA):
  - Car (MVA) , motorcycle, pedestrian

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- Heavy object fall:
  - TV, wall, metal, earthquake

Type of injury

- Fall: height, point of impact, twist
- Sport: type, direction of force
- Road traffic accident (RTA):
  - Car (MVA) , motorcycle, pedestrian
- Heavy object fall:
  - TV, wall, metal, earthquake
- Assault & firearms / blast

http://simple.wikipedia.org/wiki/Blast_injury

Mechanism of Injury

- Low energy
- High energy

Need to Differentiate

Mechanism of Injury

- Low energy
- High energy

- Direction of force

Mechanism of Injury

- Low energy
- High energy

- Direction of force

- Blunt / Sharp
- Closed / Open

When the hematoma is exposed to the external environment

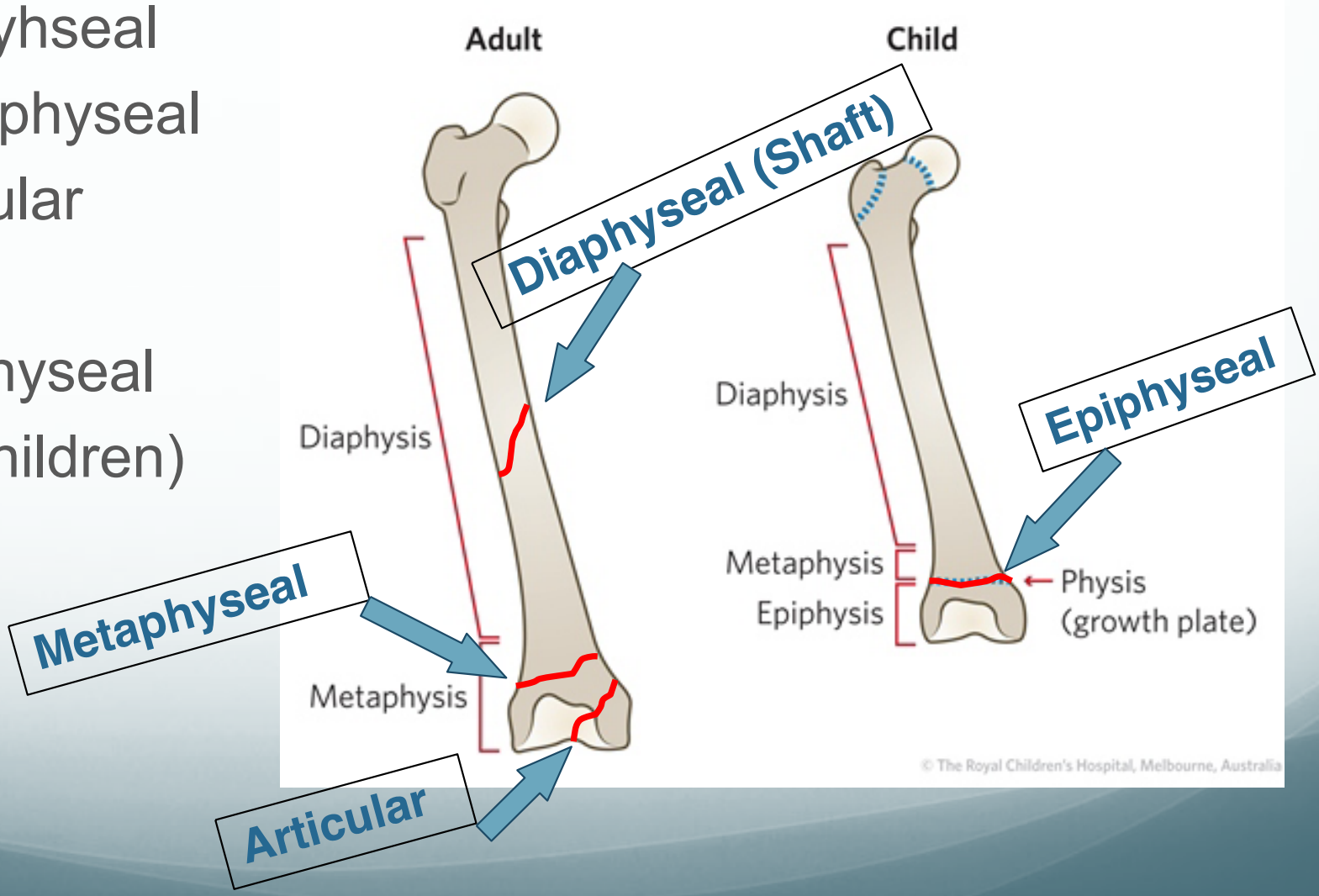
Energy dissipated during injury

Kinetic Energy = ½ MV^2

- If a Simple fall = 1
- Skiing injury = 3-5
- High-velocity gunshot = 20
- Car bumper (25 km/hr) = 100

Fracture Classification

- According to site of Fracture:
  - Diapyhseal
  - Metaphyseal
  - Articular
  - Epiphyseal (in children)



Fracture Classification

- According to fracture line:
  - Complete (usual)
    - Cortex fractured on both sides

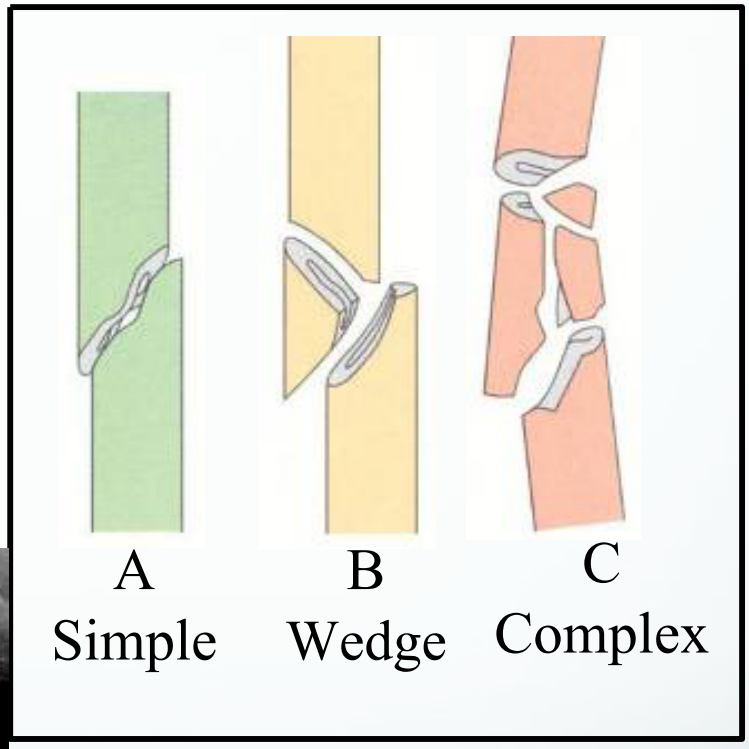
https://orthoinfo.aaos.org

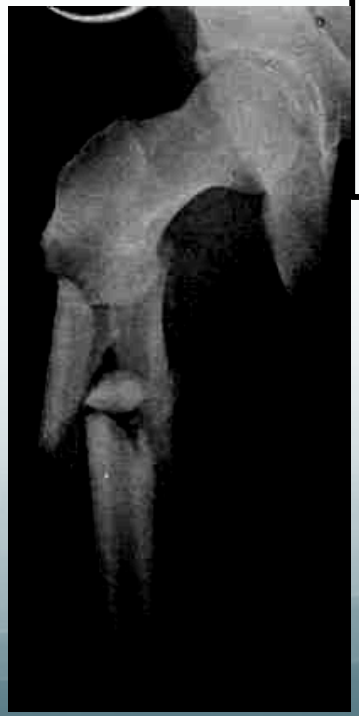
Fracture Classification

- According to fracture line:
  - Complete (usual)
    - Cortex fractured on both sides
  - Incomplete (in children)
    - Green stick / Torus, Buckle /Deformation

Fracture Classification

- According to fracture pattern:
  - Simple
  - Wedge comminuted
  - Complex comminuted
    - Multi-fragmented



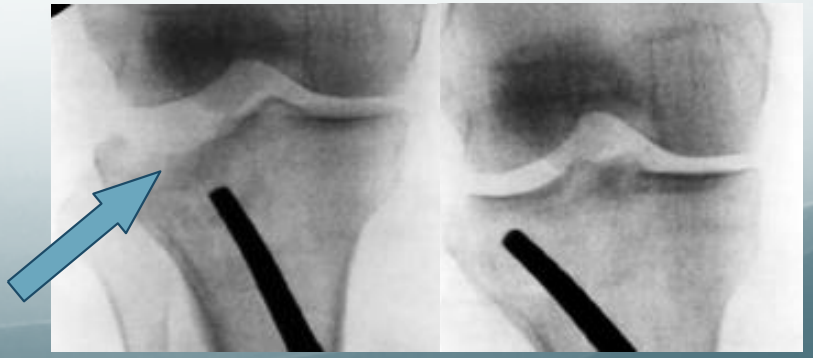


Fracture Classification

- According to fracture pattern:
  - Compressed

http://www.wikiradiography.net/

  - Depressed



J Korean Fract Soc. 2014 Jul;27(3):245-250

Fracture Classification

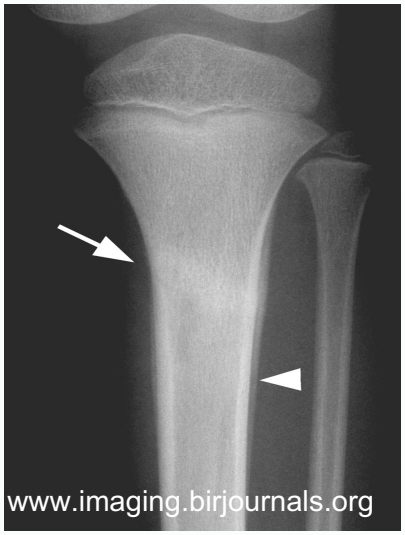
- According to type of injury (force):
  - Ordinary fracture
    - Expected from force of injury
  - Stress fracture
    - Repetitive loading
  - Pathological fracture
    - Force too weak to cause fracture
    - Bone is pathologically weak
  - Avulsion fracture
    - Resisted muscle action, or where ligaments and tendons pull a bone fragment off

Stress Fractures

- Bone reacts to repeated loading, may become fatigued & a crack develops
- Fatigue fractures
  - Abnormal stress or torque on a bone that has normal elastic resistance
  - Examples:
    - military recruits, athletes, ballet dancers
- Insufficiency fractures
  - Normal muscular activity stresses a bone that is deficient in mineral or elastic resistance

Stress Fractures

- Fatigue fractures
  - Usually Transvers
    - 2nd metatarsal
    - Tibia
    - Fibula



- Insufficiency fractures
  - In osteopenia, osteomalacia
    - Neck of femur
    - Ribs
    - Neck of humerus
    - Scapula

Pathological fractures

- Fractures caused by trivial force on abnormally weak bone. Seen in:
- Local bone disease
  - Osteomyelitis
  - Benign tumors and Bone cysts
  - Malignant tumors and matastasis
- Generalized disease
  - Metabolic: osteoporosis, rikets
  - Congenital: osteogenesis imperfe
  - Others: Paget's disease

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  - Others: Paget's disease

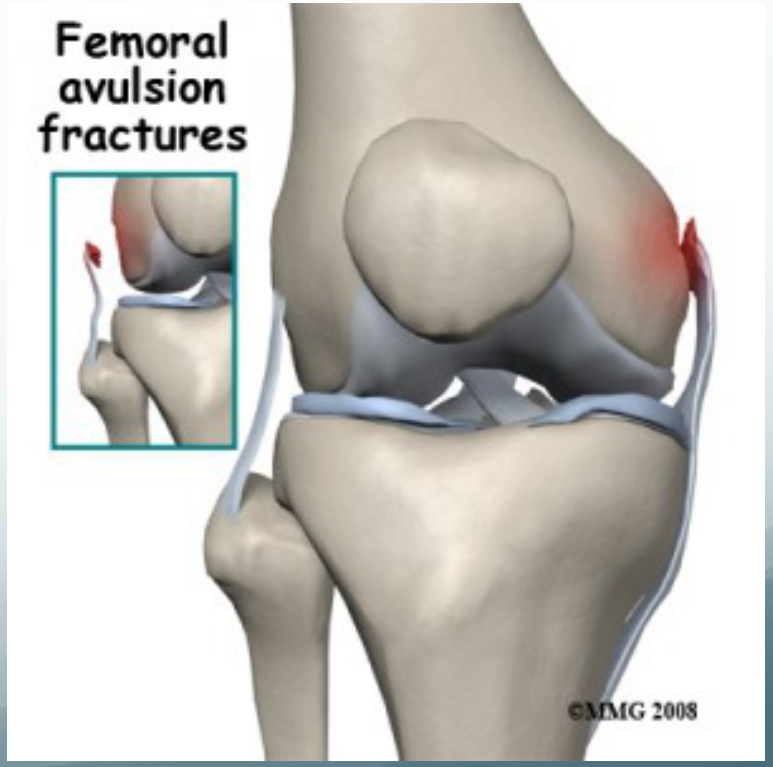
Force & Fractures

- Normal bone:
  - Strong force: ordinary fracture
  - Repetitive stress: Stress (fatigue) fracture
- Weak bone (Pathological fracture)
  - Weak (trivial) force: pathological fracture
  - Normal daily activity: Insufficiency fracture

Quality of Bone	Type of Force	Type of Fracture
Normal	Strong	Normal
Normal	Repetitive loading	Stress - fatigue
Abnormal - weak	Normal daily activities	Stress - insufficiency
Abnormal - weak	Trivial injury	Pathological

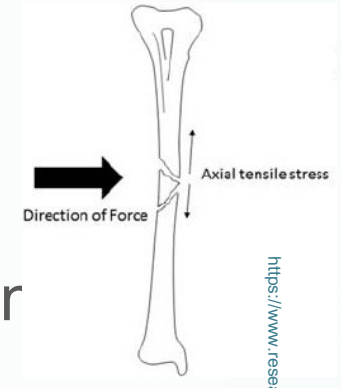
Avulsion fractures

- Part of bone separated by forceful sudden resisted muscle action
  - Caused by ligament or tendon pull on bone
  - Part of bone avulsed – bone weaker than tendon/ligament

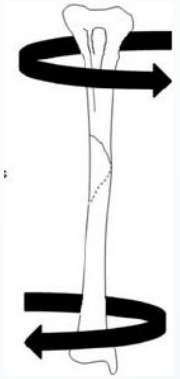


Type of injury

- Direct
  - Mild force: transverse / Severe force: comminution
  - Soft tissue more injured
- Indirect
  - Pattern of fracture depends on force direction
  - Less soft tissue injury
- Penetrating
  - Missiles
    - Low velocity < 300 m/s - damage along the tract
      - Comminution
    - High velocity: >300m/s - sever comminution
      - Comminution with wide soft tissue damage

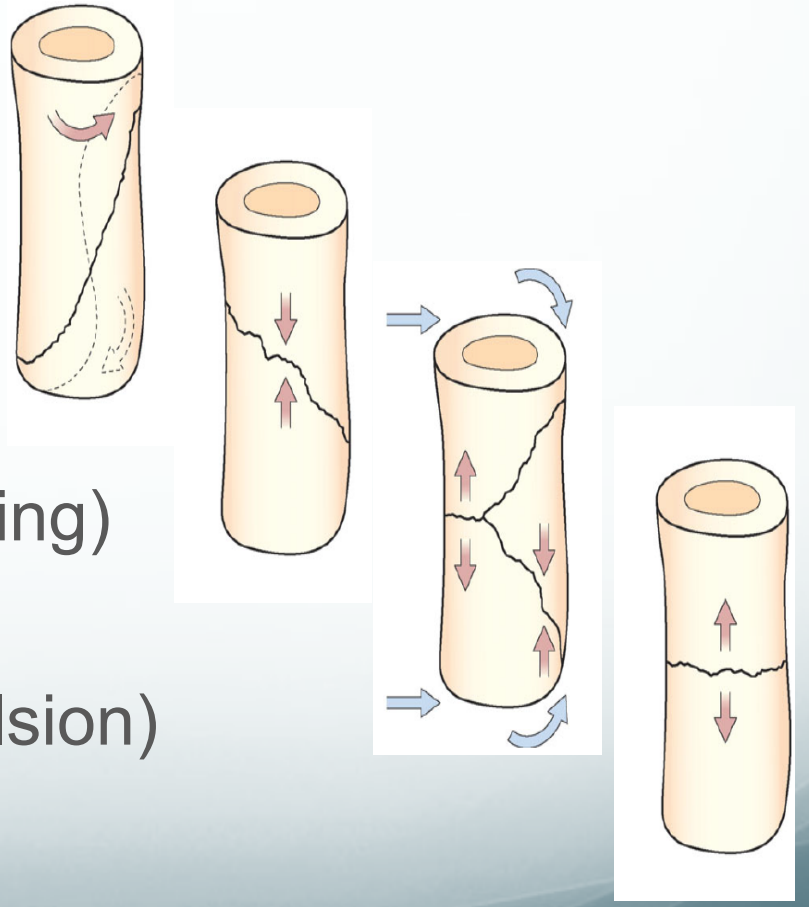


https://www.researchgate.net/publication/236633377_

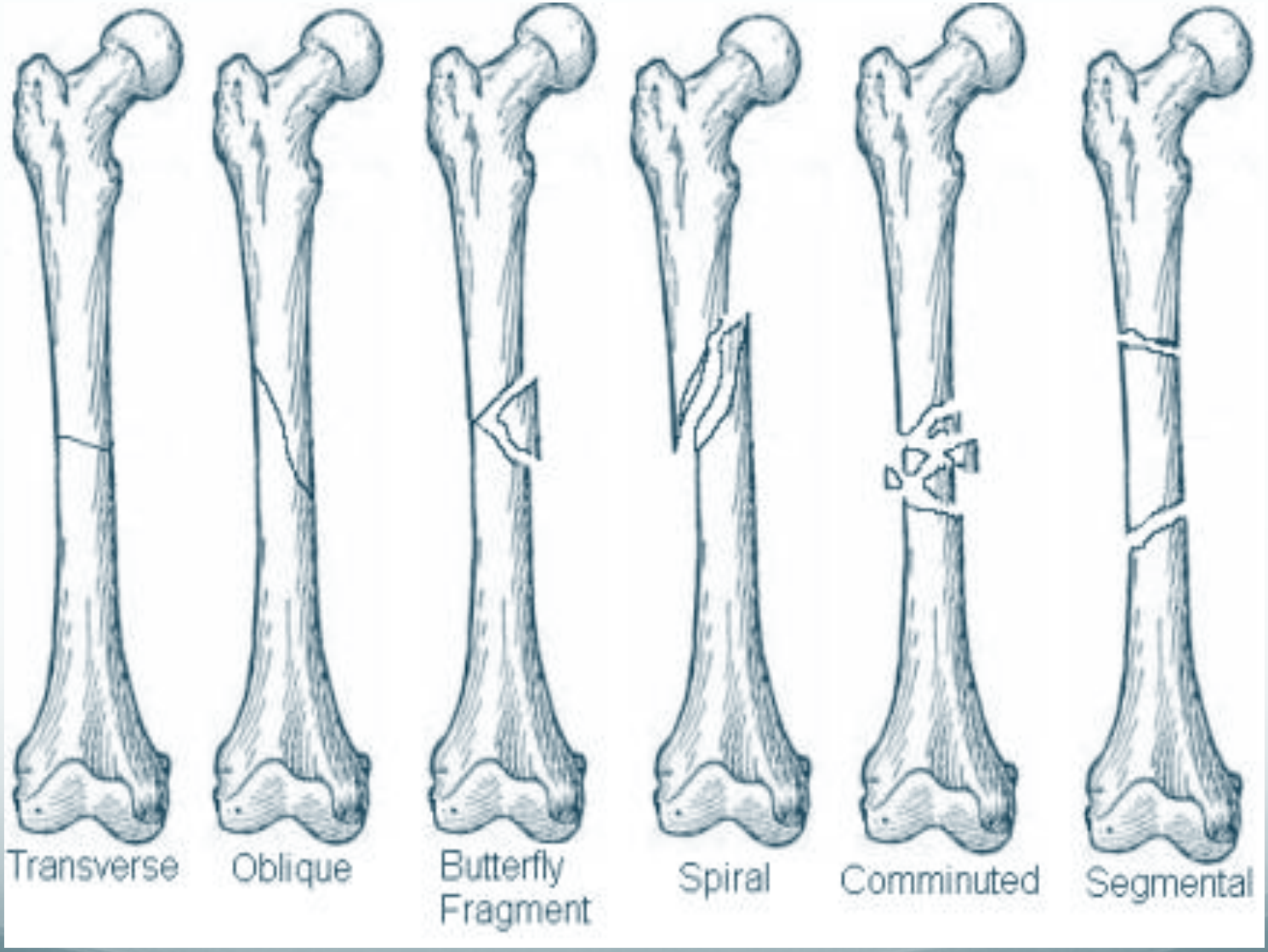


Force & fracture pattern

- Fracture pattern suggests mechanism of force
  - Spiral: (twisting)
  - Short oblique: (compression)
  - Wedge: (compression + bending)
  - Transverse: (angulation) (avulsion)



Force & fracture pattern



Coffee Break

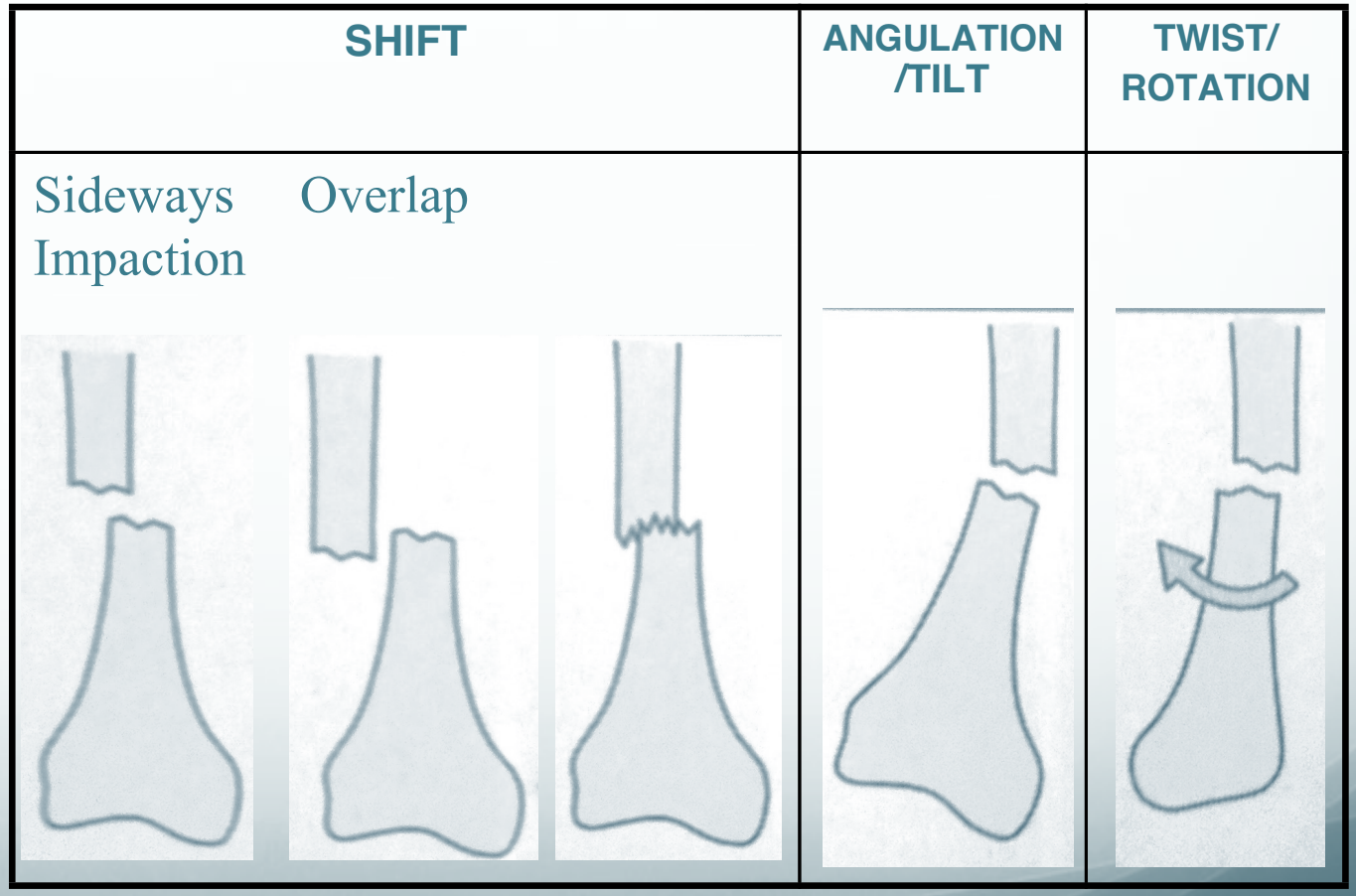
Displacement

- Described as: Position of distal in relation to proximal
  - Un-displaced
  - Displaced

Displacement

- Described as: Position of distal in relation to proximal

- Un-displaced
- Shift
  - Sideways
  - Shortening
  - Distraction
- Angulation
  - In all planes
- Rotation



Displacement

- Described as: Position of distal in relation to proximal

- Un-displaced
- Shift
  - Medial / Lateral
  - Anterior / Posterior
  - Shortening (overlap)
  - Distraction
- Angulation
  - In all planes
- Rotation

Displacement

- Described as: Position of distal in relation to proximal

- Un-displaced
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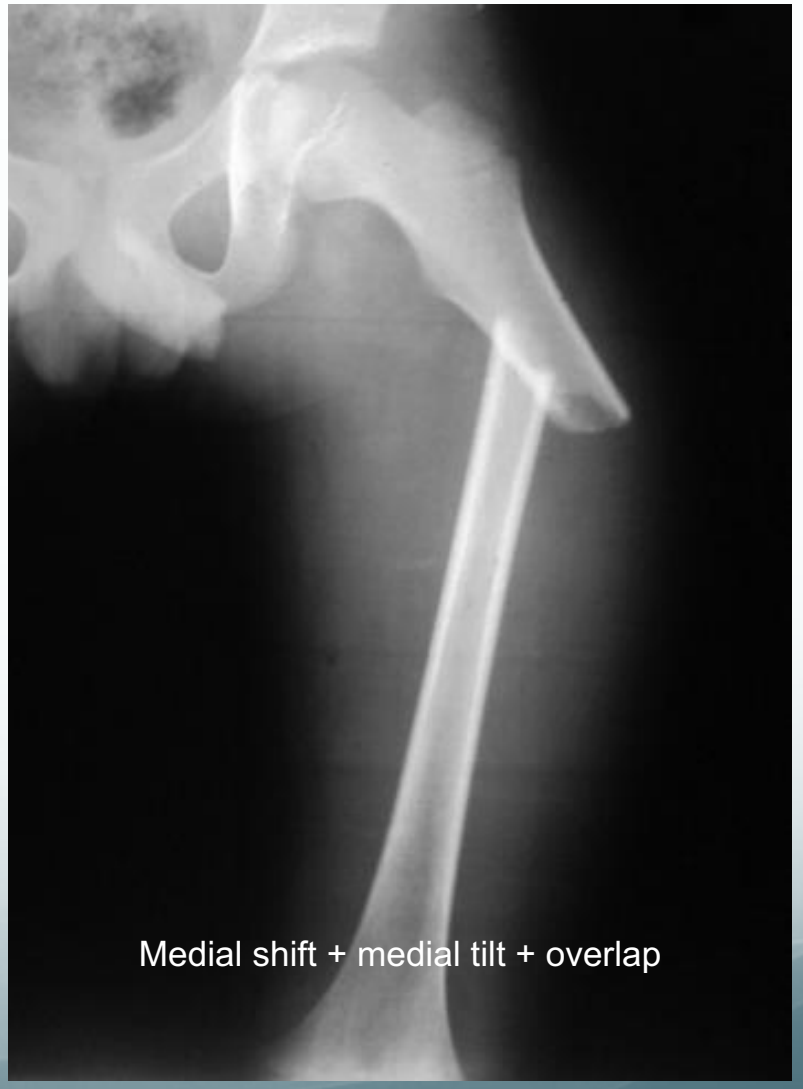


http://medpic.org

Fracture Diagnosis

- History
- Clinical features
- Imaging: Radiology (x-Ray)

Trauma History

- Mechanism of injury
  - Date, time, type, method of impact, …
- Consciousness
- Function of injured part
- Open wound / bleeding
- Other injuries
- Anti-Tetanus status (if skin breached)

Approach - history

- Details of injury
  - Mechanism, force, bleeding, consciousness, …
- Details of facture
  - Deformity, pain, loss of function, ..
- Other medical problems
- Anti-tetanus status if open injuries
- Careful:
  - Fractures are not always at the site of impact
  - Some fractures do not need severe force

Shall be discussed separately

Clinical Features

- History of Trauma
- Symptoms and signs:
  1. Pain
  2. Swelling
  3. Deformity
  4. Loss of function
  5. Localised bony tenderness
  6. Loss of motion
  7. Abnormal movement
  8. Crepitus

Approach – clinical exam

- General medical condition
  - Should be evaluated to exclude
    - Shock
    - Brain injury
    - Other problems
- Vital signs
  - Should be observed and followed up

Approach – clinical exam

- Look:
  - Adequate exposure
  - General on patient
  - Local:
    - Swelling, deformity, bruises, color, …
    - Special attention is to be paid to wounds

Approach – clinical exam

- Feel:
  - Localized bone Tenderness
  - Pulse distal to injury – capillary refill
  - Sensory and motor deficits
  - Compartment syndrome
  - Temperature and crepitus on movement
- Move:
  - With care
    - make sure not to cause more pain or injury
  - Crepitus & abnormal movement indicates a fracture
  - Joints distal to the affected area

Approach – clinical exam

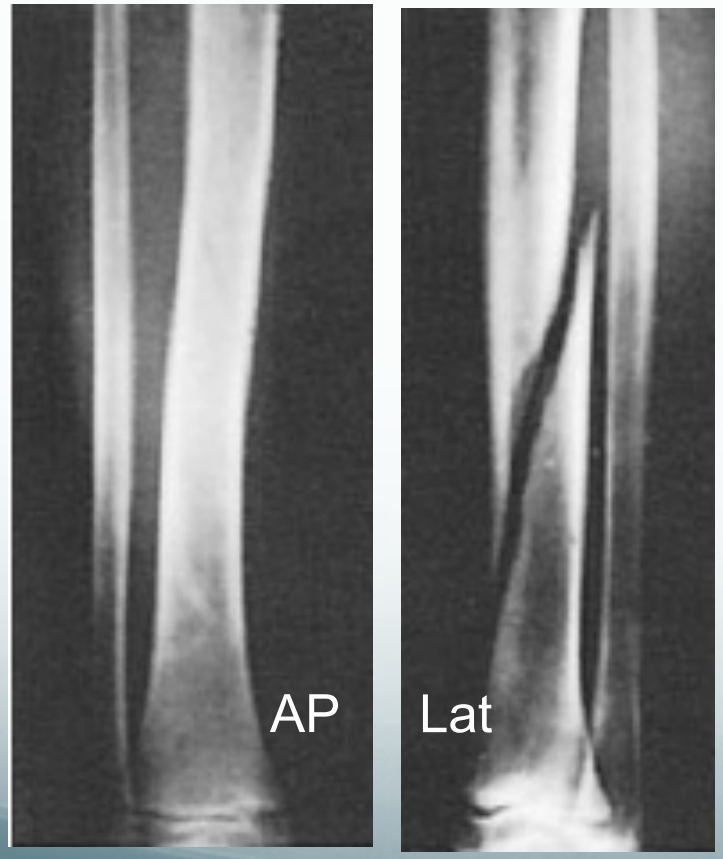
- Examination of the viscera
  - Liver and spleen in rib fractures
  - Urinary bladder and urethra in pelvic fractures
  - Neurological examination in head and spinal injury

Investigations - Imaging

- X-rays:
  - Low of 2s
    - Two views: AP and Lateral – special views
    - Two joints: Above and Below
    - Two sides: Right and Left
    - Two occasions
    - Two injuries
    - Two Doctors !
  - Special views:
    - Obliques, Tunnel view, skyline, stress views,
    - functional flexion/extension, traction films
    - Arthrography:
      - Shows intra-articular structures
    - Functional in hip

Imaging

- Plain x-ray: (law of twos)
  - Two views: AP and Lateral



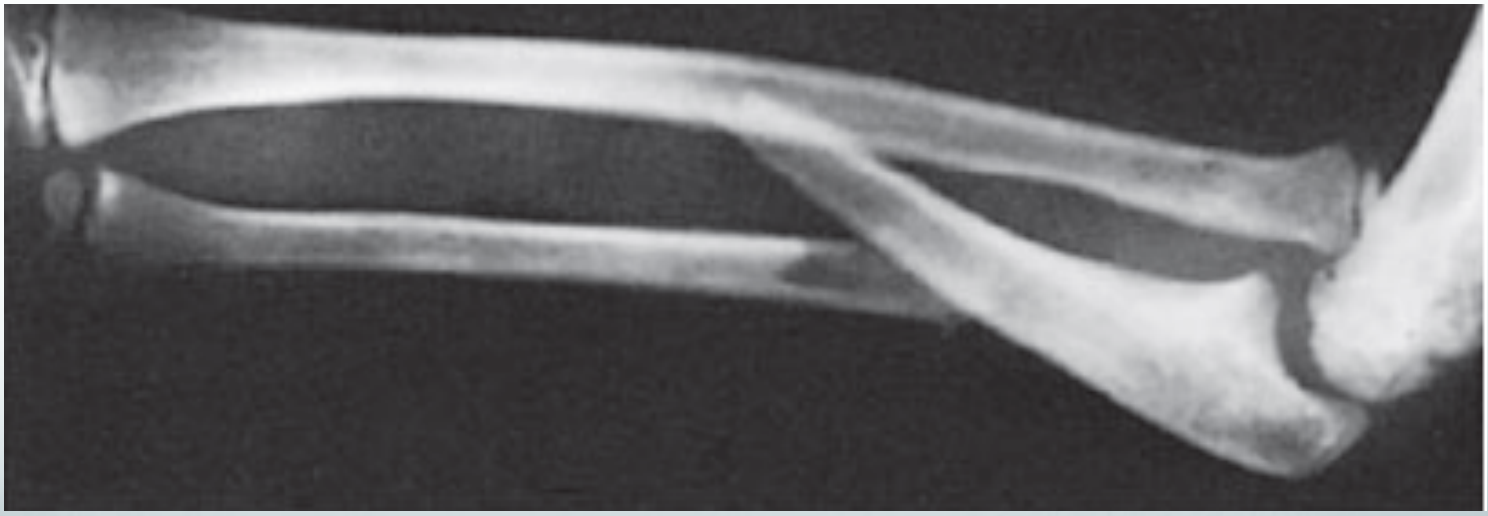
Apley's System of Orthopedics & Fractures

Imaging

- Plain x-ray: (law of twos)
  - Two views: AP and Lateral

Imaging

- Plain x-ray: (law of twos)
  - Two views: AP and Lateral
  - Two joints: joint above and joint below
    - To show other injuries

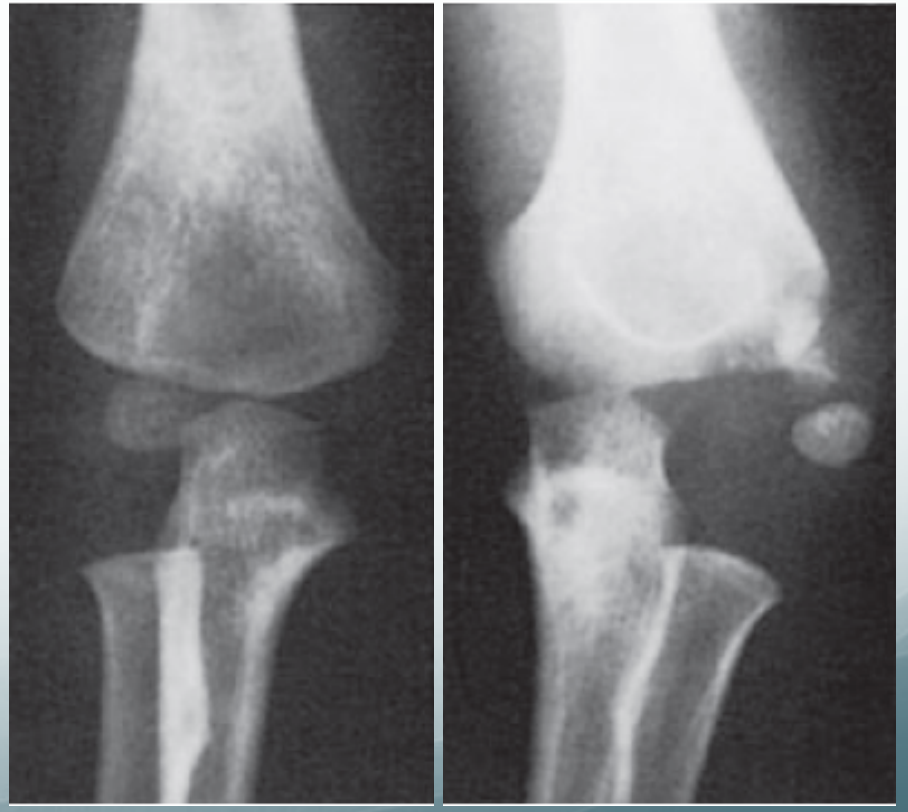


Imaging

- Plain x-ray: (law of twos)
  - Two views: AP and Lateral
  - Two joints: joint above and joint below
    - To show other injuries
    - To assess rotation

Imaging

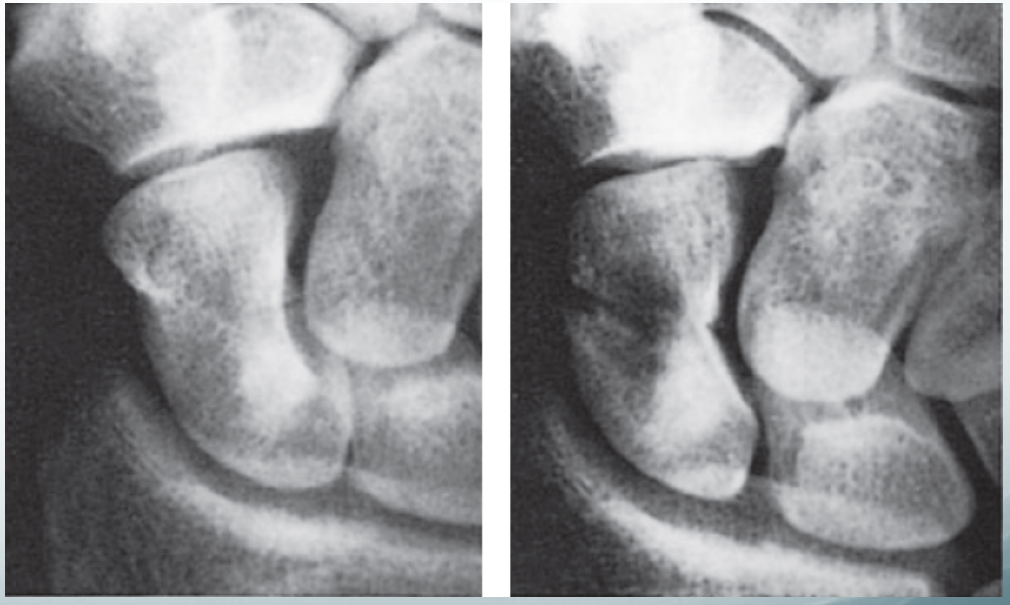
- Plain x-ray: (law of twos)
  - Two views: AP and Lateral
  - Two joints: joint above and joint below
  - Two limbs: for comparison
    - more in children to compare epiphysis



Apley's System of Orthopedics & Fractures

Imaging

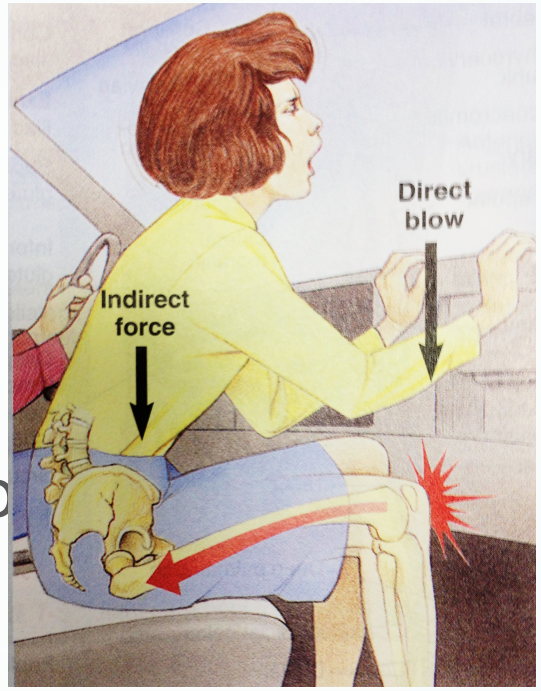
- Plain x-ray: (law of twos)
  - Two views: AP and Lateral
  - Two joints: joint above and joint below
  - Two limbs: for comparison
  - Two occasions
    - e.g. stress fractures
    - e.g. scaphoid fracture



Apley's System of Orthopedics & Fractures

Imaging

- Plain x-ray: (law of twos)
  - Two views: AP and Lateral
  - Two joints: joint above and joint belo
  - Two limbs: for comparison
  - Two occasions
  - Two injuries
    - e.g. patellar fracture and hip injury
    - e.g. calcaneal fractures & spine injuries



Imaging

- Plain x-ray: (law of twos)
  - Two views: AP and Lateral
  - Two joints: joint above and joint below
  - Two limbs: for comparison
  - Two occasions
  - Two injuries
  - .....and two Doctors!!

www.123rf.com/

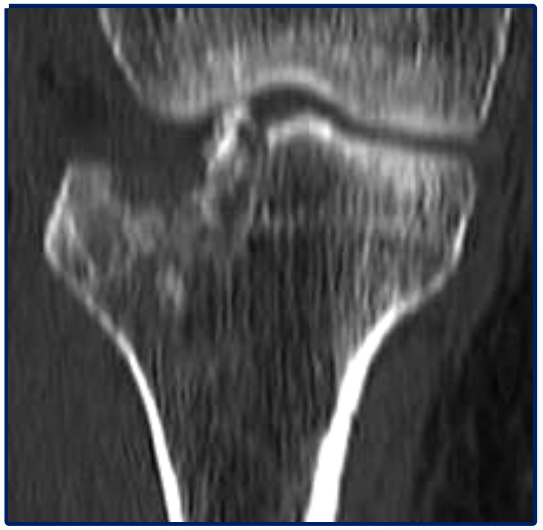
Imaging

- Plain x-ray: (law of twos)
- Special views:
  - Ankle mortis
  - Calcaneal view
  - Scaphoid views
  - Shoulder dislocation: axial view
  - Acetabular fractures: 45° tilt views
  - Stress views
  - Traction views
  - Functional flexion/extension (spine)

https://radiopaedia.org

Imaging

- CT Scan:
  - In complex and ntra-articular fractures
  - In spine
  - In pelvic and acetabular fractures
  - In calcaneal fractures



Summary

- What is a Fracture – the soft tissue part
- Fracture types - classification
- Relation between fracture and force
- Principles of imaging – Law of “Two”s