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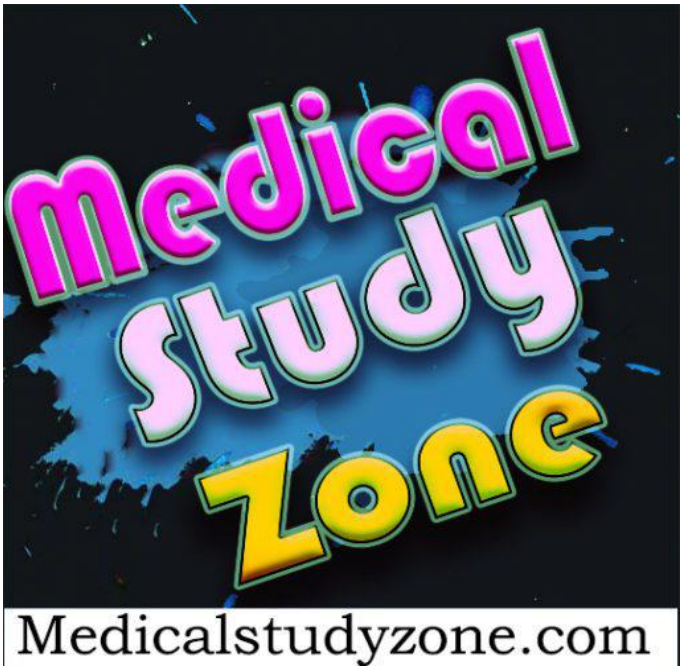

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BONE IMAGING

Introduction and History of Orthopaedics

→ Term coined by **Nicolas Andry**

→ Ortho – Straight, Pedis- Child

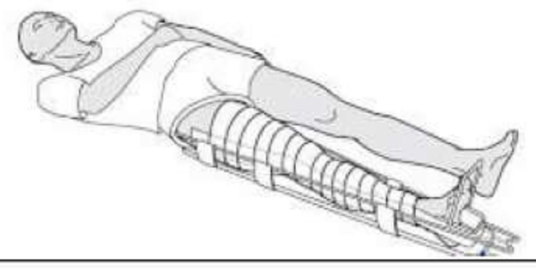
→ **Nicolas Andry** wrote the 1st book of orthopedics
& the emblem of orthopedics

→ H.O. Thomas

↓

Collar → for cervical spine injuries	
Wrench → for correction of Deformities	

PrepLadder

Test → for Hip flexion deformity	
Splint → for lower limb -> TB of knee (designed for his wife)	
CTEV (Congenital Talipes Equino Varus)	Shoes

Rule of splintage → To immobilize one joint above & one joint below

→ Father of British Orthopedics - H.O. Thomas

→ Father of Orthopedics - Nicolas Andrey > H.O Thomas

→ Father of Modern Orthopedics - Robert Jones (Nephew of Thomas)

→ Largest Joint of body - Knee

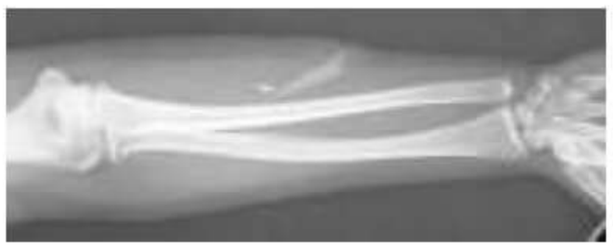
→ Father of Arthroscopy - Watanabe

→ Father of Arthroplasty- Charnley

PrepLadder

Approach to normal limb X-rays in Orthopaedics

A. Cortex [Fracture → microscopic/macroscopic break in the continuity of the Cortex]
   Marrow- Diseases and intraosseous tumors
   Soft tissue plane
B. In Osteomyelitis, earliest radiological feature is **loss of soft tissues planes after 24 hours > Periosteal reaction (7 – 10 days)**
C. In Tuberculosis, earliest radiological feature is **loss of Curvature of Spine** > Reduced disc space
D. Joint space is cartilage (which is not seen on X-rays) & reduction of Joint space refers to arthritis



X- rays is the first investigation for glass injury

In Osteoarthritis of Knee joint, the medial compartment of knee joint is destroyed leading to reduction in joint space and distal part is deviated medially – Varus

In Rheumatoid Arthritis distal part is deviated laterally – Valgus (Knock Knee)

PrepLadder

Valgus–Rheumatoid arthritis

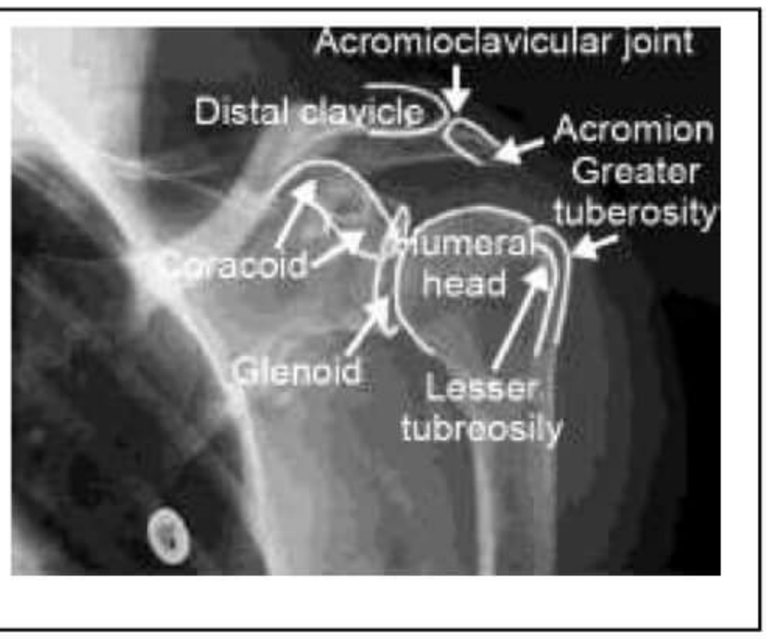
Varus–Osteoarthritis

Shoulder joint

→ Ratio between Head of Humerus and Glenoid – 4 :1 **"Golf ball on a Tee"**

→ Clavicle is the highest bony landmark in AP X-ray of shoulder

→ In the infraclavicular fossa, the bony landmark palpable is **coracoid.**



ELBOW

→ Capitulum is first center to ossify around elbow

→ Radial Head is the second center to ossify.

Ossifications around elbow

Mn: **C R I T O E**

→ **C**apitulum -2 years

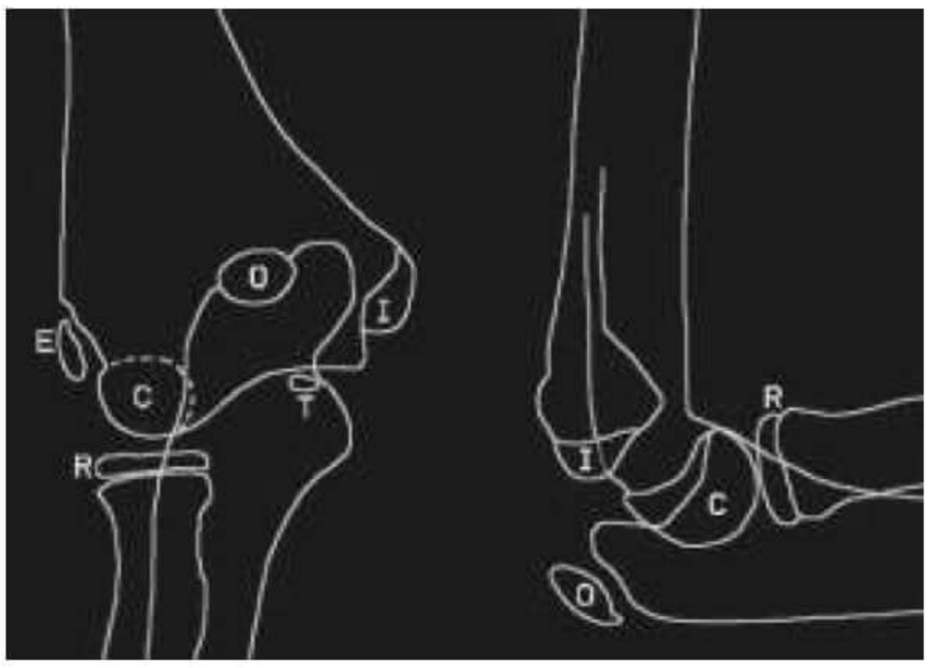
→ **R**adial head – 4 years

→ **I**nner/medial epicondyle – 6 years

→ **T**rochlea – 8years

→ **O**lecranon -10 years

→ **E**xternal/lateral epicondyle – 12 years



PrepLadder

WRIST

Radiocarpal Joint

→ Lunate comes out & other carpal Bones stays in - Lunate Dislocation

→ If Lunate stay in & other Carpal Bones comes out - Peri lunate dislocation.

Ossification of Carpal bones

Mn- SHE LOOKS TOO PRETTY

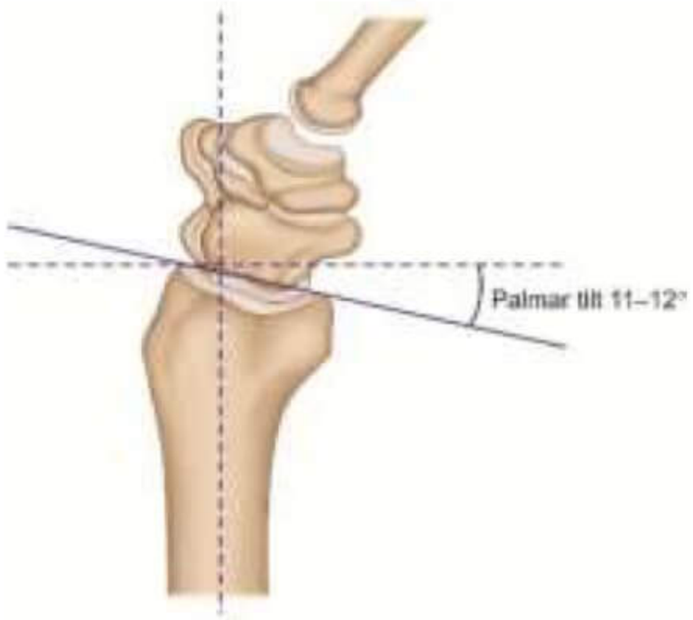
TRY TO CATCH HER

$S_5\ L_4\ T_3\ P_{12}$

$T_5\ T_5\ C_1\ H_1$

→ 1st carpal to ossify = Capitate

→ Largest carpal bone = Capitate



Lower end of radius

→ **Palmar tilt** = 11° -12° (Radius is not straight it's slight tilt towards palm)

On AP view

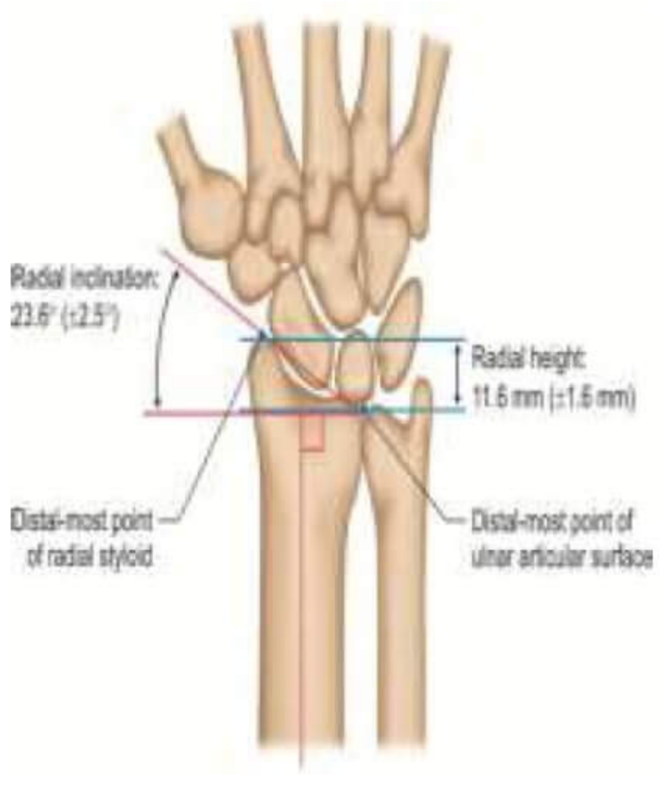
→ **Radial Height** AKA Ulna Negative (Radius is distal to ulna)

→ **Radial inclination** = Horizontal = 23.6° (± 2.5°)

Palmar tilt = 11 °

R H= 12 mm

Radial inclination = 23° (11 +12mm =23°)



PrepLadder

Pelvis

→ Along the Inter-trochanteric line lies the capsule

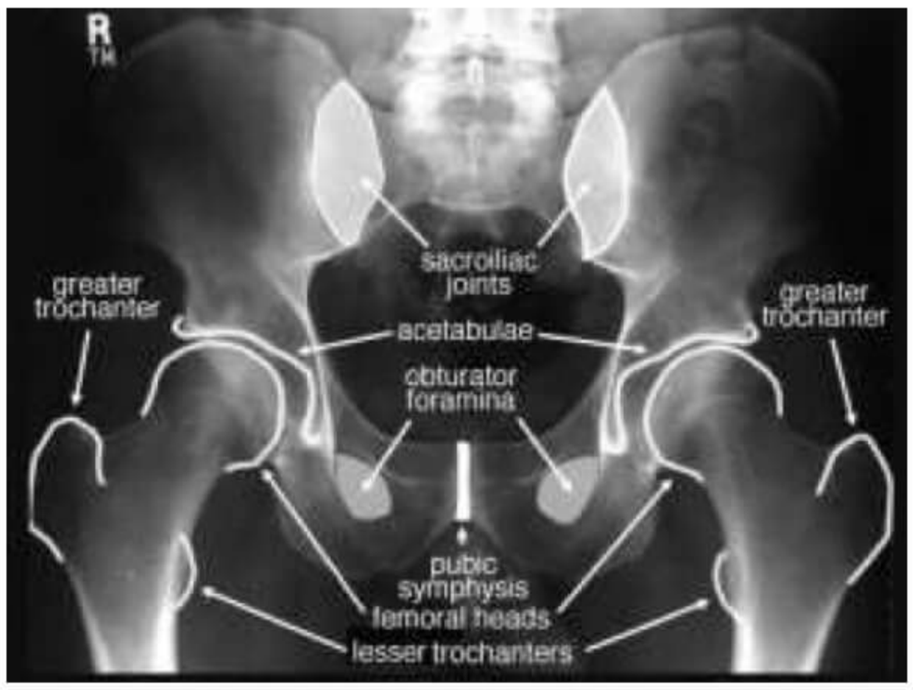
→ Femoral Neck - intracapsular

→ Inter Trochanteric area - Extracapsular

→ Sacroiliac Joint - Ankylosing Spondylitis

Gluteus Medius inserts to greater trochanter

Ilio-psoas inserts to lesser trochanter



Knee Joint & Ankle Joint

→ Talus Has no Muscle attachment

Bone & its parts

→ Articular Cartilage Aka Hyaline Cartilage – towards the joint

- Cartilage Type 2 Collagen (Car + **Two** + Lage)
- Bone = Type 1 Collagen (B + **One**)

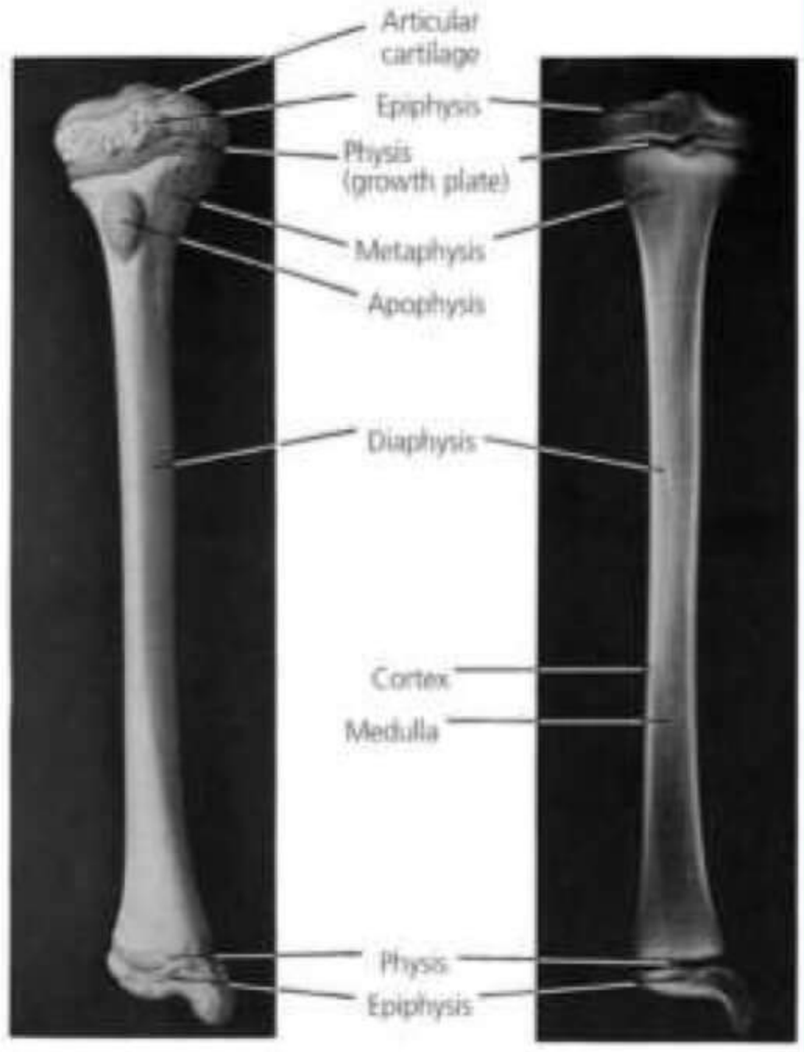
→ Epiphysis

→ Physis

→ Metaphysis -Most Vascular area of bone and it is the **most common location for infection & tumor**

→ Diaphysis (Middle) - **Ewing Sarcoma** occurs here

- Upper end of bone – Epiphysis +Physis +Metaphysis
- Middle of bone – Diaphysis



PrepLadder

On X-ray

→ Cartilage not seen.

→ Physis seen as Radiolucent because Physis is also made up of Cartilage.

Zones of Articular cartilage

Above Articular cartilage, Joint Fluid is present

→ **Zone 1**

- Superficial zone
- **Progenitor Cells** for Articular Cartilage
- High density chondrocytes
- **High water content** (as it is close to joint fluid which is above it)

→ Zone 2

- Transition Zone – Thickest
- **Chondrocytes are in low density**

→ Zone 3

- Middle Zone
- **Most Active Chondrocytes**
- **Highest Density Proteoglycans**
- Low density water content

→ Zone 4

- **Calcified Cartilage** – because it's close to bone (Epiphysis)

Types of epiphysis

1. Pressure Epiphysis

→ Intra Articular & weight Bearing

→ e.g. Head of Humerus, Lower End of Radius & Head of femur.

2. Traction Epiphysis

→ Extra articular

→ K/A Apophysis

→ Severe to pull & site of muscle attachment ossify, later than pressure Epiphysis

→ e.g. Greater & Lesser trochanter of femur & Tubercles of Humerus.

3.Aberrant Epiphysis

→ Anatomical Anomaly

→ Accessory Ectopic Epiphysis

→ e.g. Head of 1st Metatarsal or base of 5th metacarpal bone

PrepLadder

4.Atavistic Epiphysis

→ Phylogenetically independent but becomes fused

→ e.g. **Coracoid process of scapula**

Rotator cuff muscles

Mn: **SIt- s**

→ Supraspinatus
→ Infraspinatus
→ Teres minor
} attached to greater tuberosity

→ Subscapularis-attached to Lesser tuberosity; **Forgotten Tendon** (as it is difficult to see in MRI)

→ All the other three are attached to greater tuberosity

Growth plate (Physis)

→ Lies between Epiphysis & Metaphysis
- Resting Zone (Reserve) – Storage Disorders
- Proliferative (Growth) – Dwarfs / Giants – Laron syndrome (dwarfs + Truncal obesity)/scurvy
- Maturation zone – trauma (Hypertrophic)
- Provisional calcification –Mineralisation disorder like Rickets

BONE

→ 65% - Inorganic - $(Ca)_{10}(PO_4)_6(OH)_2$ - Calcium Hydroxyapatite

→ 35% - Organic (Type I Collagen)

↓

→ Gives Tensile Strength to bone

→ **Defective type I collagen causes Osteogenesis imperfecta**

→ It causes multiple bone fractures in children at birth

→ **Organic component (35%)**: [Matrix – 95%] + [cells 5%]

→ **Matrix** → Proteoglycans (Compressible strength)

→ **Proteins** → Collagen – Type 1 – Tensile strength

Non-Collagen proteins (Osteocalcin, Osteopontin, Osteonectin)

Enzymes – Bone specific ALP

PrepLadder

Elevated Osteocalcin and ALP – (+) bone turn-over & high osteoblastic activity

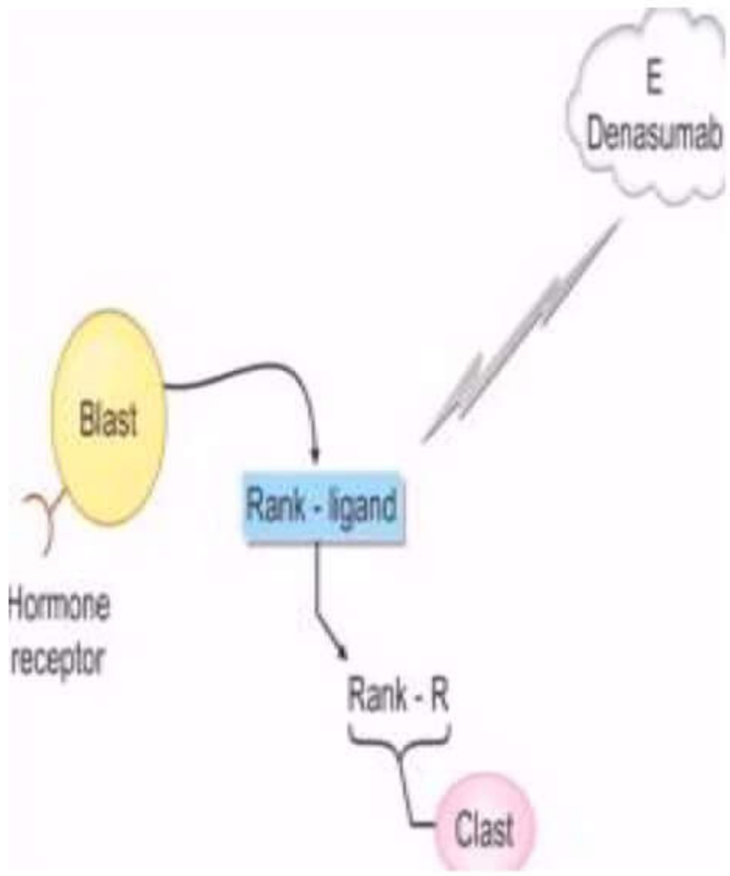
Terms

1. Osteoid - Immature Bone
2. Osteon - Mature (Mineralized)

Their ratio is important to assess the mineralization disorders.

PrepLadder

Parathyroid Hormone on Bone



PTH

↓

Act on Bone

Receptors of Osteoblast -stimulate

Release of Rank ligand

Rank ligand binds to osteoclast

Osteoclast stimulation (Remodeling of bone)

Remodeling of bone

The cycle of removing the damaged bone by osteoclast (resorption) and creating a new bone by osteoblast is known as remodeling/renovation of bone.

→ In females, Estrogen inhibits RANK ligand

→ PTH Adenoma – high level of PTH

- Bones (Osteitis Fibrosa Cystica + Blood)

  (Brown Tumor)
- Renal Stones
- Abdominal Groans(dyspepsia)
- Psychic Moans

→ Low dose PTH (20 µg s/c daily) – it stimulates osteoblast but cannot release RANK ligand, hence it can be used for treatment of Osteoporosis

→ Denosumab – inhibits RANK ligand

→ Bisphosphonates and calcitonin – inhibit osteoclast

→ Bisphosphonates – DOC for osteoporosis

→ Drugs stimulating osteoblast – low dose PTH

→ Drugs inhibiting resorption – **B**isphosphonates (B), **C**alcitonin (C) **D**enosumab (D), **E**strogen (E),

→ **Strontium** acts both ways - Stimulates formation & inhibits Resorption as well.

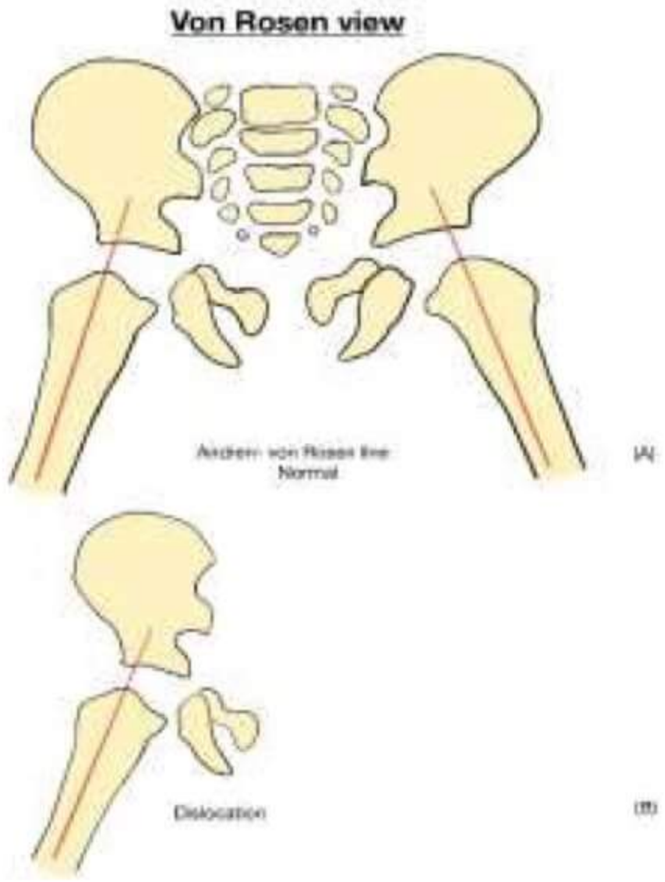
PrepLadder

Imaging in Orthopaedics

Von Rosen View

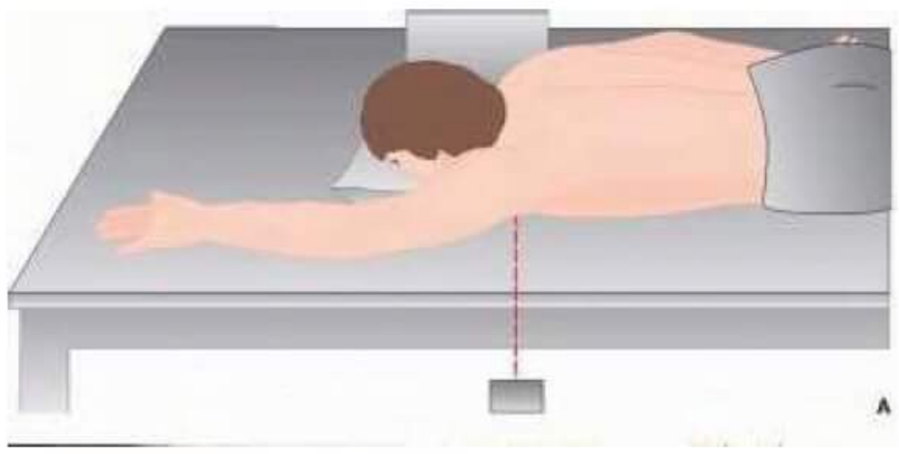
→ Used for DDH

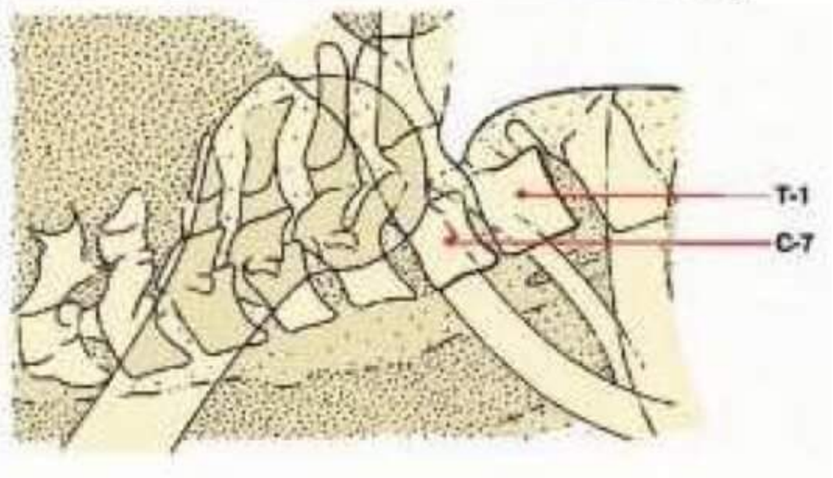
→ Shows shallow acetabulum



Swimmer's view

→ Done for Cervico thoracic junction





Shenton's arch

→ **Lost in fracture or dislocation (fracture of pubic Rami or dislocation of Hip)**

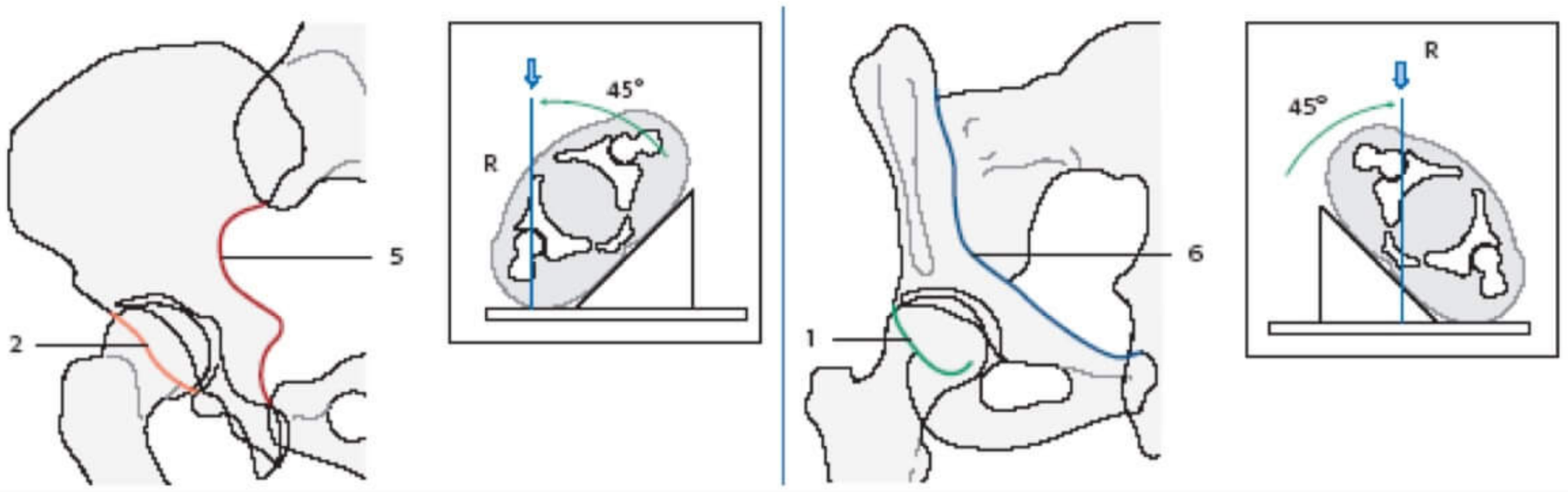
Open mouth view

→ Used for Odontoid fracture and to see upper cervical spine C1 & C2

PrepLadder

Judet View:

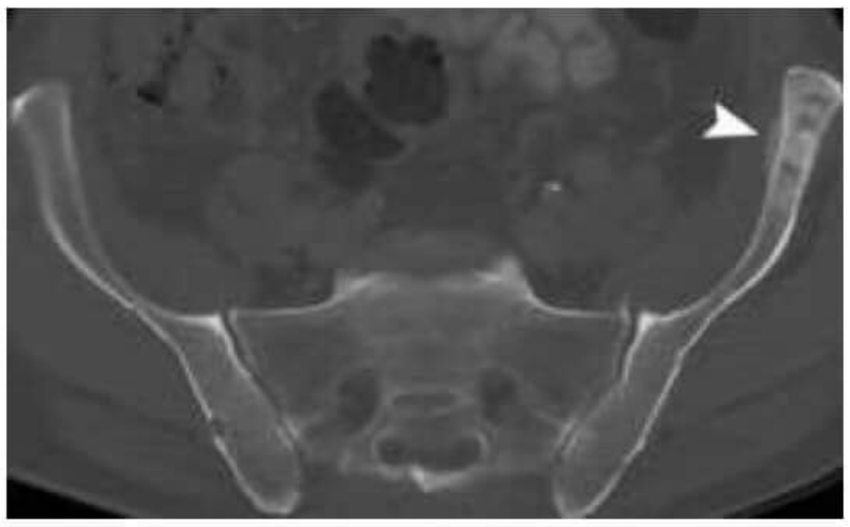
→ To view different orientation of Acetabulum



CT scan:

→ Cortex - Calcification

→ Cortex looks white (opaque, sclerotic) on CT



MRI:

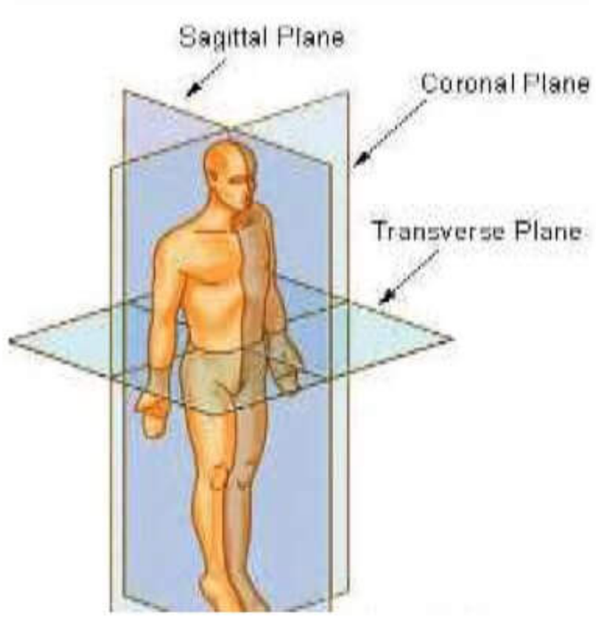
→ Bone Marrow

→ Cartilage seen on MRI

→ Nerve, Muscle, fascia, ligament (all soft tissues) visualized on MRI

SAGITTAL VIEW MRI KNEE

→ Posterior crucial Ligament [PCL] is the most posterior structure, inserts at the upper
end of Tibia



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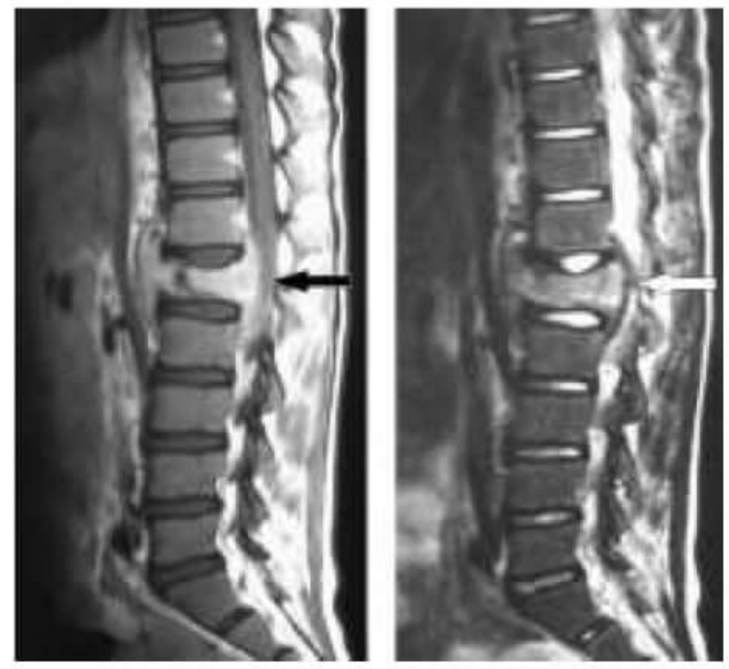


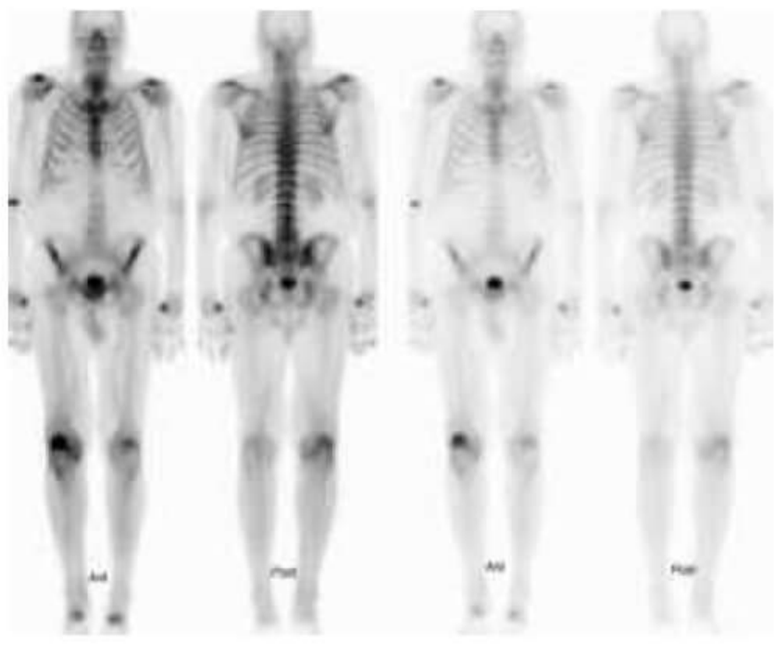
T1 Vs T2 weighted images of MRI

→ T_1 weighted image - "CSF black" -Anatomy

→ T_2 weighted image - "CSF white" -Pathology

→ STIR image - Fat suppressed image

→ Diffusion weighted image – Benign has no restriction of diffusion & in Malignant, Restriction is seen.



Stress fracture / Occult fracture

→ Break in marrow due to abnormal force(stress)

→ Radiologically, it shows marrow edema

→ Overall IOC - MRI

→ Unilateral stress fracture - MRI

Bone Scan - Blastic Activity

→ Radioactive technetium dye is used and picked up by osteoblasts. It will show radio-activity

→ Bone scan positive, if any of the following occurs

- Fracture
- Malignancy
- Infection in bone

STRESS FRACTURE

→ Overall IOC - MRI

→ Unilateral - MRI

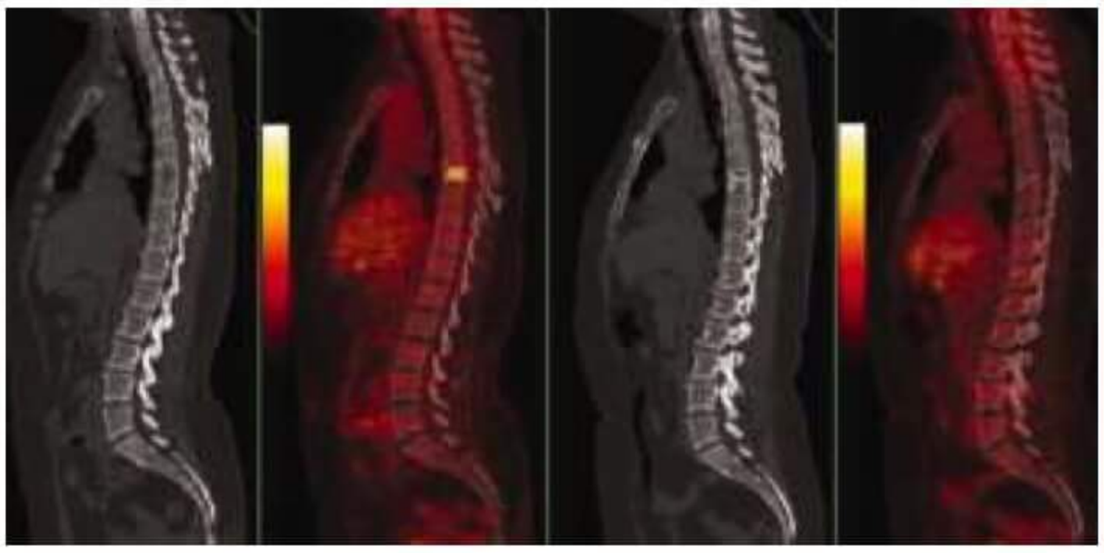
→ Bilateral - Bone Scan

PET-CT

→ Specific for metastatic tumors

PrepLadder

→ Patient injected with radio-active Fluorodeoxyglucose and is Picked up by tumor cells and shows radio-activity.



Metastasis diagnostics

→ Single - MRI
→ Multiple - PET Scan
→ Multiple with Osteoblastic Activity or sclerotic metastasis (seen in prostate) - Bone scan

Infection

Case: 6yr. old boy complaints of pain over his Leg, swelling over tibial shin as shown below & fever. What is the most likely diagnosis?

Significant features - Pain, Fever & Swelling

→ Tumors & infection can mimic each other (Ewing Sarcoma (Diaphyseal) > Osteosarcoma)
→ Metaphyseal * (most common area for infection and tumors)
→ Differentiated by Tissue Diagnosis
→ Culture for infection
→ Histopathology for Tumor

"Culture all Biopsies, Biopsy all cultures"

PrepLadder

Investigations

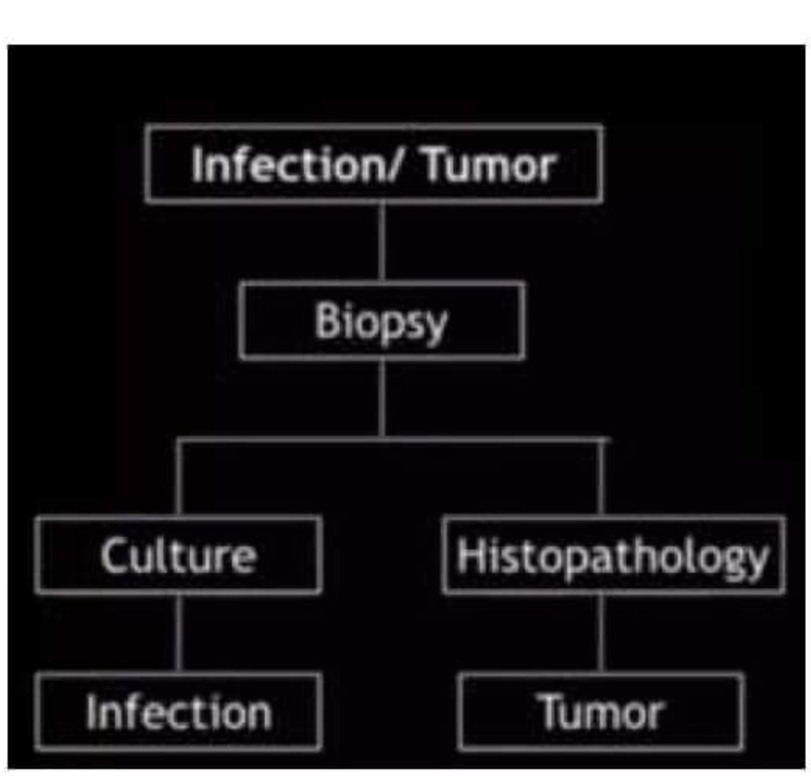
Osteomyelitis

→ MRI > Bone Scan > X-Ray

→ MRI show changes in 6 -8 Hours

→ Bone scan show changes in 12-24 Hours

→ X Rays can show > 24Hours



Bone Tumors

→ IOC- MRI Except - Osteoid osteoma (is in cortex, CT is done)

First investigation – X-ray

Next investigation – MRI

Best investigation (Gold standard)- Histopathology/ Biopsy

DDH (Developmental Dysplasia of Hip)

→ IOC - MRI

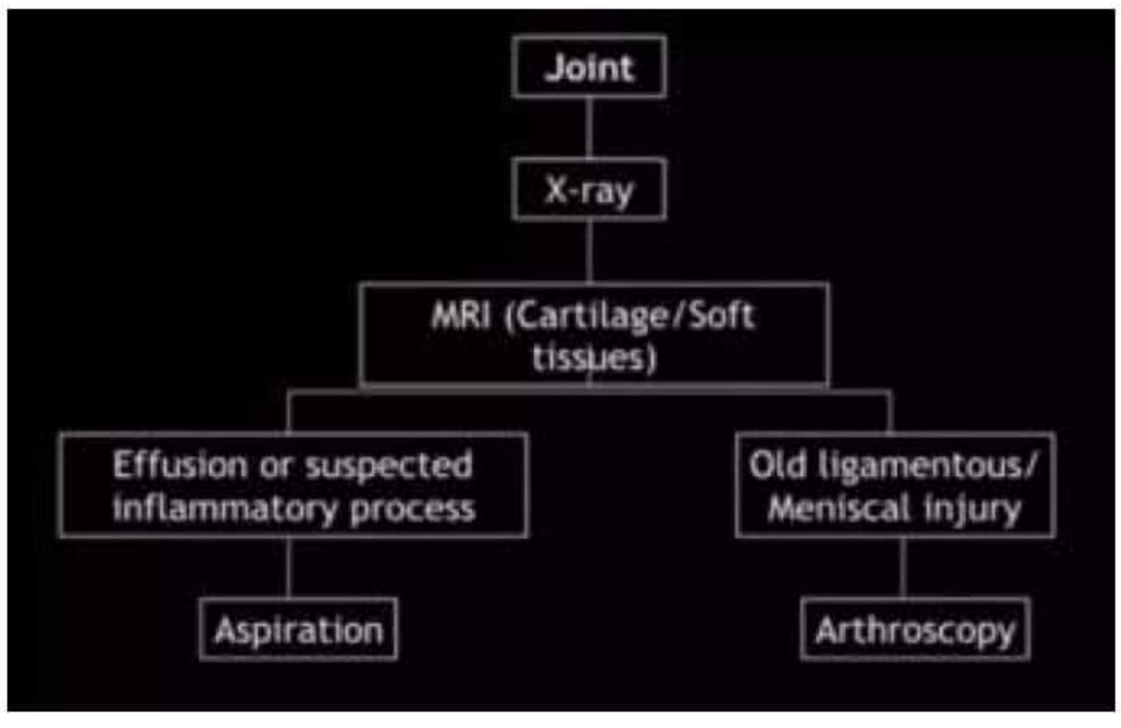
→ Screening of hip instability - USG

→ α -Angle decreases on USG

Joint Swelling (Limping child)

→ Aspiration is done USG guided

→ Most common joint for Arthroscopy → knee Joint



Periosteum & Classical Radiological features

Periosteum

→ It is a covering of bone and it is attached to the bone by **Sharpley's fibers**

→ Has 2 layers

- Fibrous layer – useless (Only structural)
- Cambium Layer - Cellular layer

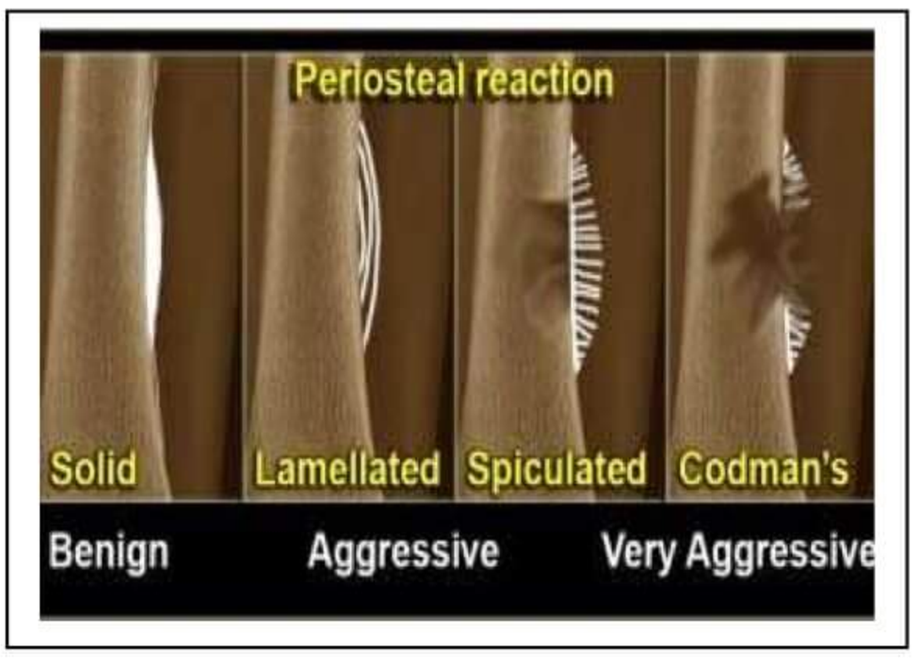
Functions of Cambium layer

→ In fracture, cambium helps **bone to unite/union**
(Non-union occurs at neck of femur because of absence of cambium layer at neck of femur)

→ **Periosteal Reaction** – Narrow zone (Benign) vs Wide zone (Malignant)

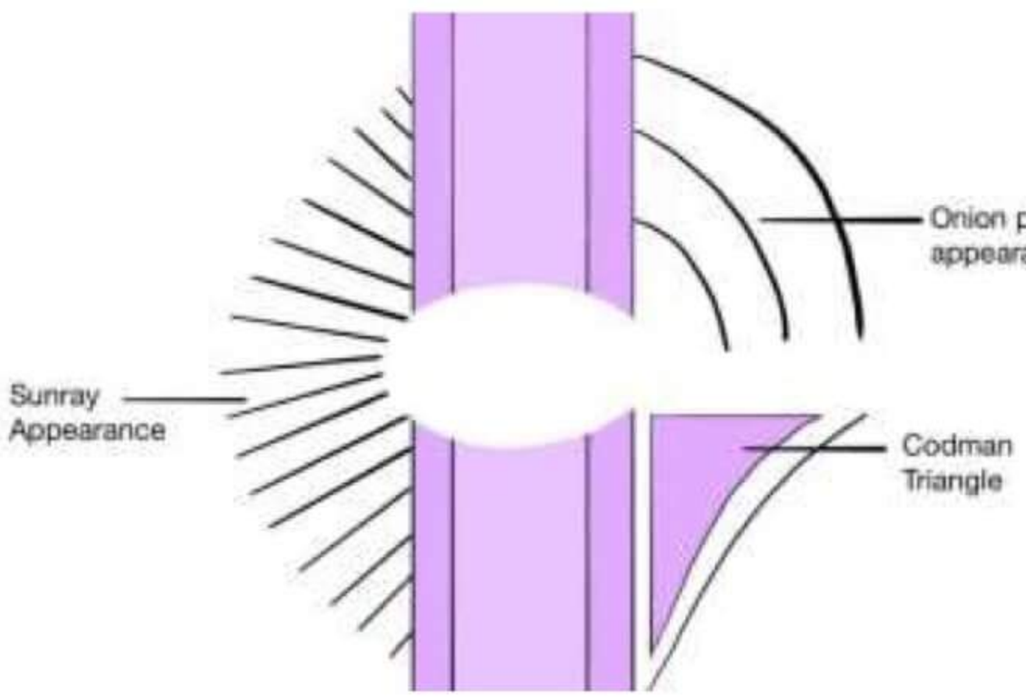
→ Bone Tumors occurring in periosteum - **Osteochondroma / osteosarcoma**. They require Extra-periosteal resection (Removal along with Periosteum)

Narrow Zone Vs Wide Zone



Periosteal reaction in osteomyelitis – occurs in 7-10 days

WIDE ZONE



PrepLadder

Codman's triangle: seen in osteosarcoma (lower end of Femur)	Sun ray appearance seen in osteosarcoma	Onion peel appearance seen in Ewing's sarcoma
		
Giant cell tumour showing Soap bubble appearance (goes Up to joint surface)	Mottled/patchy calcification – cartilaginous tumours- Chondrosarcoma/ Chondroblastoma	
		

Normally Tumors respect Joint and cartilage except Giant cell tumor but Infection destroys both

Classical Radiological Features

→ Sun ray appearance/ Codman's Triangle	→ Osteosarcoma but can be seen in any malignant Lesion
→ Onion Peel appearance	→ Ewing Sarcoma but can be seen in any malignant Lesion or chronic osteomyelitis
→ Soap bubble appearance	→ Osteoblastoma (GCT)> Adamantinoma
→ Patchy calcification	→ Chondrosarcoma> Chondroblastoma
→ Homogenous calcification	→ Osteogenic tumors (osteosarcoma)

→ Non-aggressive Reactions
- Solid
- Thin
- Thick
- Irregular

→ Aggressive reactions
- Sunray appearance
- Onion peel appearance
- Codman's triangle

PrepLadder

BONE & JOINT INFECTIONS

OSTEOMYELITIS

→ In pediatrics, after ruling out trauma, absent movement of limbs – **Osteomyelitis**

→ In pediatrics, after ruling out trauma, absent movement of joints – Joint infection

↓

Septic arthritis (Fluid or pus in joint)

Osteomyelitis

→ **MC organism: Staphylococcus aureus**

→ MC location – Metaphysis

→ MC spread of infection – **Hematogenous**

Exceptions

- Sickle cell anemia : Salmonella – diaphysis (MC)
  S. aureus – metaphysis
- IV drug users / foot infection – Pseudomonas
- Human bites – Eikenella
- Animal bite – Pasteurella
- Open injuries– Staph Aureus
- Acute, subacute, chronic, open injuries infection (MC organism – **S. Aureus**)
  (Involvement of any bone)

→ Commonest site– Metaphysis

Because:

1. Depleted RES (monocyte macrophage system weak)
2. Vascularity high
3. Hair pin loop system (Stasis of circulation)
4. Microtrauma (commonly occurs here)

→ Overall most common site – **Lower end femur**

→ Overall most common site in adult – **vertebral body (spine)**

→ Overall most common joint – **Knee**

PrepLadder

Rx

Reduced movement of limb,
Toxic child (↓ sleep, appetite; ↑ TLC, ESR, CRP)
Metaphysics tender
(Clinical Diagnosis)

Osteomyelitis < 24 hrs.

↓

X-ray: No loss of soft tissue planes

↓

MRI - marrow changes in metaphysis

↓

Bone scan - ↑ activity

↓

Rx: started within IV antibiotics
(6 weeks > 4 weeks)

↓

Once condition improves or CRP return normal (2 weeks usually), then antibiotics Orally for 4 weeks

Osteomyelitis > 24 hrs.

↓

X-ray: Loss of soft tissue planes

↓

MRI - marrow changes in metaphysis

↓

Bone scan - ↑ activity

↓

Rx: Evacuation & exploration of pus
+
antibiotics for 6 weeks

→ MRI change occurs within 6 hrs. of infection
→ Bone scan changes within 12 hrs. of infection
→ X-ray changes occurs after 24 hrs. of infection (X-ray differentiates whether to operate or not)

OSTEOMYELITIS in New born

→ Organism - S. aureus
→ Location - Metaphysis
→ Mechanism Of spread - Hematogenous
→ Multi-focal (spread wide)
→ Paucity of clinical signs (Newborn has less immunity)
→ Poor prognosis

PrepLadder

Types of osteomyelitis

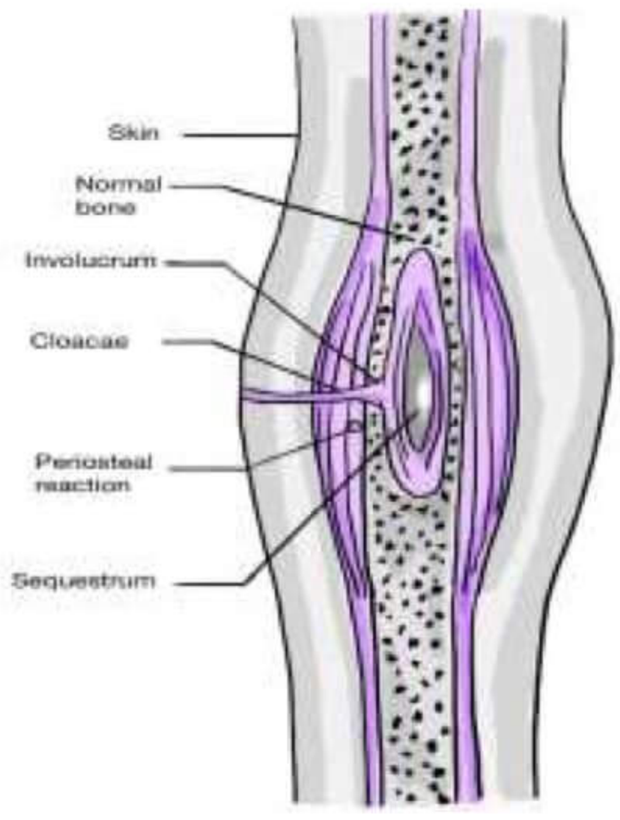
→ Acute - < 2 weeks
→ Subacute- 2-3 weeks
→ Chronic - > 3 weeks (AKA "*dead bone*")

BRODIES ABSCESS

→ Subacute osteomyelitis > chronic osteomyelitis
→ Location - Upper end of tibia
→ Lytic lesion with sclerotic margin
(Seen in Immunocompetent host)

CHRONIC OSTEOMYELITIS

→ **Sequestrum** – Sclerosed Dead bone (sequestrum is cause of sinus)- Pathognomic of chronic osteomyelitis.
→ Involucrum - Reactive live bone
→ Cloacae – sinuses through involucrum
→ Complication - Amyloidosis, Malignancy (Squamous cell carcinoma)



Rx

→ Remove sequestrum

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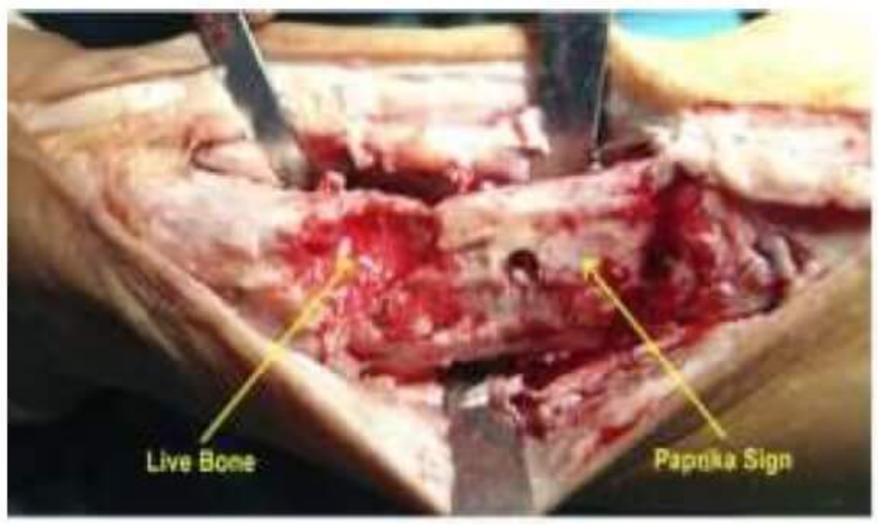
Paprika Sign



Bone cutter → Used for cutting bone	Bone nibbler → Nibbling of the bone
	

→ While removing the dead bone, there is presence of bleeding from the live bone underneath the dead bone known as paprika sign

→ Control the infection (most important)

→ Fill the gap (using bone graft (iliac crest)/bone cement (PMMA- Polymethyl meth acrylate)

→ Soft tissue coverage

NPWT (negative pressure wound therapy)

→ AKA vacuum assisted closure (VAC)

→ Vacuum dressing enhances healing of wound by removal of fluid collecting within it

→ Suction pressure: -75 to -125 mmHg

→ Continuous or intermittent

→ Gives good granulation tissue

→ C/I → Malignancy, Untreated OM, Necrotic Eschar

→ NPWT is also used for pressure sore

Garres sclerosing osteomyelitis

→ Chronic Osteomyelitis

→ Involves long segments of bone

→ Mandible > Tibia

SAPHO SYNDROME

→ Synovitis

→ Acne

→ Pustulosis

→ Hyperostosis (thickened bone)

→ Osteitis (Inflamed bone)

Chronic recurrent multifocal OM

↓

Misnomer for SAPHO

PrepLadder

→ HLA B27 positive

→ Auto immune Disease

Treartment - NASIDS / Steroids / DMARD

Note

MC organism for multifocal OM – **Salmonella**

Other HLA B_{27} positive disease - **Ankylosing spondylitis** (> 90%)

JOINT & SOFT TISSUE INFECTION

Infections of the fingers

→ MC organism - Staph. Aureus

→ MC infection of hand - Paronychia

Felon

→ Involves pulp space of hail

→ AKA whitlow

→ Common location - Thumb > Index finger

→ MC organism - S. aureus

→ Rx - Surgical: Vertical incision – preferred (septae in different directions are broken)
Fish mouth (horizontal) incision - not preferred

→ Complication - Osteomyelitis > Tenosynovitis

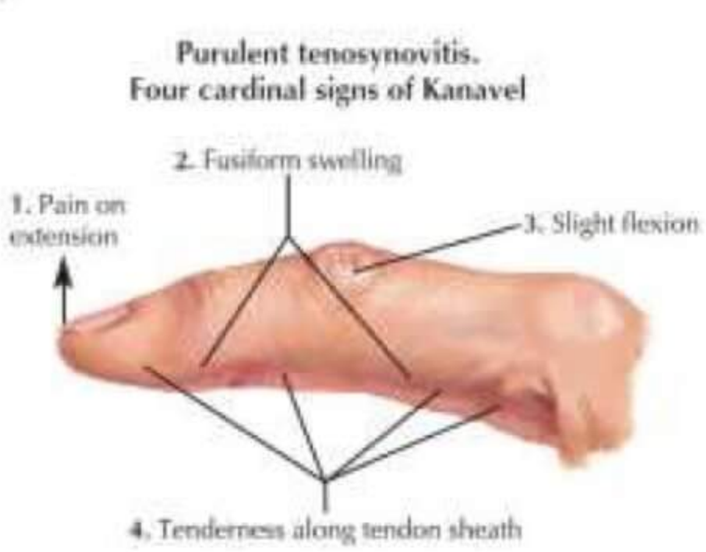
Paronychia

→ Involves nail bed

→ Rx: Antibiotics + surgical drainage
(Sometimes requires removal of part of nail)

Infectious tenosynovitis

→ Infection of flexor tendon sheath of finger



Kanavel's Sign

→ Pain on extension (stretch)

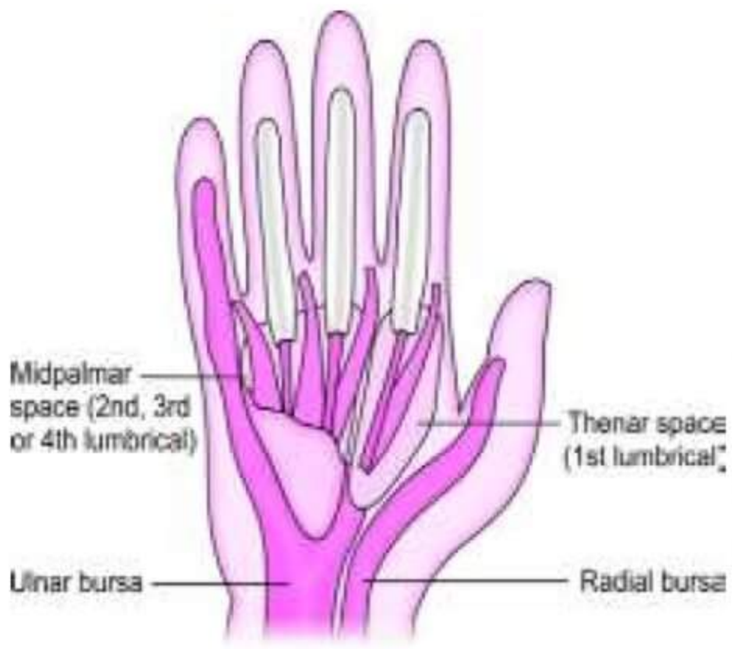
→ Fusiform swelling

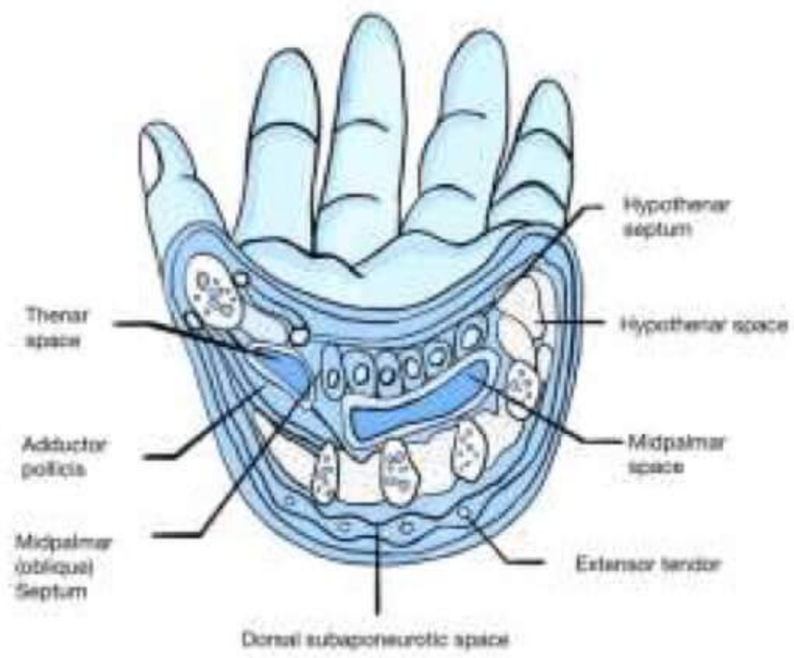
→ Flexion of finger

→ Tenderness along tendon sheath → most specific

(Percussion tenderness)

Spaces in Palm





→ **Thenar space**: Index finger tendon & 1st lumbrical (no thenar muscles)

Infection of index finger tendon spreads to thenar space

→ **Mid palmar space**: middle, ring & little finger & 2nd, 3rd & 4th lumbricals

Lower limb movements

→ FABER ⟶ Lengthening of limb

Flexion + Abduction + External rotation

Occurs in

→ Synovitis

→ Infection (Septic arthritis-misnomer))

→ Ilio-tibial band contracture (polio)

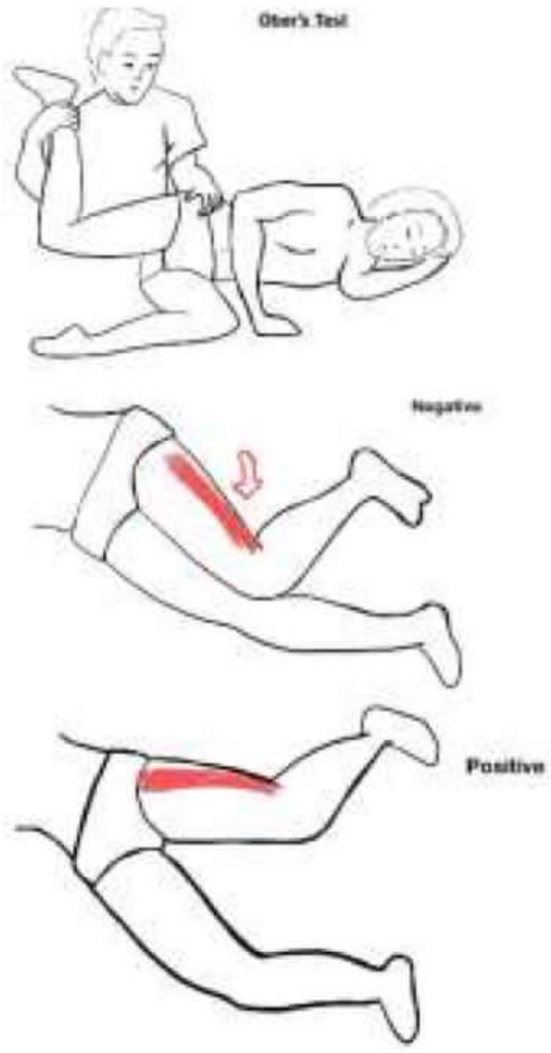
(Permanent Ilio-tibial tract shortening)

→ Anterior dislocation of hip joint (trauma)

FABER= Maximum Capacity

PrepLadder

Ober's test



→ Hip is abducted & extended by examiner and
Then he/she drops the leg
↓
→ If knee of same side drops down, it means there is no contracture → **Negative**

→ If the ilio-tibial tract is under contracture the thigh remains abducted → **Positive**
→ This is a test for
Ilio-tibial band contracture in Poliomyelitis

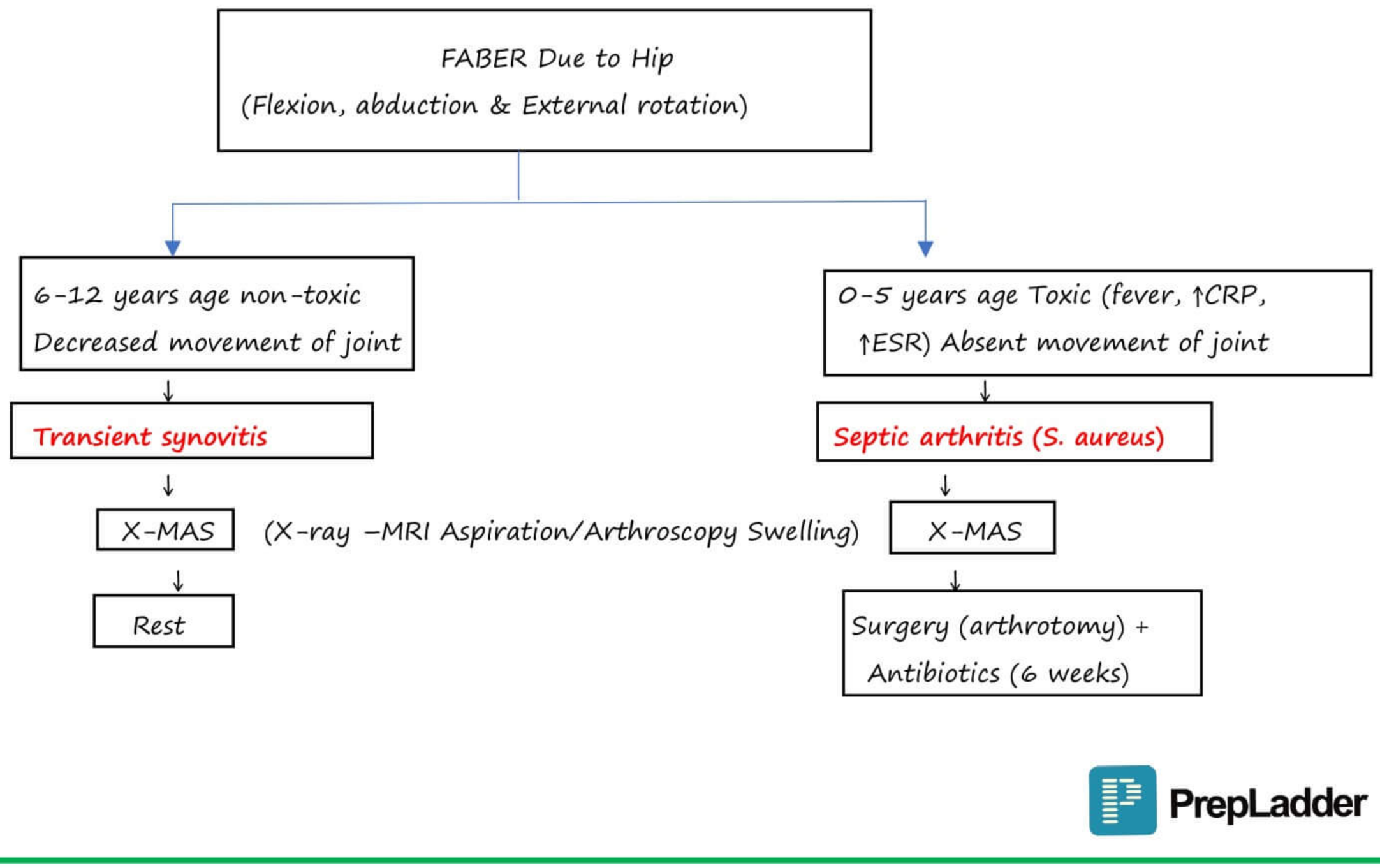
FADIR

Flexion + adduction + Internal rotation

Occurs in
→ Posterior dislocation of hip joint (trauma)
→ Arthritis (actual destruction of cartilage)

Note

At hip joint→ Posterior dislocation (90%) > Anterior dislocation



PrepLadder

→ In OM (bone infection), non-surgical mgt exists for less than 24 hrs.

→ Septic arthritis (joint infection)- absolute indication for surgical Mgt

Arthrotomy → opening of joint capsule

→ Immediate surgery is indicated for orthopedics for

1. Pelvic fracture
2. Vascular injury
3. Compartment syndrome
4. Septic arthritis

	SEPTIC ARTHRITIS	TRANSIENT SYNOVITIS
	Positive FABER	Positive FABER
AGE	< 5 year	6-12 years
MOVEMENT OF JOINT	Absent	Decreased

→ If we ruled out trauma

- Absent movement of limb - Osteomyelitis
- Absent movement of joint - Septic arthritis

Tom-smith Arthritis

→ AKA Septic arthritis of Hip in infants

→ Destroyed femoral epiphysis

↓

Hypermobility of Hip joint

→ When part of bone is destroyed, it leads to hypermobility

→ Hypermobility → assessed by instability of hip

→ Hypermobility is a sequela of initial infection destroying the joint. (because initially absent movement)

MYCETOMA

→ AKA **Madura foot**

→ Has multiple discharging sinuses

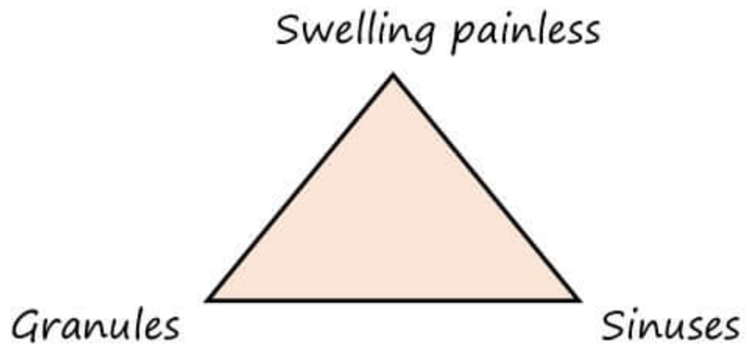
→ **"Dot in circle" sign** in MRI

→ **Mycetoma**- Chronic progressive granulomatous exogenous infection of subcutaneous tissue

→ Caused by thorns / soil (barefoot) – exogenous

PrepLadder

→ **Triad**



→ Sunray appearance & Codman's triangle is seen.

→ Lytic cavities in bone is seen

→ Involves all structures except nerves and tendons

Actinomycetoma (AM) → Mandible

Mycetoma(MF) → Foot

Eumycetoma	**Actinomycetoma**
Fungi	Bacteria
Well-encapsulated within clear margin	Diffuse within no clear margin
Few sinuses	Many sinuses
Diff colors of grain mostly white or Black	Diff colors, but not black
Slowly progressive	Inflammatory & rapid progression
After a long time, bone invasion occurs	Rapid
Cavities small in number, but larger in size	Numerous, small in size
DOC: Ketoconazole, Itraconazole	Dapsone + streptomycin Rifampicin or sulfadoxine pyrimethamine Amikacin + Co-trimoxazole
Partial cure on medical treatment	Medical treatment useful in most cases

Note:

Painless conditions: 1. Mycetoma

2. Charcot's joint (Neuropathic)

PrepLadder

TUBERCULOSIS OF BONE & JOINTS

→ **Lung** (MC primary site) > Lymph nodes
→ Hematogenous spread & lesions are paucibacillary (difficult to isolate)
→ Spine – **"Pott's spine"**
→ Hip
→ Knee

} Order of involvement- Spine > Hip > Knee

→ Shoulder – "**Caries Sicca**"
→ Digits - "**Spina Ventosa**"

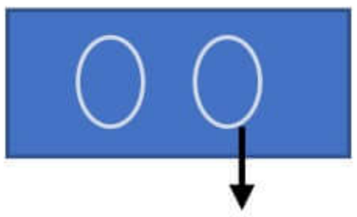
TB of spine

→ 2 consecutive vertebrae along with disc are involved
- As it arises from same mesodermal somite
- has common segmental Blood supply

Paradiscal Lesion (Involves 2 consecutive vertebra)

→ **Anterior disease**
→ Abscess positive
→ Malignancy → posterior elements & single vertebral disease
→ MC presentation of tb spine – Paradiscal
→ **Rarest presentation**
- Facet joints
- Spinous process

PrepLadder

Normal Vertebra	Winking Owl sign	Blind bat sign
 Pedicles		
	Destruction of one of the pedicles  	Destruction of both the pedicles
	Due to malignancy of metastasis	

Aneurysmal sign

→ Abscess erodes anterior margin of vertebra (←)

→ Feature of TB

→ Location

Dorso-lumbar > Dorsal > Lumbar > DL junction			
(D1 – D12)+(L1 -L5)	(D1-D12)	(L1 -L5)	(D11 -D12, L1)

Pott's Spine

→ Earliest symptom - Pain

→ Earliest sign - Tenderness

→ Earliest neurological - Increased deep tendon reflex (Clonus)

PrepLadder

Tuberculosis

(chronic pain, constitutional symptoms, (+) **night pain**)

- HIP
- Back pain → **Pott's spine**
- Knee → **Triple knee deformity**

1st symptom – Pain

1st sign – tenderness

1st neurological symptom – ↑ DTR

X-ray / MRI – **Paradiscal lesion**

Biopsy – Gold Standard

"Middle Path Regimen" →Rx: Rest + Anti-tubercular Treatment + surgery indicated → Sequelae: Bony ankylosis

Indications for surgery in any disease of spine

→ Bowel / bladder involvement

→ Worsening of symptoms

→ No improvement

Surgery approach for TB spine

→ Anterior → Not used, because of too many structures

→ Posterior→ Not used, can damage posterior structures of vertebrae

→ **Left side approach**→ Aorta → **preferred as artery can be repaired**

→ Right Side approach→ IVC, not used (difficult to repair once torn cannot be repaired)

PrepLadder

Two surgeries for TB Spine:

1. Antero lateral decompression + Bone grafting
2. Anterior decompression + Bone grafting- Better

> Never touch posterior element in TB spine

Arthrodesis

→ Surgical fusion – bony – painless

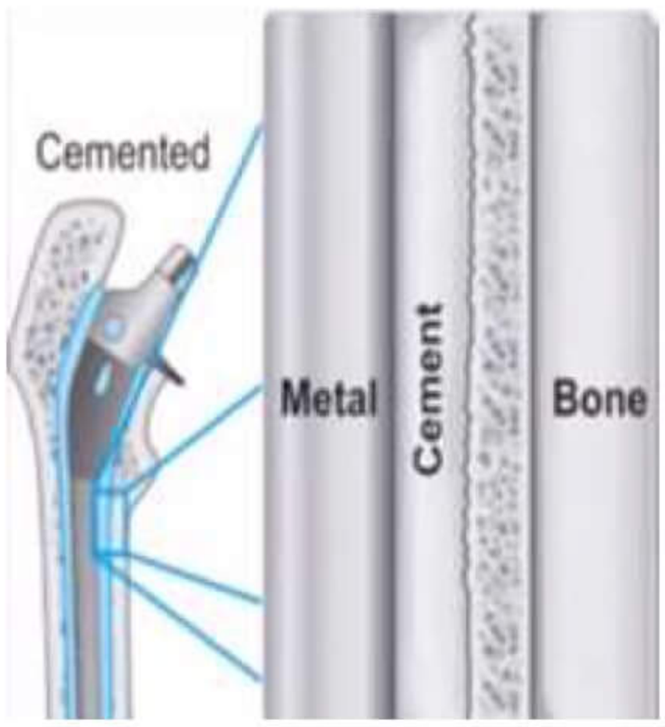
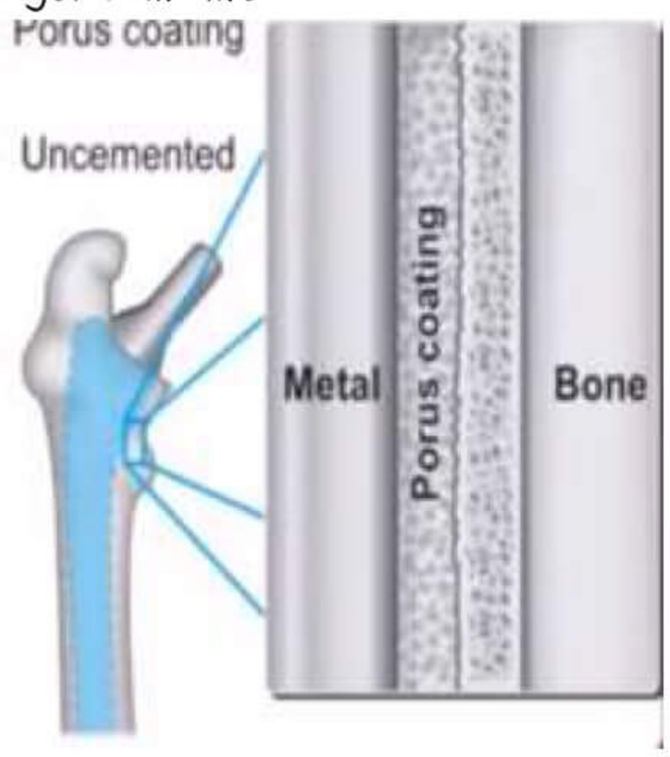
→ **Cobra plate – used for hip arthrodesis**

Ankylosis

→ Pathological fusion

Fibrous ankylosis	Bony ankylosis
Painful	Painless (solid)
→ TB hip & knee → RA	→ Septic arthritis > TB spine > ankylosing spondylitis

Joint Replacement

Cemented	Uncemented
1. Using cement	1. Using porous coating
2. Cheap	2. Expensive
3. Elderly patients	3. Patient with normal bone quality (young patients)
4. Shorter $t_{1/2}$ 	4. Longer half-life 

PrepLadder

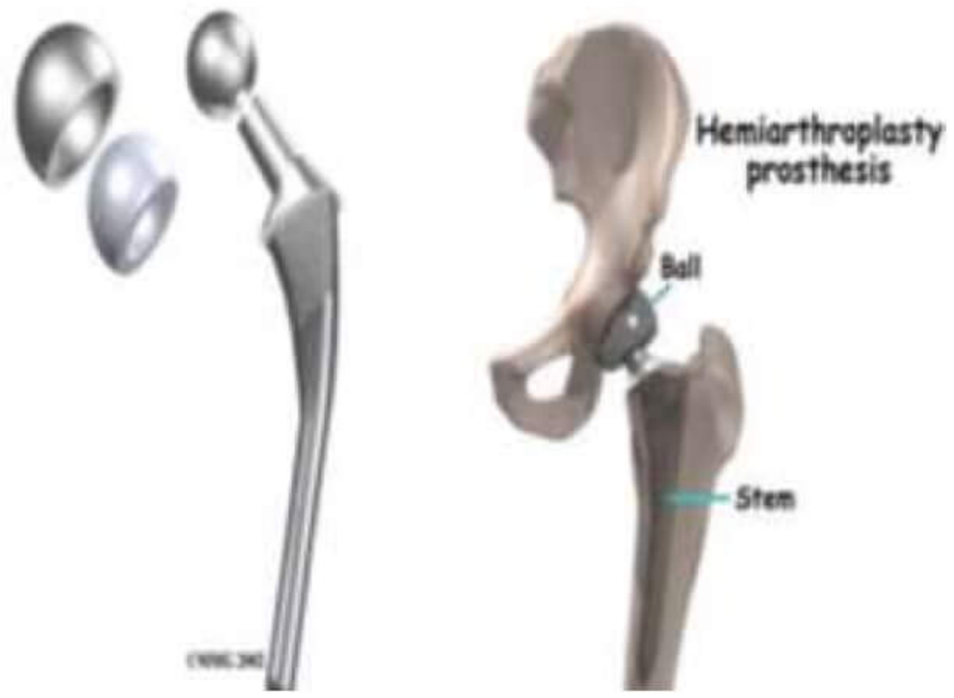
Excision arthroplasty

→ Femoral head & neck removed

→ "Girdle stone" for TB hip

Hemiarthroplasty

→ Replacing one side of the joint



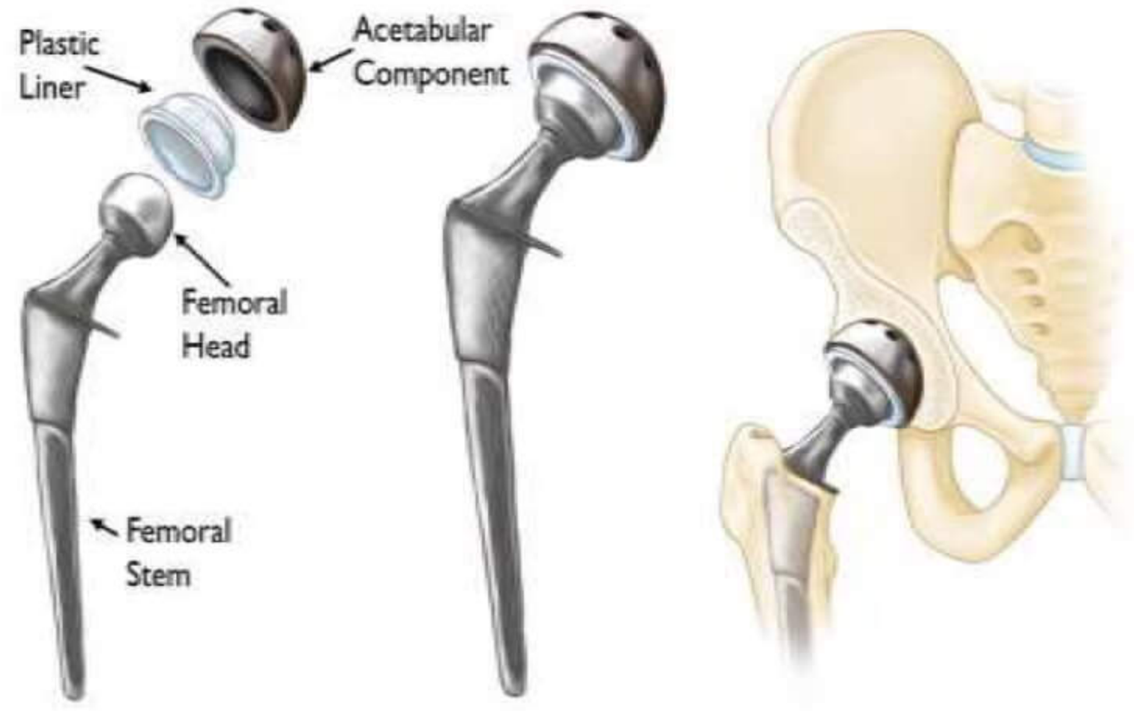
Types

1.Austin Moore	2. Thompson
→ Stem has two fenestrations/holes **Mn**: Two OO – Two holes 	→ Prosthesis without fenestrations 

Total Hip replacement:

→ Replace both sides of the joint

→ Both acetabulum & femur



Complications

→ Infection (rare)

→ Dislocation (rare)

→ Mortality Cause: **MI>CRA** (cardio-respiratory arrest) >**PE** (Pulmonary embolism)

→ Pulmonary embolism – >48 hrs. duration

Clinical Scenario 1
- Patient who underwent THR on day 0
- Day 2 → breathless
- Right side changes in ECG / echo

Clinical Scenario 2
- History of fracture, after removal of cast
- Presents with breathlessness
- Right side changes in ECG / Echo

PrepLadder

Long term immobilization leads to DVT→ PE

→ Metal associated complications:

- Hyper sensitivity
- Teratogenicity
- Renal insufficiency
- Chromosomal abnormalities (prostate& lung CA)
- Carcinogenesis

TB HIP

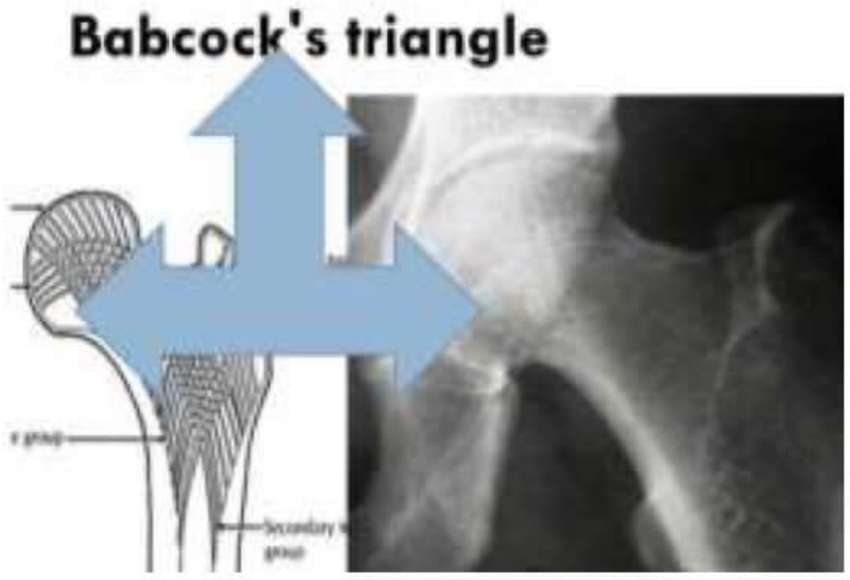
Babcock's triangle

→ In upper end of femur → proximal part→ monocyte- macrophage is depleted

→ MC site for TB proliferation

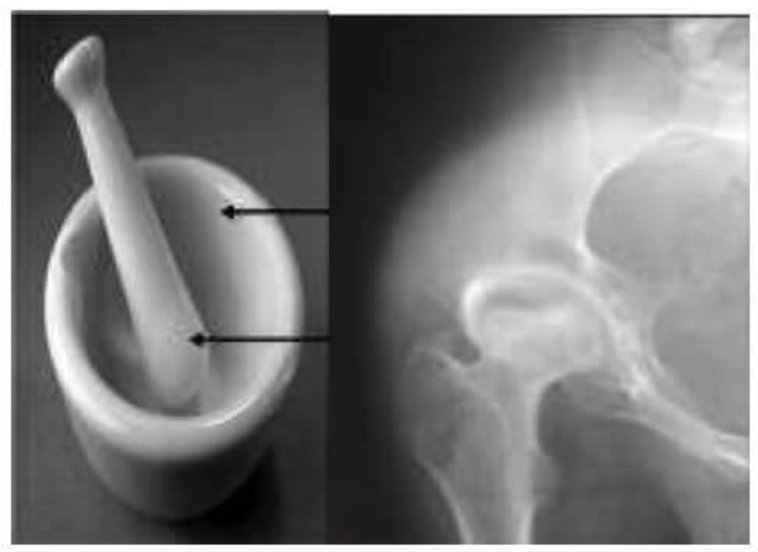
→ Overall MC site – Acetabulum

→ Mc site in femur – Babcock's triangle



Stages of TB Hip

1. Synovitis → FABER (lengthening)
2. Early arthritis → FADIR + < 1 cm shortening
3. Late Arthritis → FADIR + >1 cm shortening
4. Wandering acetabulum (misnomer – femoral head wanders)
5. Fibrous ankylosis (TB arthritis)



Pestle and mortar appearance

→ In TB hip, femoral head becomes much smaller and head of acetabulum gets bigger giving a characteristic pestle and mortar appearance

Peri articular osteopenia

→ Due to hyperemia caused by inflammation of TB hip

→ 1st radiological feature of TB arthritis – **Peri articular osteopenia**

→ 1st radiological feature of TB spine – **Loss of curvature of spine**

TB Knee

→ Gradual pain – Chronic

→ Limp

→ Knee flexion – More capacity

PrepLadder

→ Synovitis – flexion of knee joint

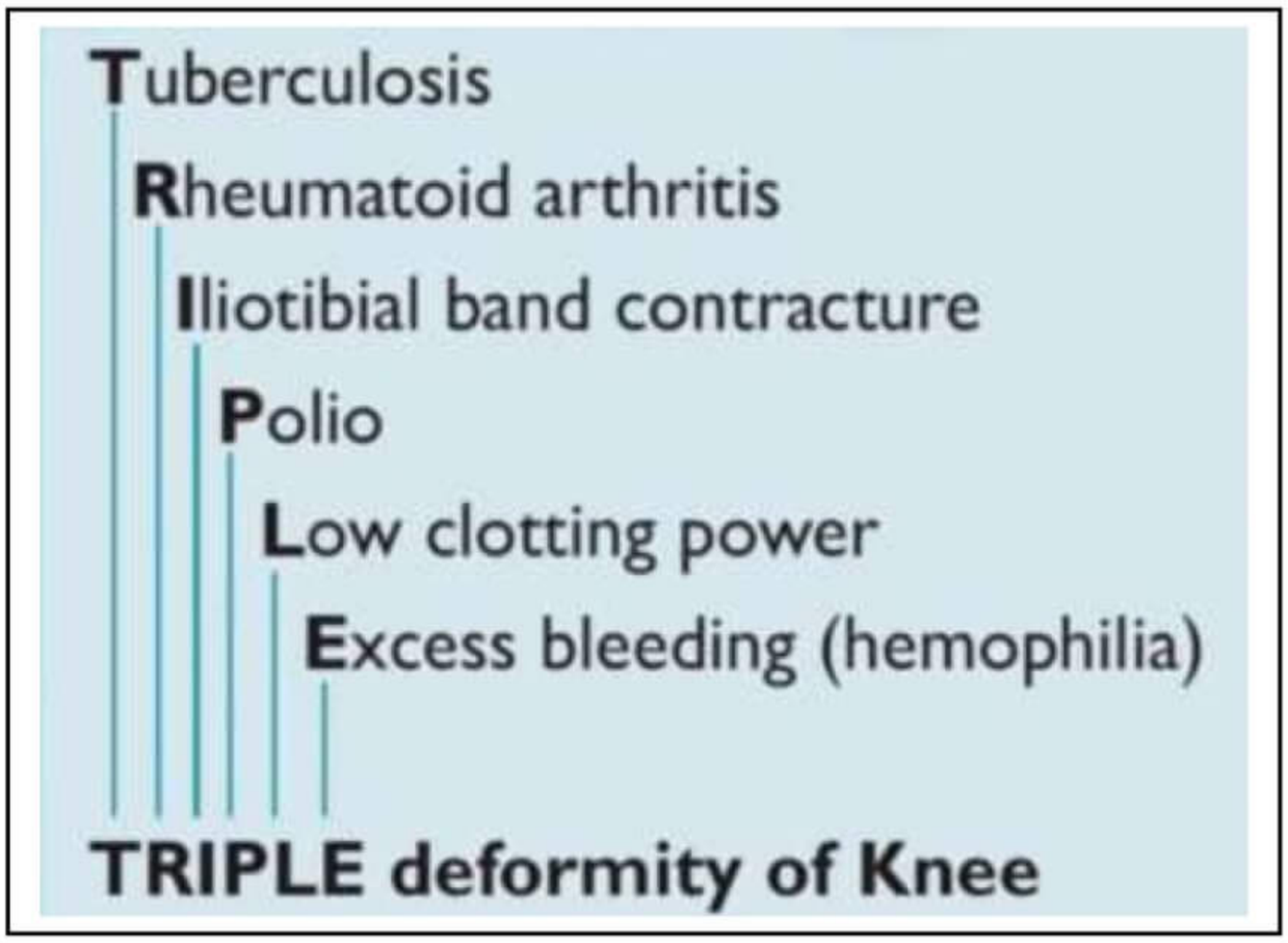
→ **Radiological evidence** - Synovial proliferation / Synovitis

→ Diagnostic → Tissue

→ **Complication: TRIPLE Deformity (Mn: PERF)**

1. Posterior subluxation of tibia
2. External Rotation of leg
3. Flexion of knee

Triple deformity of knee is also seen in



PrepLadder

ORTHOPEDICS ONCOLOGY

General Principles of bone tumor

NO. 1 investigation for bone tumors – Biopsy

Benign	Malignant
→ Well defined margin → uniform consistency	→ Ill-defined margins → variables consistency

Dx of bone tumor: Age of patient < Part affected

Skeletal maturity

→ Physis disappears
→ Epiphysis fuses with metaphysis
- Shoulder- 18 years
- Elbow-16 years
- Wrist- 18 years
- Hip- 16 years
- Knee- 18 years
- Ankle- 16 years

Occurrence of bone tumors based on part of the bone

1. Epiphysis
   i. Chondroblastoma
      - Before skeletal maturity; (+) Calcification
   ii. Giant cell tumor
      - After Skeletal maturity
2. Metaphysis (most common location for tumor/ infection)
   i. Osteosarcoma

PrepLadder

3. Diaphysis
   i. Osteoid osteoma
   ii. Adamantinoma→ **Soap bubble appearance**
   iii. Ewing's sarcoma

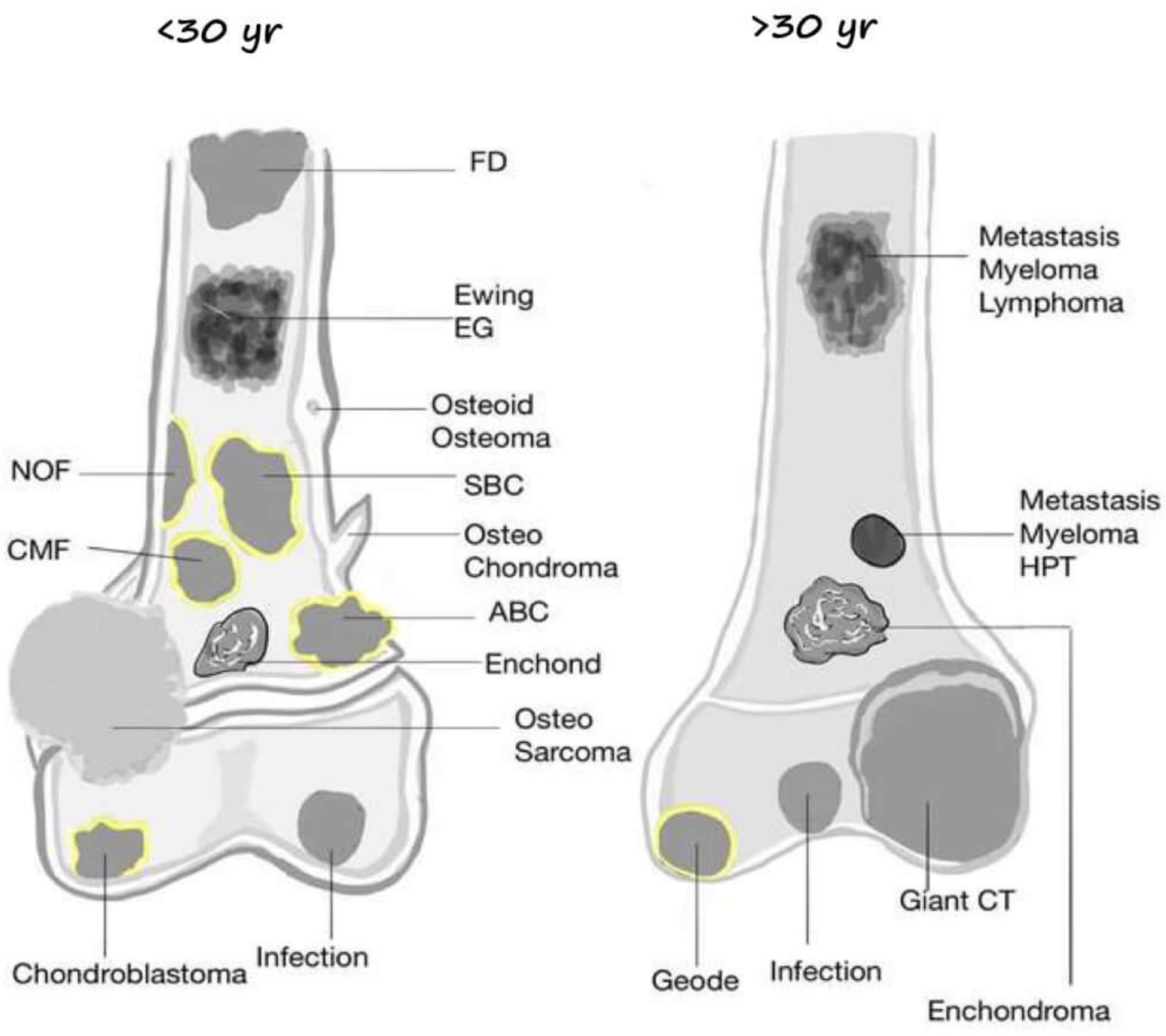
4. Upper end of Humerus: Unicameral bone cyst > Chondroblastoma

5. Epithelial Tumors:
   → Tibia → Adamantinoma
   → Mandible →Ameloblastoma
      - In mandible, most common tumor is SCC. Ameloblastoma most commonly occurs in mandible.

Bone tumors – Enneking staging

→ Part affected > age
→ 1st decade → ES
→ 2nd decade → OS
→ After skeletal maturity (20-40 years) → GCT
→ After 40 years → Metastasis > Multiple myeloma

Ewings sarcoma →More common in 2nd decade > 1st decade



PrepLadder

→ Most common tumor of bone → Metastasis

→ Most common primary tumor of bone→ Multiple myeloma

Most common site of bone tumors

→ Unicameral bone cyst (single cavity cyst) -Upper end Humerus

→ Upper end Humerus - UBC > CB

→ Aneurysmal bone cyst - Lower limb metaphysis (Tibia & femur)

→ Osteoid osteoma - Femur > Tibia

→ Osteoma (Ivory / compact/eburnated) - skull & facial bone

→ Enchondroma - Short bones of hand & feet

→ Epithelial bone tumors

a. Adamantinoma → Tibia

b. Ameloblastoma → Mandible

→ Multiple Myeloma - Lumbar vertebrae

→ Metastasis - Thoracic vertebrae

Metastatic Bone Disease

→ Most common primary tumor for bone metastasis, overall → Breast > Prostate > Lung

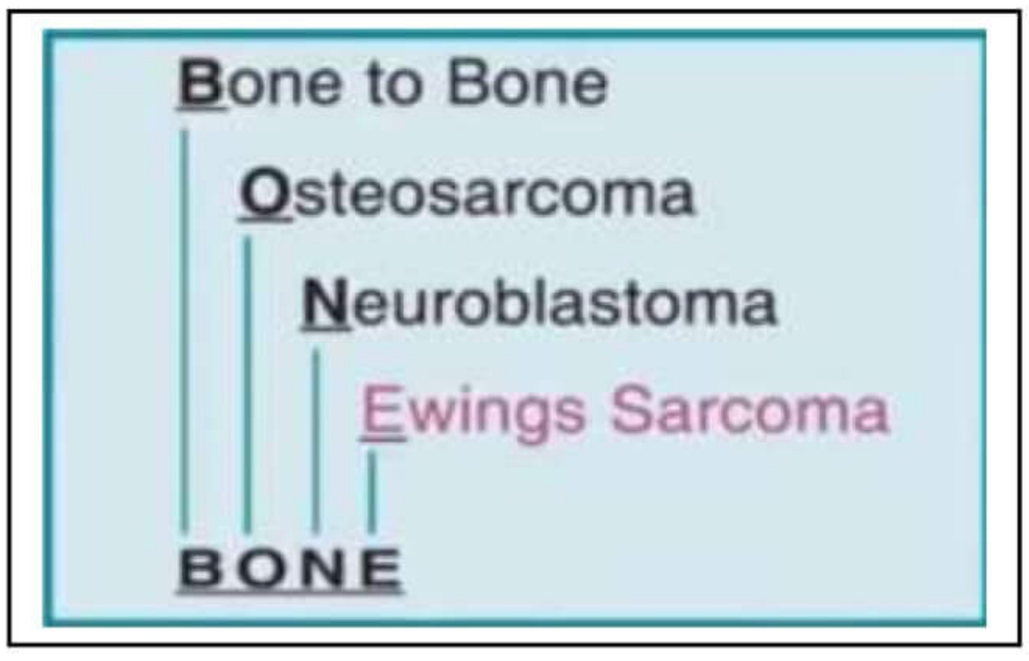
→ Most common site of primary tumor for bone metastasis

- In males → Prostate > Lung
- In Female → Breast > Lung
- In children → Neuroblastoma

→ Skeletal sites most frequently involved - Spine (Dorsal)

→ Purely osteoblastic secondaries → Prostate / carcinoid / Medulloblastoma **(mnemonic: PCM)**

→ Metastasis from bone to bone



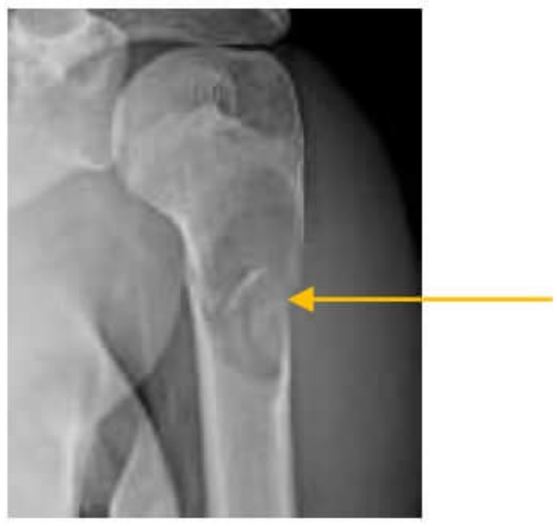
PrepLadder

BENIGN BONE TUMORS

- → Unicameral bone cyst -single, central cavity
- → Aneurysmal bone cyst - Multi-located, eccentric
- → Osteochondroma - Larger to feel, smaller on X-ray
- → Osteoid osteoma - Night pain relieved on taking salicylates
- → Chondroblastoma - Epiphysis + calcification before skeletal maturity
- → Non-Ossifying fibroma -Most common benign lesion of bone
- → Enchondroma -Most common tumor of bones of hand and feet
- → Giant cell Tumor -Tumor goes until the end of bone; After skeletal maturity
- → Fibrous dysplasia -Tumor like stick of shepherd

Unicameral Bone cyst

- → Single, central cavity
- → In metaphysis
- → **Upper end of Humerus**
- → AKA **simple bone cyst**
- → 1st decade of life
- → Filled with straw colored fluid
- → **"Trap-door sign"**
  "Fallen leaf sign" (fallen fragment sign)



Fallen leaf sign

Treatment

- → **Curettage + Bone grafting** → Standard Rx
- → Aspiration+ steroids
- → Aspiration+ sclerosants

Bone nibbler

Curette

Cyst in the Centre of the Bone	Cyst in the Corner of the Bone
Brodie's abscess/Brown tumor **E**osinophilic granuloma **E**nchondroma **C**hondroblastoma **H**emophilia **BEECH** – Cyst **(Simple bone cyst)**	**N**on ossifying fibroma **A**neurysmal bone cyst **G**iant cell tumor **E**ccentric **NAG** – **E**xpands

Aneurysmal Bone cyst (ABC)

→ Multi-loculated eccentric & expansible

→ 2nd decade of life

→ In metaphysis

→ **Before skeletal maturity** (11 to 16/18 years)

→ Commonly in Tibia

→ MRI → "Fluid-Fluid level" seen (multiple-Septate)

Aneurysmal bone cyst

Rx

→ **Extended curettage**

- best chemical used-**Liquid Nitrogen**

→ **Embolization**

- highly vascular tumor - blocks Arterial supply

PrepLadder

Osteochondroma (Exostosis)

→ Before skeletal maturity

→ Diaphyseal aclasia (development malformation)

→ Large to feel, small on X-rays

→ Causes pain due to

- **Bursitis** overlying
- Neuro-vascular compromise
- Fracture
- Malignant transformation
  - Solitary -< 1%
  - Multiple- 6%

→ Grows away from the joint

→ Palpable, pedunculated

→ Undergoes malignant transformation

→**chondrosarcoma**

→ **Malignant degeneration- chondrosarcoma occurs when**

- Cartilage thickness > 2 cm (in MRI)
- Rapid increases in size
- Growth after skeletal maturity
- Loss of differentiation (cortico-medullary differentiation)

osteochondroma

cauliflower like growth - osteochondroma

Treatment

→ Removal along with periosteum

"Extra-periosteal resection" (cambium)

→ Indications of surgery

1. Cosmetic
2. Pain
3. Malignant transformation
4. Joint obstruction
5. NV compromise

"Cauliflower like growth" – Osteochondroma

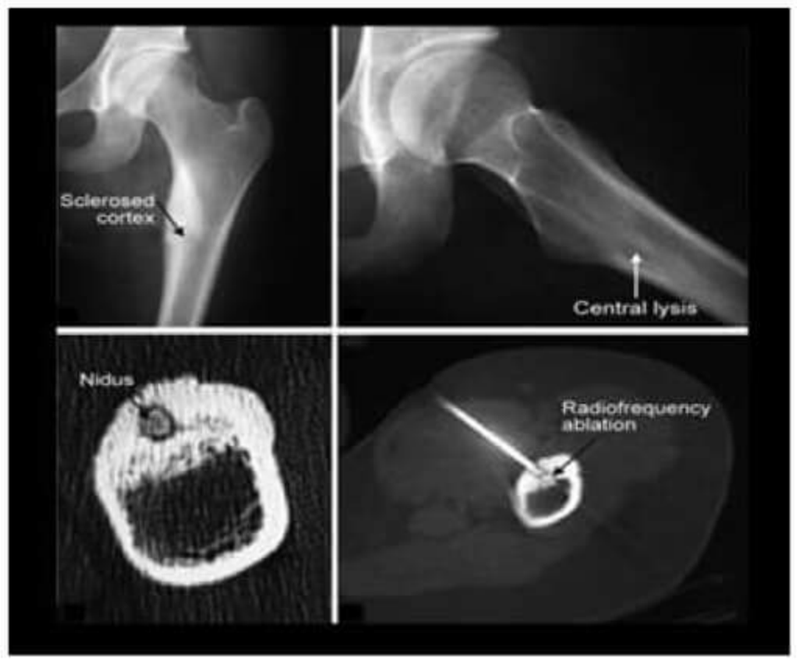
PrepLadder

Osteoid Osteoma

→ Night pain relieved on taking salicylates

→ Cortical tumor "thickened cortex" (CT)

→ In diaphysis



Osteoid osteoma

→ Nidus→ Lytic center with sclerotic margin

→ Nidus(seed) has

1. Osteoblast
2. Osteoclast

→ Periphery is dark and center is light

Osteoid osteoma

Treatment

→ Radio-frequency Ablation Preferred > surgery

Ivory osteoma

→ AKA compact osteoma/eburnated osteoma

→ In Skull vault

→ Requires no treatment.

Codman's Tumor

→ AKA chondroblastoma

→ Seen in upper end of humerus

→ Epiphyseal tumor with calcification

→ Biopsy shows – chicken wire calcification

→ Before skeletal maturity

→ Rx: Extended curettage

Codman's TUMOR

Codman's TRIANGLE -periosteal reaction

Non-ossifying Fibroma

→ AKA Fibrous cortical defect

→ Most common benign lesion

→ In 1st decade

PrepLadder

→ In metaphysis
→ Self-resolving
→ Not pre-malignant

Enchondroma

→ Most common tumor of bones of hand / feet
→ Metaphysis
→ Has hyaline cartilage
→ 5% cases - premalignant
→ Rx: Extended curettage

Enchondroma

→ Pre-malignant potential
→ OC→ <1% solitary
6% multiple
→ Solitary enchondroma→5%
ollier's -30%
Maffuci- 100%

Syndromes associated with Enchondroma

1. Ollier's syndrome
   → Only enchondromas
   → multiple
   → 30% premalignant

2. Mafucci syndrome
   → 100% pre-malignant
   → Multiple enchondroma
   → Hemangioma
   Phlebolith (calcified superficial veins)

Mafucci syndrome

PrepLadder

Enchondroma	Chondroma
→ Medullary 	→ at the end of the bone → Popcorn calcification → O-ring sign 

NOTE

Popcorn calcification

1. Breast-Fibroadenoma
2. Lung-Hamartomas
3. Bone-Chondroma

Giant cell tumor (GCT)

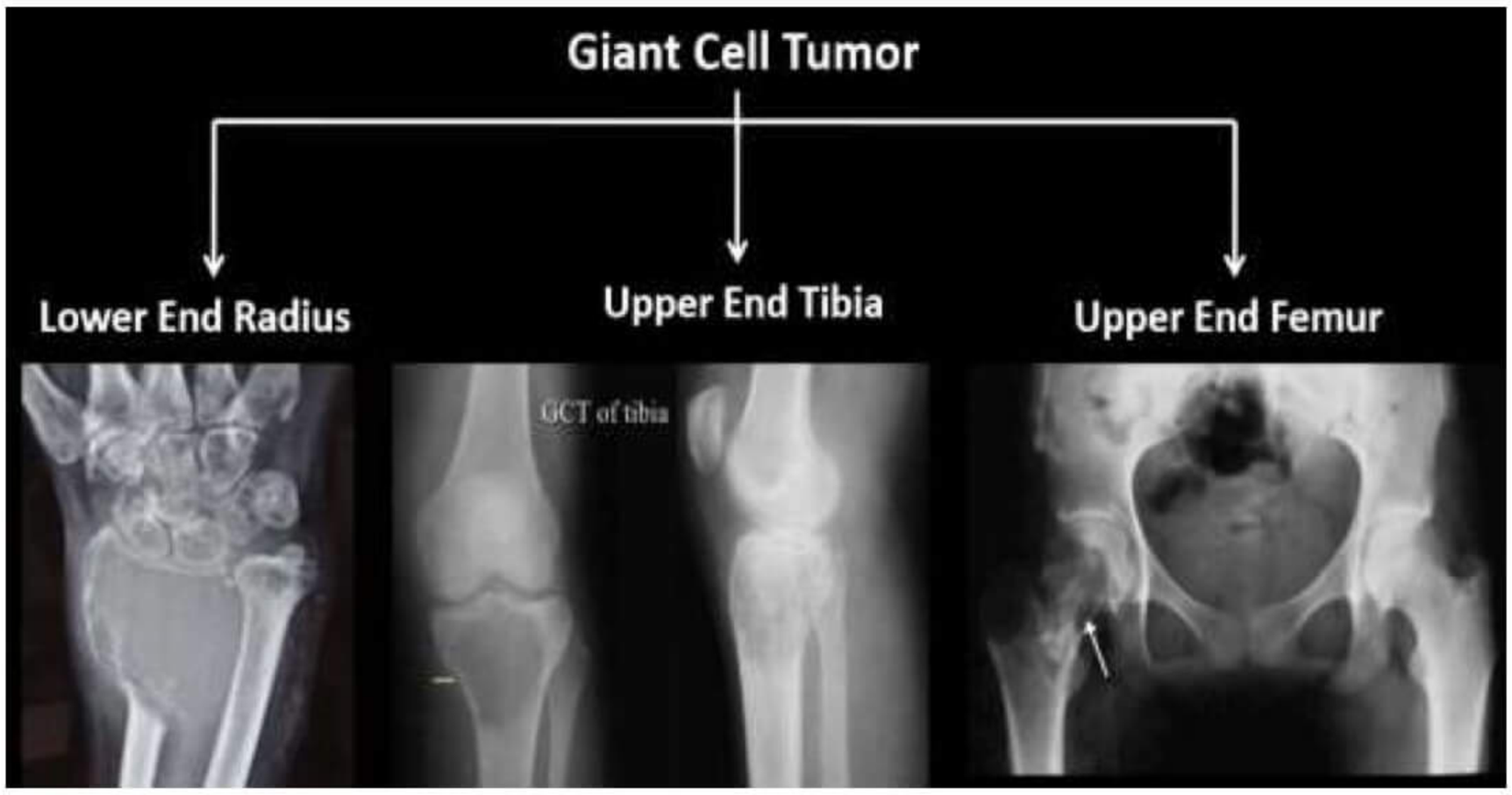
→ Locally aggressive tumor (Also Adamantinoma)
→ In epiphysis
→ Has 2 cells
   1. Giant cells
   2. Mononuclear cells – Malignant component
→ "Egg shell cracking" (loves to eat bone)
→ Only tumor to involve the cartilage
→ After skeletal maturity (30 Years)


GCT-Mononuclear(Malignant)

Note

→ Tumor of distal end radius is always GCT until proven otherwise
→ MC site of Giant cell Tumor is Lower end femur
→ Lower end femur is M/c site for
   - Giant cell tumor
   - Osteosarcoma
   - Osteomyelitis

PrepLadder



→ **Tumor of Upper end of Tibia** – two types

1. **ABC** (metaphyseal; before skeletal maturity)
2. **GCT** (epiphyseal; after skeletal maturity)

Treatment

→ **Procedure of choice**– **Extended curettage** by **PMMA** (Polymethyl Meth acrylate/**Bone cement**) or Phenol or liquid N_2+ **Bone grafting** (Iliac crest)

→ **Excision** Lower end of Ulna, Upper end of fibula

→ **Excision**& replacement by vascularized bone graft
Lower end of radius where upper end of fibula is grafted

Giant cell variants

→ have giant cells and are lytic.

1. FCD or non-ossifying fibroma(**commonest**) ("Fibrous cortical defect") } Fibrous
2. FD (Fibrous dysplasia) }
3. ABC (**closest**) } CYST
4. UBC }
5. Chondroblastoma } chondro
6. Chondromyxoid fibroma }
7. Osteoblastoma / osteosarcoma } Osteogenic
8. Brown tumor (hyperparathyroidism) } metabolic

Commonest variant–Non-ossifying Fibroma

Closest variant– Aneurysmal bone cyst

PrepLadder

→ **Tissue biopsy** – to differentiate between GCT and GC variants

1. GCT	2. GC Variants
→ **Identical nucleus** (multiple mononuclear cells combine to form a giant cell) → Mets to lungs – **3% cases**	→ **Non-identical nucleus**

Locally Aggressive tumors

→ GCT

→ Adamantinoma

Fibrous Dysplasia

→ **Shepherd crook deformity**-bone is replaced by fibrous tissue

→ Ground Glass appearance and bone looks hazy

→ At Upper end of femur

↓

Lytic lesion with sclerotic margin

↓

"Rind sign"

→ Developmental malformation

→ Associated with McCune-Albright syndrome

Rind sign – fibrous dysplasia

Ground glass appearance – fibrous dysplasia

Shepherd crook deformity

Mc Cune-Albright syndrome

Mn: PPP

→ Polyostotic fibrous dysplasia (multiple bones are involved)

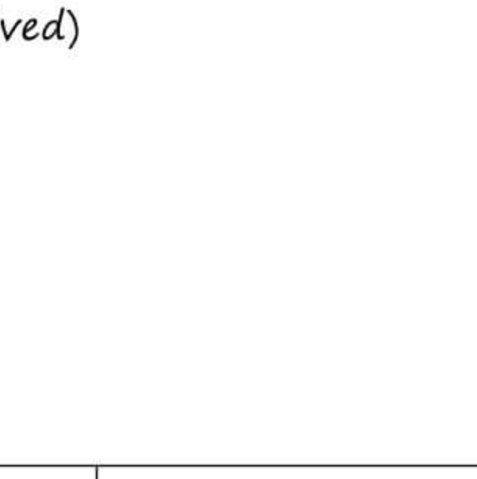
→ Precocious puberty

→ Pigmentation (**café au lait**- coffee colored spots)

Café au lait spots

Disease	Border type	Known as
Neurofibromatosis	Smooth	Coast of California
McCune-Albright Syndrome	Irregular	Coast of Maine

Langerhans Cell Histiocytosis



→ Types

1. **Letterer siwe disease**
   → <3 years fatal
2. **Hand schuller Christian Disease**
   → Lytic skull lesion, exophthalmos & Diabetes Insipidus
3. **Eosinophilic granuloma**
   → Solitary bone or lung lesions (Pulmonary histiocytosis)

PrepLadder

→ **Skull→ most common bevelled lytic lesion**

→ Biopsy → Cells with **Birbeck granules** (Tennis racket appearance)

→ Spontaneous resolution

Hemangioma

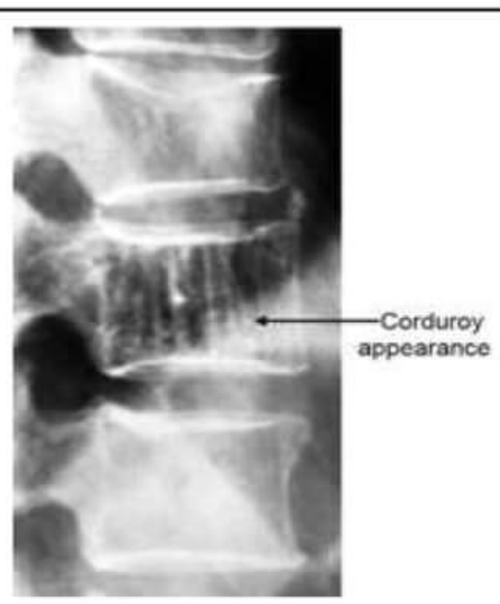
→ X-ray shows

- "**corduroy appearance**"
- Vertical striations in vertebrae
- "Jail Bar appearance"

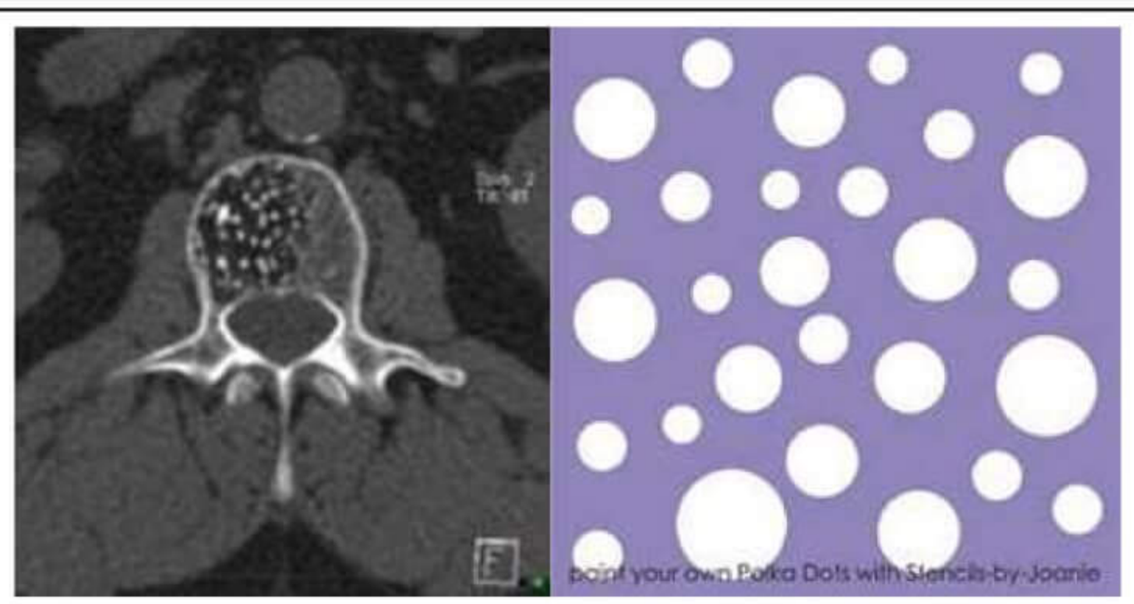
→ CT Scan- Polka **Dot sign**– characteristic and very rare

Treatment

→ Spontaneous resolution (rarely requires radiotherapy)



Corduroy Appearance- Hemangioma



Polka dot sign - hemangioma

Chordoma

→ Origin - Notochordal remnants

→ 2nd common malignancy of spine after multiple myeloma

→ Most common site →**Sacrum**

→ **Physaliferous cells** are seen (vacuolated cells)

chordoma

Treatment

→ Surgical excision + / - Radiotherapy

PrepLadder

Vanishing Bone Disease

→ Seen in

- Gorham's disease
- Angiomatosis of bone

Vanishing bone disease

MALIGNANT BONE TUMORS

Pulsatile bone tumor

→ "When we open the tumor, the margins of tumor have pulsatility"

- Aneurysmal Bone Cyst
- Giant cell tumor
- Osteosarcoma (Most Important)

Osteosarcoma- Cancer of the Young

→ 2nd decade

→ In metaphysis

→ Radiation induced sarcoma (after 10-15 year of Radiotherapy)

→ Radio-resistant bone tumor

→ Osteoid (Matrix) forming bone tumor

→ **"Bone forming bone tumor"**

→ OS & soft tissue sarcomas are associated with germline retinoblastoma

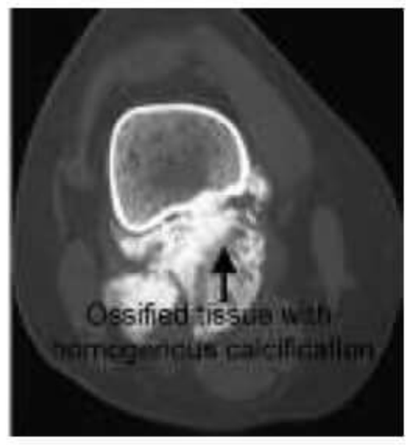
→ Most Common site → **Lower end of femur**

→ Has homogenous uniform calcification

→ Positive Codman's triangle (wide area of activity)

→ (Knee-skeletal maturity 18 years) Patient's age-18 years {2nd decade}

→ **Metaphysis in lower end of femur**



Clinical features

→ Pain / Night pain

Types

1. Classical – Intramedullary / intra-osseous
2. Periosteal – Arise from cambium layer
3. Parosteal– Posterior aspect of lower femur -**Good prognosis**
4. Pagetoid – AKA **Osteitis deformans**- **Worse prognosis**
5. Radiation Induced (10-15 years)

Parosteal osteosarcoma

Treatment

T-10 protocol → used for OS

→ **Methotrexate** – very important drug (Etoposide not used)

→ Chemotherapy → Tumor shrinks → Excision (Calculate the % of necrosis)

PrepLadder

- > 95% necrosis → chemosensitive tumor

↓

Same chemotherapy is given post-op

- < 95% necrosis → chemo-resistant

↓ post op

New Chemotherapy combination

→ T-10 Protocol→ 70% of 5 years survival

Prognosis

→ Poor prognosis

→ Depends on :

→ Extent of disease (Stage) - More important

→ Grade of lesion

→ Most common site of metastasis → **Lungs (poor prognosis)**

→ **Systemic metastasis > Pulmonary Metastasis**

OS is malignancy causing Penumothrax

Ewing's sarcoma

→ Presents like osteomyelitis

→ Pain – universal compaint

→ At femur- diaphysis

→ Age- **Second decade > 1st decade**

→ Origin → Marrow cells

→ Marrow biopsy – to see extent of the disease

→ Has variable consistency

- Positive soft tissue component
- Positive onion-peel appearance

→ It is a round cell humor with glycogen positive cell

→ **Most common translocation → t (11:22)**

- Others → t (21:22) & t (7: 22)

→ Trisomy 8, trisomy 12

→ **MIC 2 (CD99)** – Specific marker

→ **Poor prognostic factors**:

- Age > 12 years
- Male
- Proximal
- Fever
- Anemia
- ↑ TLC / platelets / ESR / LDH

Increased TLC/ESR/LDH➔ OM

Increased TLC/ESR/LDH ➔ Poor prognosis

- Metastasis
- Chemo resistant
- Relapse

} Poorest prognosis

Ewing's sarcoma are always high grade

Treatment

→ Pre-op CT
→ Wide excision
→ Chemotherapy for 1 year
→ Subsequent RT may be given
→ Mainstay - **Chemotherapy + Surgery** - Determines prognosis

Chondrosarcoma

→ Calcified tumor seen in Pelvis
→ Metaphyseal
→ Causes Hyperglycemia
→ Treatment- Surgery

→ "**Radio resistant & Chemo-resistant**"

→ Best prognosis among malignant tumor

CS > OS > ES

↓ ↓

Best prognosis Worst prognosis

Multiple Myeloma

→ Lytic tumor
→ **Plasma cells** (destroys whole body / bone)

Clinical Features

→ **Bone pain + High ESR + Hypercalcemia**
→ Normal ALP level as it is bone-resorptive status
→ Normal bone scan – as there is no blastic activity

PrepLadder

Criteria

1. Positive proteins in serum / urine
2. Bone marrow plasma cells / Plasmacytoma
3. End organ damage

(Lesion, anemia, hypercalcemia, ↑ creatinine, hyper viscosity, amyloidosis, bacterial infection)

Multiple lytic lesions in bone ➔ Multiple myeloma

Punched out lytic lesion

Plasma cell leukemia

→ >20% plasma cells in peripheral smear

→ Destroyed by Plasma cells

Synovial sarcoma

→ Misnomer (Do not arise from synovium)

→ Characteristic translocation →(X:18) giving rise to SYT-SSX fusion gene

→ Near the joint-bursae

→ It is a biphasic tumor with epithelial and mesenchymal components

→ Treatment- **Excision**

Lytic lesions in skull Mn: MELTHORME

→ **M**-**M**etastasis

→ **E**- **E**osinophilic granuloma

→ **L**- **L**angerhans's cell histiocytosis &**L**ymphoma

→ **T**- **T**uberculosis

→ **H**- **H**yperparathyroidism (Rarest cause)

→ **O**- **O**steomyelitis

→ **R**- **R**adiotherapy

→ **M**- **M**ultiple myeloma

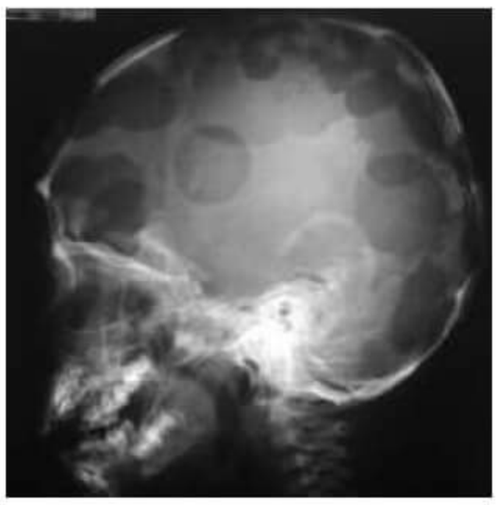
→ **E**- **E**pidermoid

PrepLadder

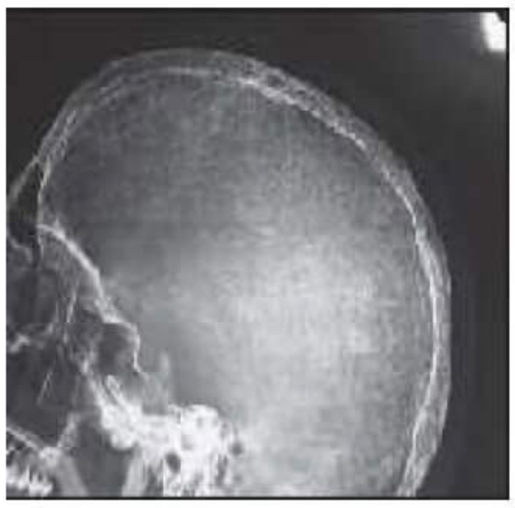
Punched out lytic lesion – Multiple myeloma

Bevelled lytic- Eosinophilic granuloma

Permeative (big) lesion – Langerhans's cell Histiocytosis



Salt & pepper skull –Hyperparathyroidism(rarest)



Cotton wool skull – Paget's Disease

→ No Lytic lesion, ↑ in skull size

Osteoporosis circumscripta – Paget's Disease

→ Osteoporosis in large area in skull

Hair on end appearance – Haemolytic anaemia (BV) & Thalassemia

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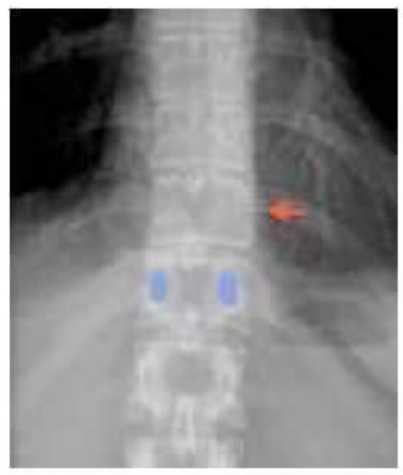
Vertebra

→ Both winking sign and blind bat sign are due to metastasis.

Blind Bat Sign	Winking owl Sign
→ Both the pedicles are destroyed 	→ One of the either pedicles are destroyed  

1. **Geographic pattern**
   - → Well defined with sclerotic margin
   - → Well defined with no sclerotic margin
   - → Ill-defined margin – CS

2. **Moth-eaten**
   - → Metastasis / Multiple myeloma

3. **Permeative:**
   - → Multiple myeloma /metastasis/ Ewing's sarcoma
   - → Ewing's sarcoma→ Most malignant tumor to cause Permeative

LESS MALIGNANT

MORE MALIGNANT

PrepLadder

Treatment of bone tumors

Curettage (dry moping)

→ Open the cavity and scoop out the contents

→ Loosely attached contents will come out

Extended curettage (dry + wet moping)

→ Remove all the sticking particles

→ Most common chemical used for extended curettage is **phenol**

Excision

→ **Intralesional or intracapsular excision** - Remove only the content from the center

→ **Marginal excision** – remove the tumor from the margin within the pseudo capsule

→ **Wide local excision** – remove a normal cuff off tissue all around

→ **Radical excision** – removal of whole compartment

→ **Most common excision is wide local excision**

→ **Normal margin taken in wide local excision is 3cm**

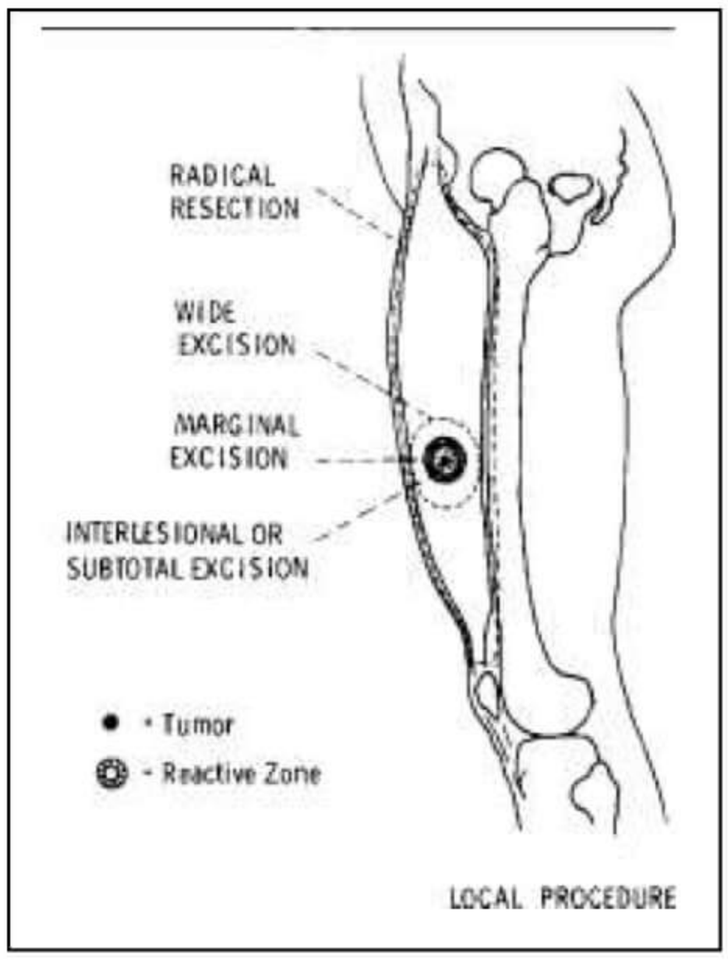
→ Benign and cartilagenous tumors (chondroblastoma / chondrosarcoma) - operated

→ Cystic lesions – curettage (unicameral bone cyst)

→ With chemical to kill residual cells – extended curettage – phenol/ **liquid N2 (best), because it has least re occurrence**

→ 4 lesion which we do extended curettage are:

1. **Aneurysmal bone cyst**
2. **Chondroblastoma**
3. **Giant cell tumor**
4. **Enchondroma**



→ Malignant tumor – neoadjuvant chemotherapy -surgery – adjuvant chemotherapy (Ewing's and osteosarcoma)

→ Ewing's is most radiosensitive bone tumor

Polyostotic / multiple lesion:

1. **Osteochondroma (exostosis)**
   → It is a developmental malformation
2. **Enchondroma**
3. **Fibrous dysplasia**
   → It is a developmental malformation

PrepLadder

4. Giant cell tumors (Goltz syndrome)
5. 5.Ewings sarcoma

Radioresistant bone tumors

1. Osteosarcoma – most radioresistant
2. Chondrosarcoma
3. Malignant fibrous histiocytoma

PrepLadder

TRAUMA-GENERAL + UPPER LIMB

Fracture-Break in continuity of cortex [macro (or) microscopic]

Sure Signs of Fracture

1. Abnormal mobility (best option)
2. Failure to transmit movements proximally
3. Crepitus

Commonest/Consistent sign - **Tenderness**

Commonest

→ Fracture: Clavicle (middle 3rd)

→ Fracture @ birth: Clavicle

→ Fracture in children: Forearm (**radius>ulna**); Hand and Elbow are common

→ Dislocation: Shoulder [Humerus: Glenoid = 4:1]

↓ ↓

Anterior "Golf ball on a tee"

→ Dislocation in children: Elbow (Posterior)

→ Rarest to dislocate: Ankle

→ Ankle = Sprain (Sprain = Ligament damage)

- **Anterior Talofibular Ligament** (on Lateral side; **MC ligament damage**)
- Medial Side = Deltoid ligament

→ **Most common tendon injured: Supraspinatus > Biceps Brachii >Tendo Achilles**

Markers

→ **Bone resorption**: Hydroxyproline / Pyridinoline / deoxypyridinoline/ Telopeptides (N & C terminal)

→ ↑ Bone formation and resorption – Paget's disease

→ **Bone formation**: Osteocalcin /ALP / serum Pro-collagen type 1(N & C terminal)

[MM= No raise in formation marker- ALP as it is lytic]

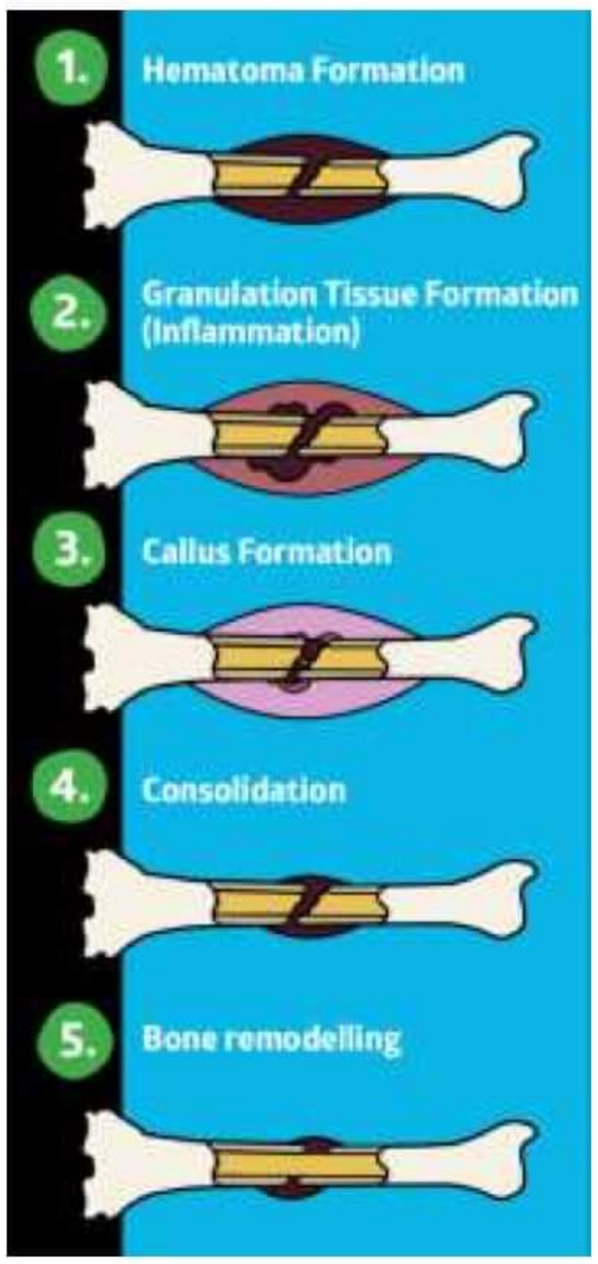
→ ↑ALP in multiple myeloma – only in fracture

PrepLadder

Stages of Fracture Healing

→ Stages of Union / Stages of Fracture healing by **Frost**

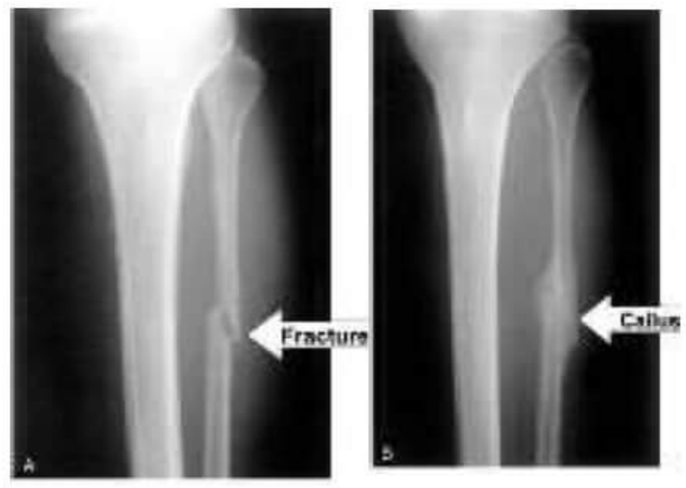
1. **Hematoma**
   - If inside skin → closed
   - If skin broken & blood comes out → Open #
2. **Granulation tissue**
3. **Callus (takes place after 3 weeks)**
4. **Consolidation (where solid bone starts forming)**
5. **Remodeling**



Callus

Forms only when there is movement

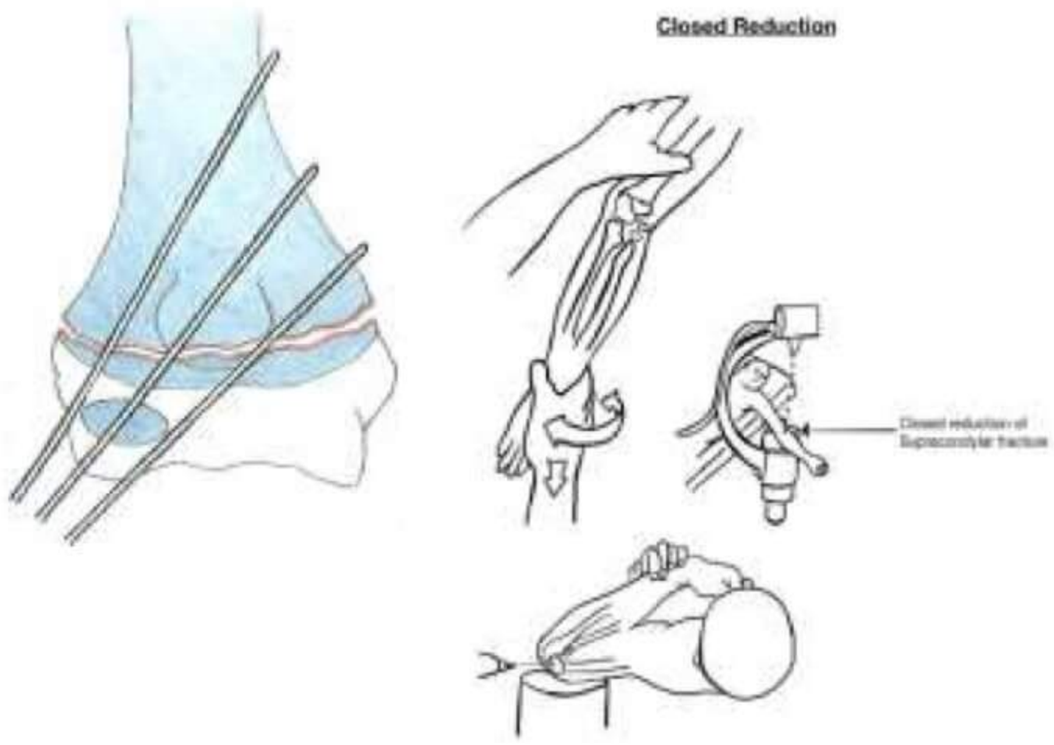
- Microscopic → Forms consolidation
- Excessive → Non-Union



Supra condylar extra – articular Fracture

→ Occurs away from the joint

→ Rx: Closed Reduction, Hematoma preserved



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Lateral condyle Intra-articular fracture

→ Joint is affected
→ Articular surface needs to be restored
→ Failure in restoration – leads to arthritis
→ Rx = **Open reduction**

Open Reduction	Hematoma exposed
Closed Reduction	Hematoma preserved

Plaster of Paris = ($CaSO_4 . {}^1/_2 H_2O$)

→ Plaster of Paris ($CaSO_4 . {}^1/_2 H_2O$) + H_2O = $CaSO_4\ 2H_2O$

	Primary Healing (Plate, No movement)	**Secondary Healing** (Cast/ Nail)
Callus	Absent ("Direct")	Present
Biological Heading (Callus Promotion)	No	Yes
Examples	Plating	Nailing/Cast

Plaster of Paris with water

→ When applied on one surface → **Slab**
→ When applied all around → **Cast**
→ When goes around the spine (Limb+spine) → **Spica**

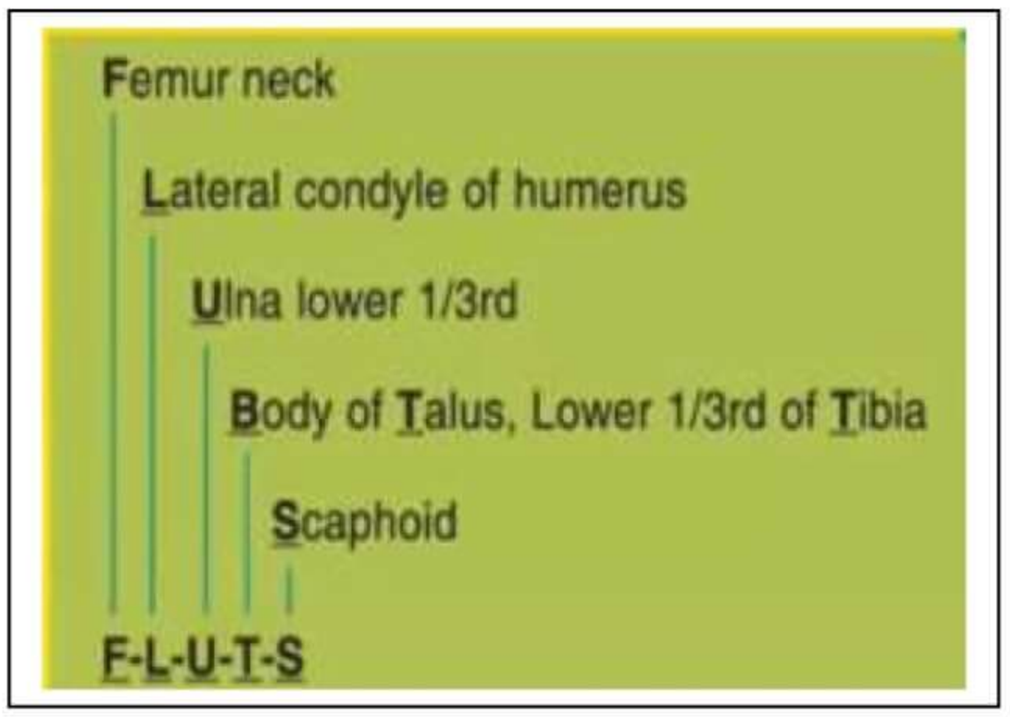
Nail

→ Opening the medullary cavity & inserting nails

PrepLadder

Fractures known for Non-union

Non-union → Condition where the fracture does not unite for 9 months of which the last 3 months, there is no progress in healing.



Types:

1. Hypertrophic

→ excess callus [(+) movement]

→ Treatment: Stabilization

2. Atrophic (avascular)

→ Treatment: Freshen the fracture (Nibbling/Rose petalling the bony segments) + stabilize + Bone graft (Bone graft → Iliac crest]

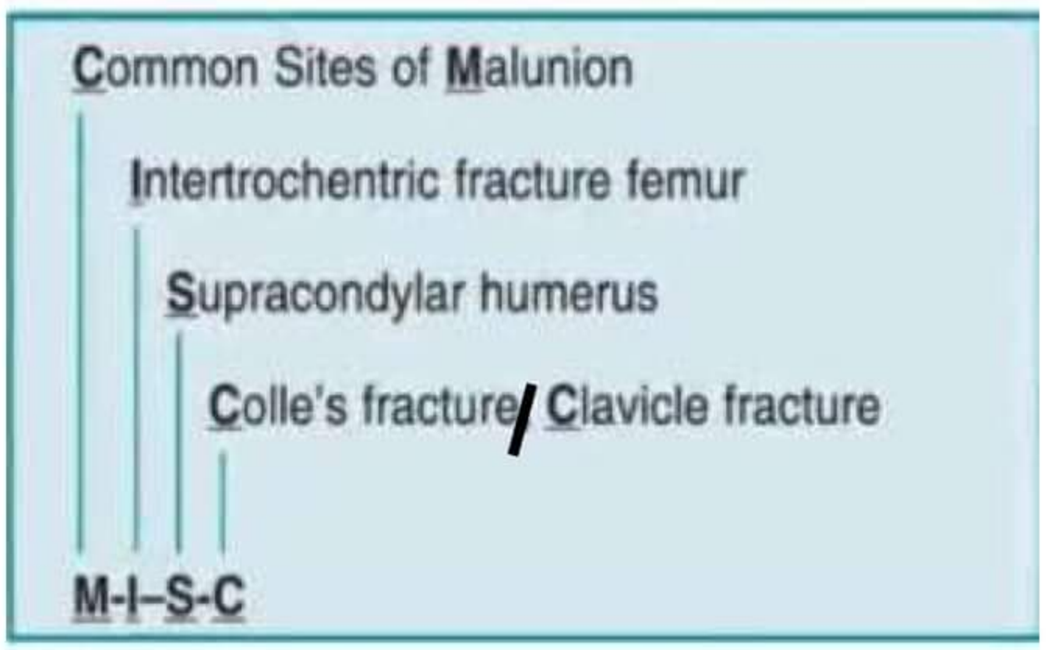
→ Femur Neck fracture: Unsolved fracture

- Cambium layer absent
- Intracapsular (synovial fluid inhibits)
- Poor blood supply
- Vertical fracture

Most Common Complication in Scaphoid→ Non-union > Avascular necrosis

Lateral condyle of Humerus - Cubitus valgus

Fractures known for malunion



Supracondylar fracture →Cubitus Varus

Colle's fracture → Lower radius;

Dinner fork deformity

PrepLadder

Gustilo and Anderson Classification

Gunshot wounds → Grade 3

→ It is used for open fracture (hematoma is exposed).

→ Rx of open fracture →Debridement +External fixator

Grade	Characteristic Feature
I	Clean wound of <1cm length
II	Wound > 1cm in length without extensive soft Tissue damage, skin flap or avulsion
III	Wound associated with extensive soft tissue damage, comminution, contamination or segmental fractures
IIIA	Adequate periosteal coverage is there
IIIB	Significant periosteal stripping and it requires secondary bone coverage procedure like skin grafting or flap
IIIC	Open fracture with Vascular injury that requires vascular repair

PrepLadder

UPPER LIMB 1

Stress fracture

→ Marrow changes are noticed early

→ IOC – (1) MRI (also for U/L stress fracture)

(2) Bone scan (for B/L or multiple)

→ DDX = 1.) Infection

2.) Early Tumor

March fracture

→ LL: Metatarsal Neck 2nd > 3rd

Ref: R/G &Campbell → Neck (✓)

→ **MC site in lower limb** – **Metatarsal neck 2nd> 3rd**

→ **MC site in upper limb** – **Olecranon**

→ In spine = **Pars interarticularis** – L5

→ Rx = Cast / Rest

RTA (Road Traffic Accident)

→ According to ATLS – ABC (Airway, Breathing, Circulation)

→ But Cervical spine has to be stabilized 1st.

Cardiac Patients

→ According to ACLS – CAB (Circulation, Airway, Breathing)

Rotator cuff

→ **Swimmers shoulder** is prone to injury.

↓

Injury to rotator cuff muscles ➔ **SIt-s**

Supraspinatus
Infraspinatus
Teres minor
} Inserts on greater tuberosity

Subscapularis →inserts on lesser tuberosity **"Internal rotator"**

Shoulder injury is common in swimmers

PrepLadder

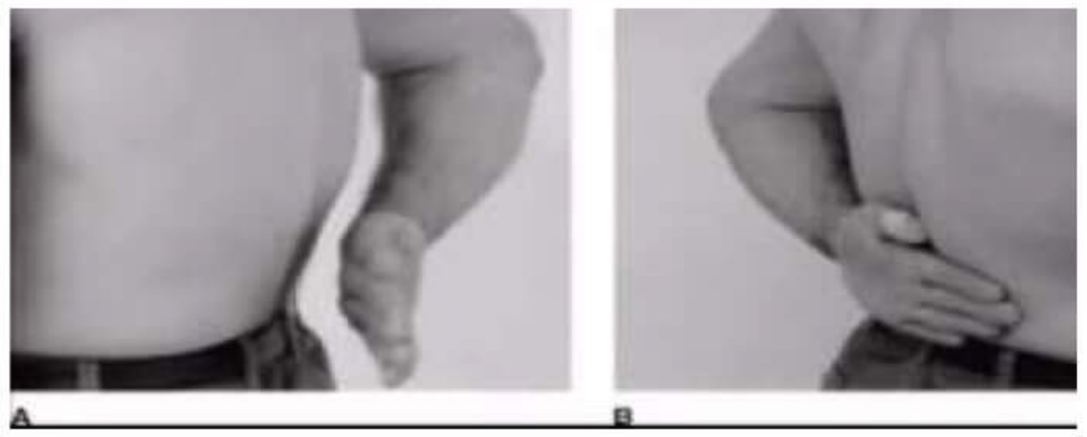
Subscapularis

→ "**forgotten tendon**" of rotator cuff"

→ Internal rotator

→ **Lift off test**

→ Difficult to pick up in MRI, arthroscopy



Lift off test: Lifting the hand from the back

If cannot, then test is positive for subscapularis tear

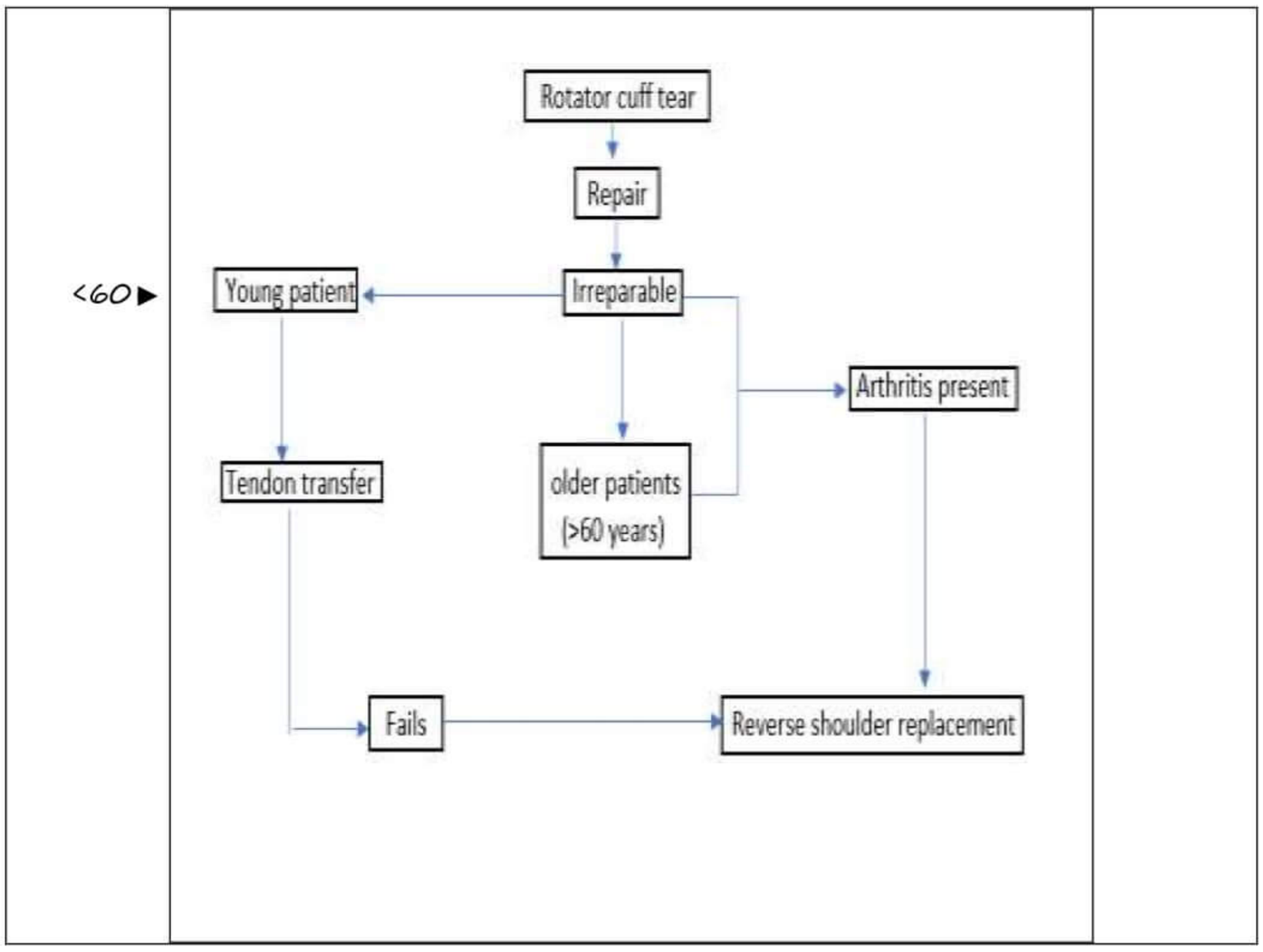
Rotator cuff tear

Treatment

→ Physiotherapy + NSAIDS (Steroids if not healed)

→ Repair

→ Irreparable → tendon transfer



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Shoulder replacement

→ **Shoulder joint – Ball and Socket joint**

→ **Ratio of Head: Glenoid – 4:1**

Standard shoulder replacement	**Reverse shoulder replacement**
Head on Humerus is replaced by a prosthesis 	Head on scapula, glenoid on Humerus **Indication:** Any joint without a good 1. Deltoid 2. Rotator cuff 

Instability – Prone to dislocate

→ Anterior – ABER (Abduction + External rotation) +Extension

→ Posterior – ADIR (Adduction + Internal rotation)

→ Inferior –Multi directional (Hyperlaxity, Ehler Danlos, Marfan syndrome, Osteogenesis imperfecta Aka Laxed joint/ Luxatio Erecta)

→ Shoulder-MC dislocation → Anterior

Weakest → Inferior

PrepLadder

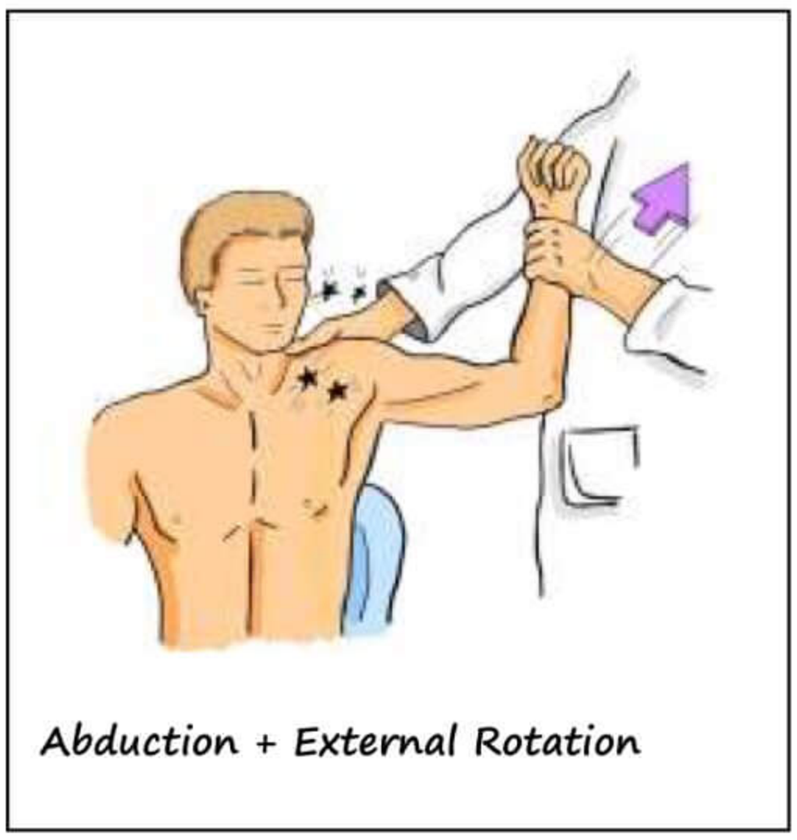
a) Anterior instability

→ Anterior drawer – head pushes out

→ Apprehension – Sympathetic over activity/restless

→ Movement – like fulcrum/Crank test

Mechanism – Abduction + External rotation



Abduction + External Rotation

b) Posterior Instability

→ Jerk test

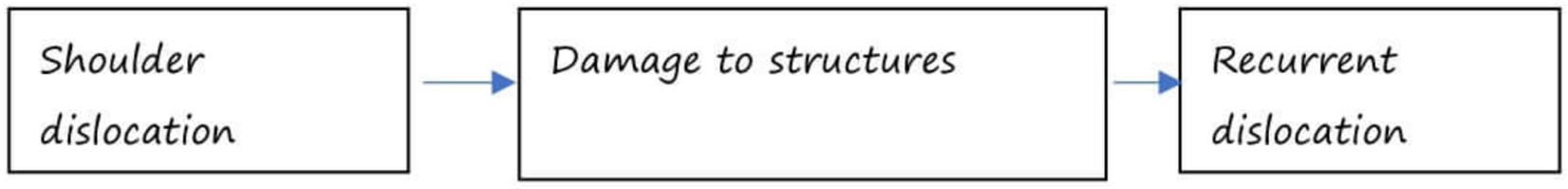
→ Mechanism – Adduction + Internal rotation

c) Inferior Instability

→ Sulcus test for multidirectional instability

Complications of shoulder dislocation

MC complication of shoulder dislocation – **Recurrent shoulder dislocation**



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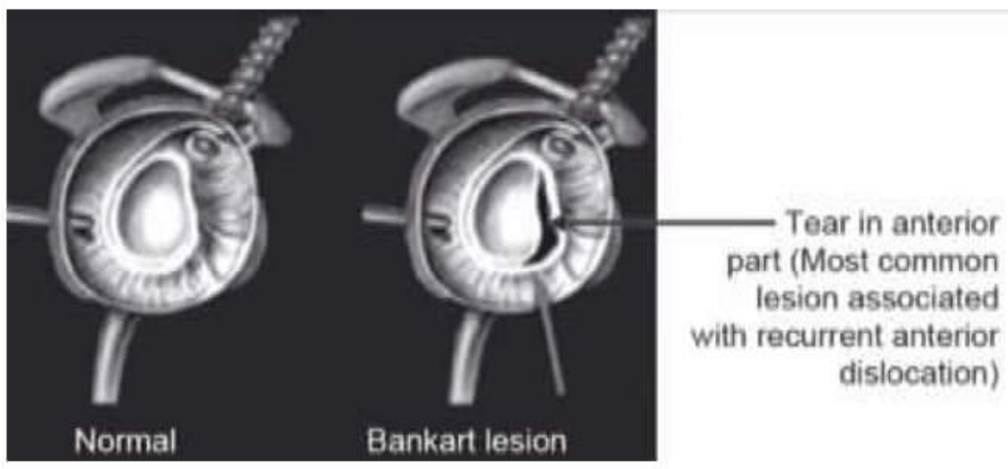
Lesions

1) Bankart's Anterior Glenoid labrum

Anterior tear in Anterior Dislocation



2) Hillsach's Head of Humerus

Posterolateral defect in Ant. Dislocation

3) Reverse Hillsach's

Anteromedial defect in posterior dislocation

Masten's classification for recurrent instability of shoulder

TUBS	AMBRII
T- Traumatic U- Unidirectional B- Bankart's S- Surgery	A- Atraumatic M- Multi directional B- Bilateral R- Rehabilitation (Hyperlaxity) I- Inferior capsular shift procedure I- Internal closure
Good prognosis	Poor prognosis

Surgery for shoulder instability

→ Bankart's repair

→ Putti plat → double breasting of subscapularis (tightening)

→ Bristow Latarjet → Coracoid transfer to anterior glenoid

PrepLadder

Shoulder Dislocation

Tests

→ **Dugas test** → Inability to touch the opposite shoulder in dislocated shoulder

→ **Callaway test** → circumference of axilla lengthens in dislocated shoulder.

→ **Hamilton ruler test** → when ruler placed on lateral epicondyle → ruler touch lateral epicondyle and acromion simultaneously in dislocated shoulder. (Normally it can't)

→ **Bryant's test** → lower level of axillary fold which can be observed from a distance in dislocated shoulder.

Management

→ Kocher's maneuver → **most common** (TEAM)

Traction + External rotation + Adduction + Medial rotation

→ Stimpson's maneuver → gravity – assisted reduction.

→ Hippocrates → not used

Dislocation in X-ray

→ If head is below glenoid - Anterior

→ If arm/thigh is abducted in X-ray - Anterior

→ If head is at level arm/thigh adducted in X-ray - Posterior

Posterior Dislocation

→ Causes:

- Epilepsy
- Electric shock

→ Glenoid cavity is empty is because head is out -**Empty Glenoid sign**

→ **Electric bulb sign**

→ Most commonly missed dislocation in human body.

UPPER LIMB 2

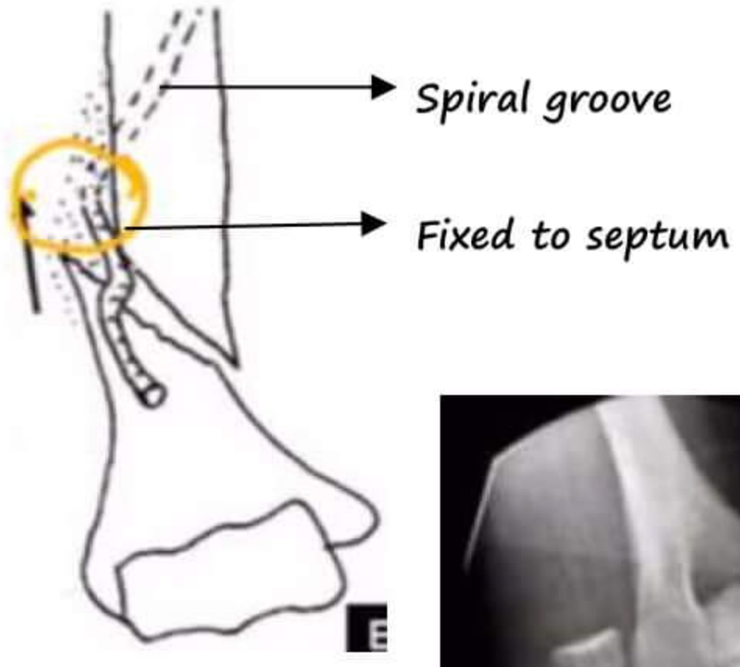
NERVE INJURY

Injury	Common Nerve Involvement
→ Anterior or inferior shoulder dislocation	→ Axillary, (Circumflex humeral) nerve
→ Fracture surgical neck humerus	→ Axillary nerve
→ Fracture shaft humerus	→ Radial nerve
→ Fracture supracondylar humerus	→ AIN > Median > Radial> Ulnar (AMRU)
→ Medial condyle humerus	→ Ulnar nerve
→ Cubitus valgus	→ Tardy ulnar nerve palsy
→ Monteggia fracture dislocation	→ Posterior interosseous nerve
→ Volkman's ischemic contracture	→ Anterior interosseous nerve
→ Lunate dislocaiton	→ Median nerve
→ Hip dislocation	→ Sciatic nerve
→ Knee dislocation	→ C. Peroneal nerve(foot drop)

Fracture of shaft of Humerus

→ Radial nerve injury usually occurs in **Lower 3rd > Middle 3rd**.

- It is because radial nerve is fixed to the septum at the lower 3rd .
- **Holstein Lewis sign**



Monteggia Fracture → Involves upper end of ulna (medial bone) fracture +radial head dislocation.

→ Injury to **Posterior interosseous nerve**, a branch of radial nerve.

Fracture of humerus

Non-operative Mgt → encouraging

Indication of surgery

(1) vascular injury (urgent indication)
(2) multiple fracture (damage control)
(3) pathological fracture (fix / tissue)
(4) Radial Nerve involvement after reduction (nerve entrapped at # site)

PrepLadder

Usual method of fixation

(1) plating (primary healing)

(2) Nailing (secondary healing)

Non- operative Mgt

(1) Hanging cast

(2) U cast

Coronal plane deformities

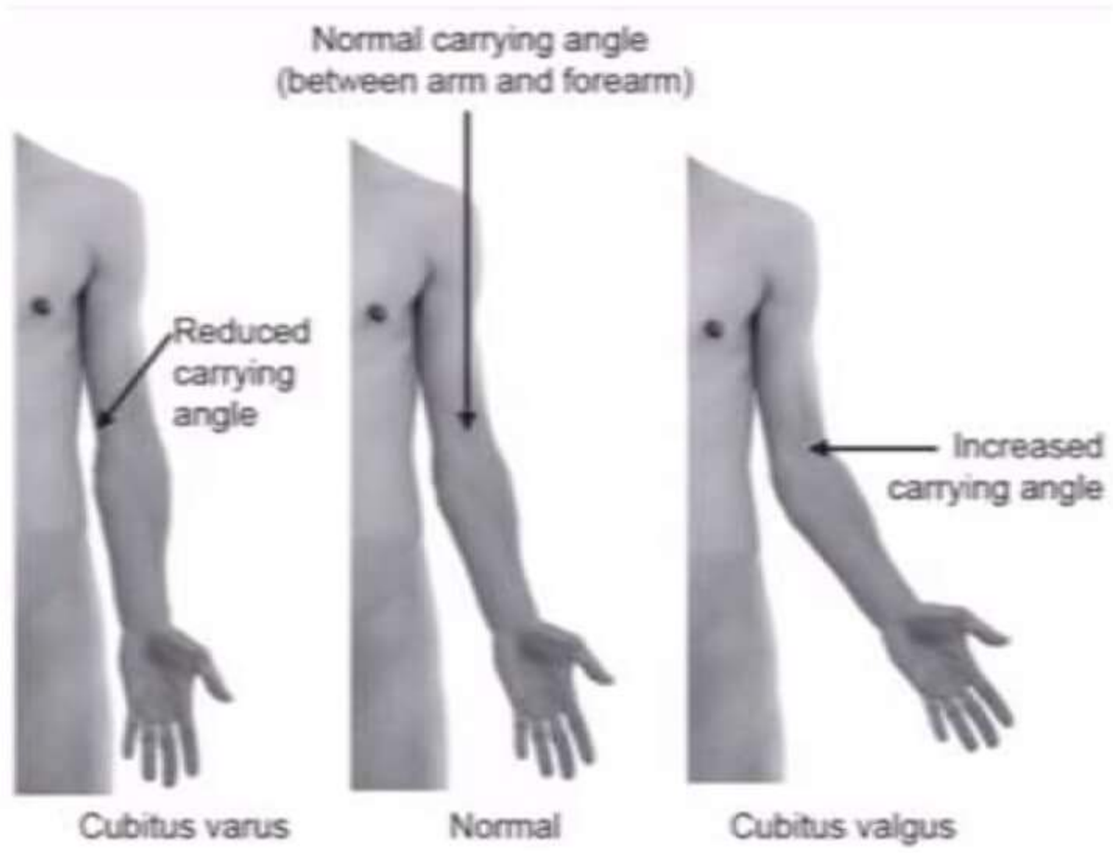
VaLgus –Lateral (distal part goes laterally)

Carrying angle:

Angle between arm & forearm

↑ angle = cubitus valgus

↓ angle = cubitus Varus



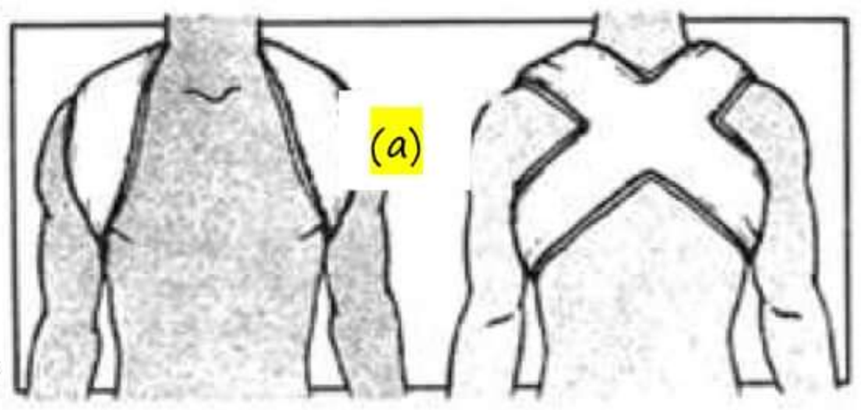
In females, **trochlea is at lower level than capitulum** (medial side lower). This leads to increased carrying angle.

Clavicle

→ MC bone to fracture

→ Occurs in

- Middle 1/3rd
- At junction of medial 2/3rd and lateral 1/3rd



→ Treatment: observation / sling / figure of 8 bandage

→ Operative indication increasing

(1) Displaced fracture

(2) Open fracture

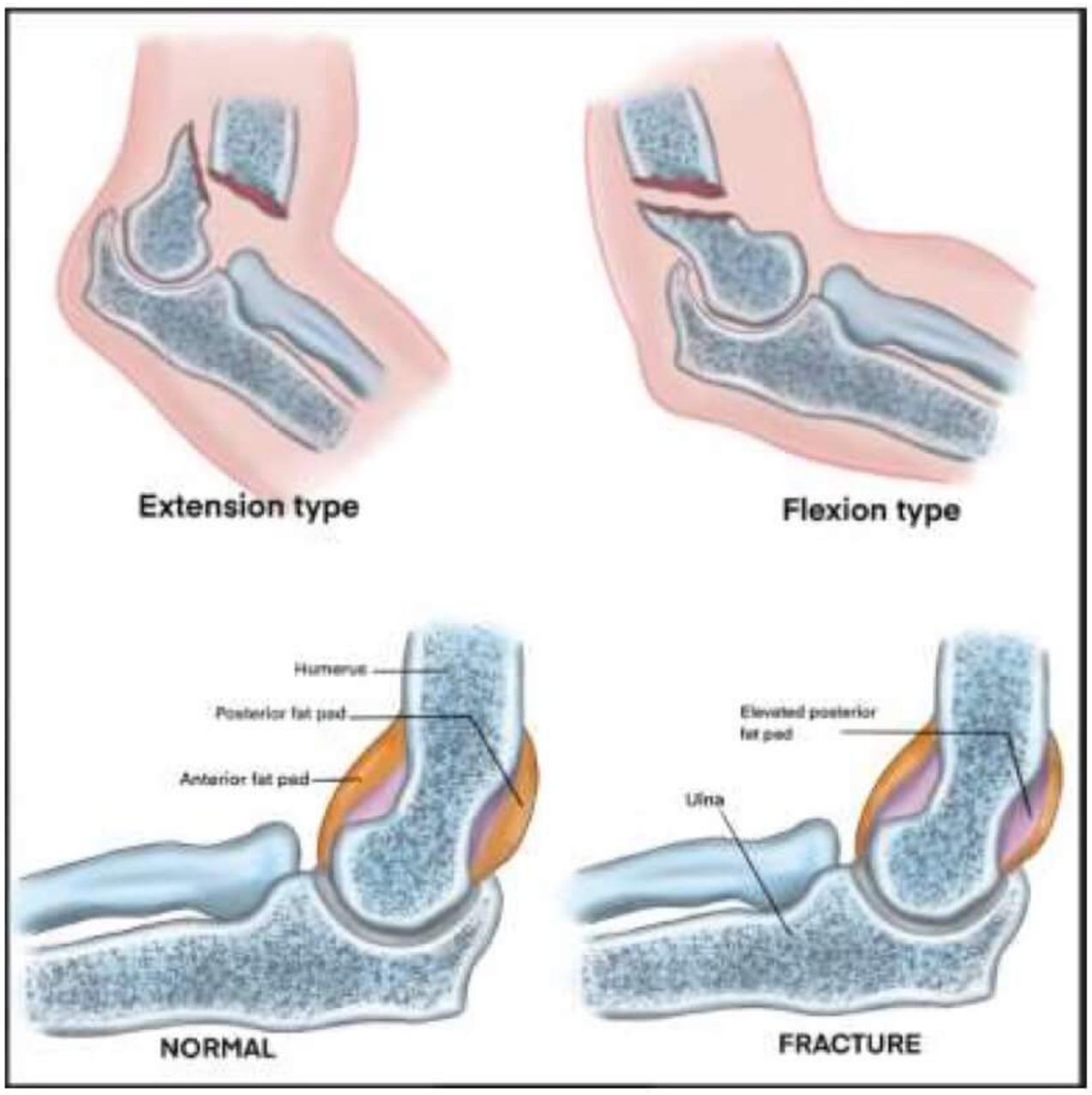
(3) Multiple fracture

Supracondylar Humerus fracture

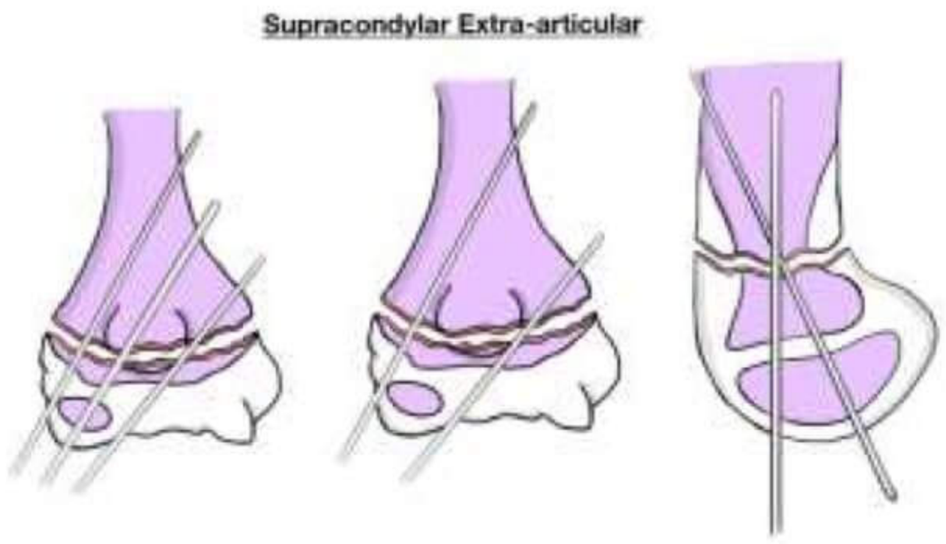
→ Undisplaced fracture of humerus →Posterior fat is elevated→ "**Fat pad sign**"

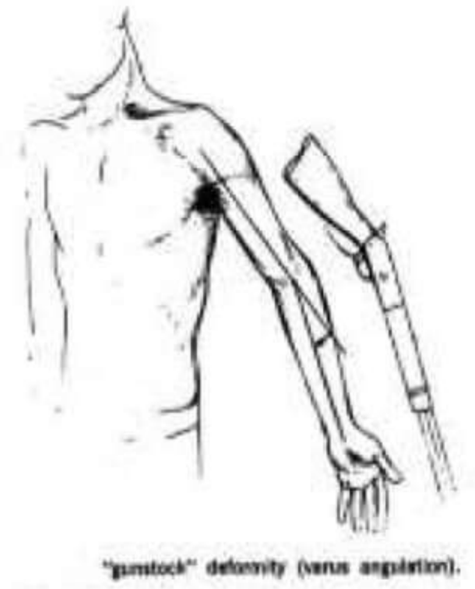
→ Fracture is displaced → Distal fragments goes posteriorly → Extension

PrepLadder


Extension type
Flexion type
Humerus
Posterior fat pad
Anterior fat pad
NORMAL
Elevated posterior fat pad
Ulna
FRACTURE


Gartland type 3 supracondylar fracture humerus




"gunstock" deformity (varus angulation).

Posteromedial displacement > posterolateral

→ It is an extra –articular injury

→ TOC- CR +K wires (fixed, stainless steel wire)

K wire → placed in children for 4-6 weeks, then removed. If reduction is not proper, it can lead to cubitus Varus

→ "Gun stock deformity"

Conservative Treatment

- Smith's traction
- Dunlop traction

Sometimes, it can lead to damage of **brachial artery**→ "pulselessness"

↓

Mgt: closed reduction & look for reappearance

↓

- Pulse
- Color- pink

If no reappearance, then explore & repair.

Closed Reduction

Most common damaged artery in SCH- Brachial Artery ?

Lateral Closing wedge osteotomy

In gun stock deformity,

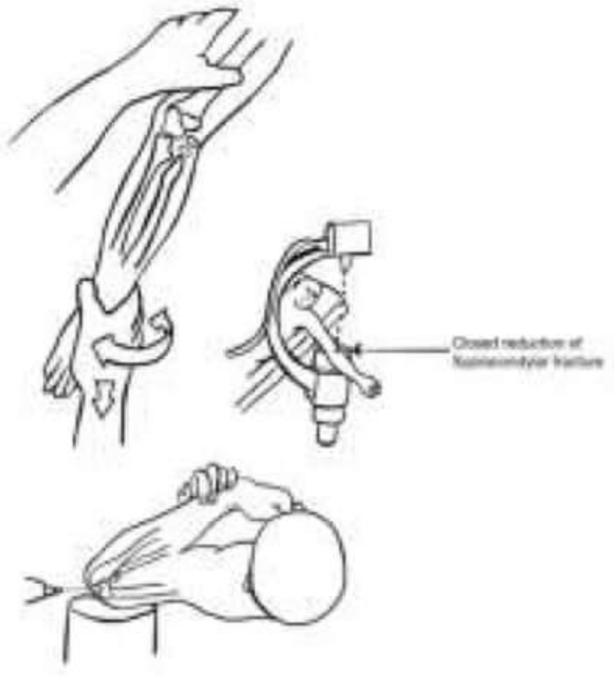
Lateral border is bigger than medial border

↓

wedge of bone from lateral side is taken out

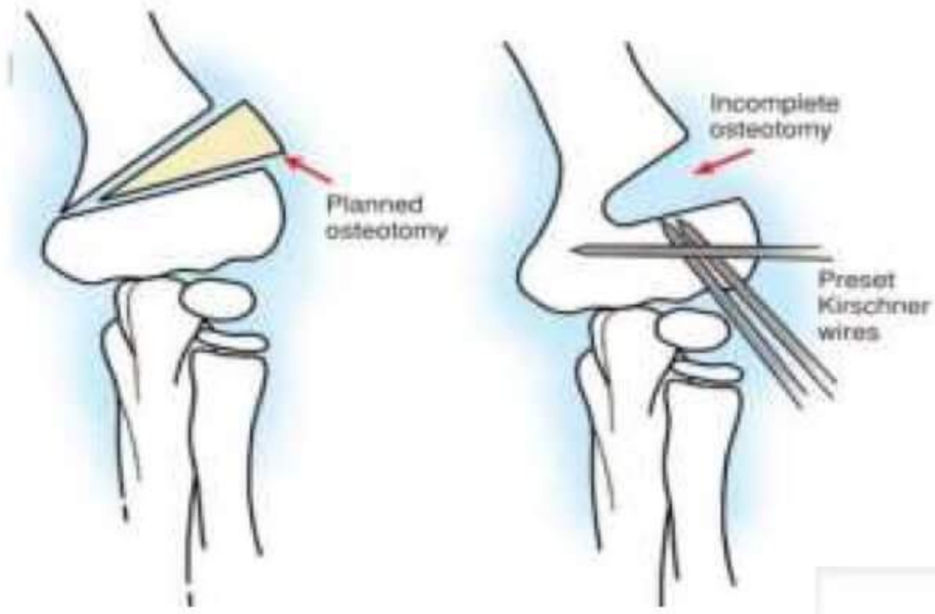
↓

Deformity corrected



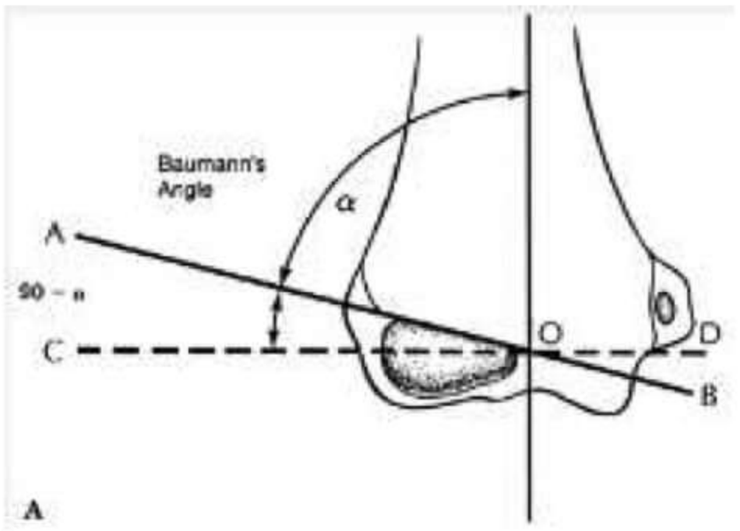
PrepLadder

→ Preferred in SCH fracture causing malunion

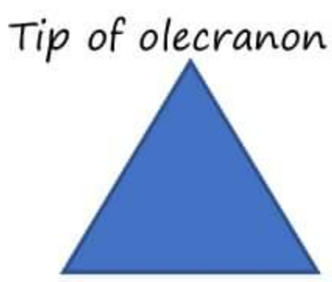


Bauman's angle

→ Angle between elbow and cubitus Varus



3 – point bony relationship in elbow



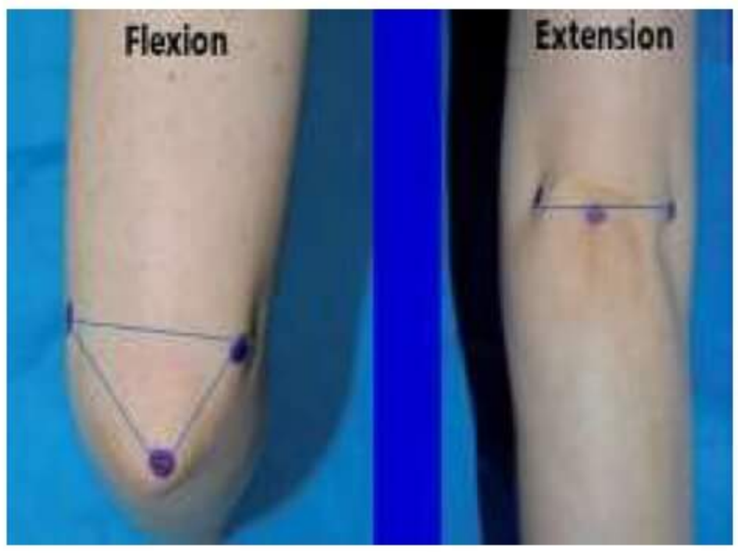
→ In extended elbow →All 3 are in the same line.

→ In elbow90° flexed→they from a triangle.

3 -point bony relationship:

Maintained →SCH

Disturbed → Elbow dislocation



→ Intra-articular fracture

→ Rx: open reduction + K wire

→ Complication:

- Non-union: "*Cubitus Valgus*'

→ This can also lead to "Tardy Ulnar nerve palsy"

Malunion in SCH #:

Very common

Lead to cubitus Varus

PrepLadder

Monteggia – bell tawse procedure

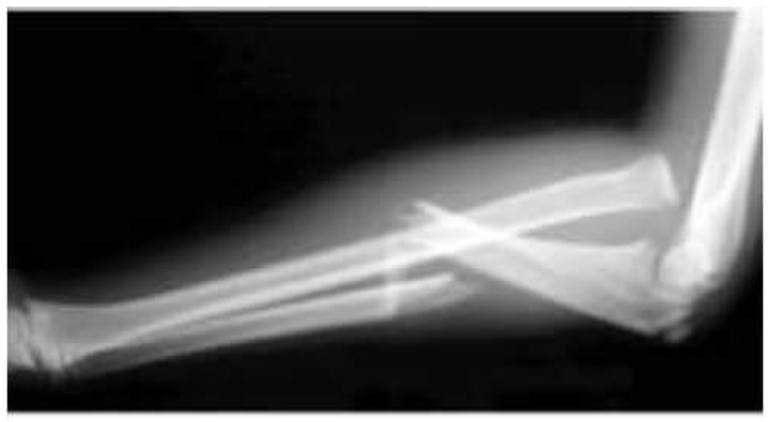
→ Monteggia= medial bone (Ulna)

→ mouth (upper ½) # with Radial head dislocation

→ Classified by **Bado**

- → Type I: Head goes anterior→ **Most Common**
- → Type II: Head goes posterior
- → Type III: Head goes lateral
- → Type IV: Forearm → both the bone fractured + radial head dislocated.

→ Surgery: Bell tawse procedure



Galeazzi fracture dislocation

(1) fracture of radius (lower ½)

(2) dislocation of distal radio-ulnar joint

(3) interosseous membrane damaged

(4) Triangular fibro-cartilage complex (TFCC) damaged

(TFCC →found in distal radio-ulnar joint)

Fractures of Necessity (requiring surgery)

→ Galeazzi fracture dislocation

→ Lateral condyle fracture humerus

→ Displaced fracture olecranon & patella

→ Fracture neck femur

→ Monteggia fracture in adults

→ Articular fracture

Compartment syndrome: **C**ast

Myositis ossificans: **M**assage

Sympathetic overactivity: **S**udeck's

Fracture of femur/ **F**orty-eight hours: **F**at embolism- Worst prognosis

Compartment Syndrome

→ History of tight cast

→ MC area: Deep posterior compartment of leg > Deep flexor forearm

↓ (overall most common) ↓ (commonest in children)

→ Earliest symptom - pain out of proportion to injury

→ Earliest sign - pain on passive stretch at distal most joint of extremity

→ Management: Remove the cast (pain – not controlled by analgesics)

→ Pulse Normal– because micro-circulation is only affected. Hence, it is not a reliable indicator.

→ Normal Pressure at leg :<11 mmHg

→ Calf pressure during walking: 200 – 300 mm Hg

→ **Treatment**: Fasciotomy (release up to deep fascia

→ **Indication**:

PrepLadder

- Pressure > 30 mm Hg
- Neurovascular compromise
- Paresthesia (+) → do fasciotomy

Volkmann's ischemic contracture (Sequelae of compartment syndrome) (shortening)

→ More common in upper limb

→ Deep flexor compartment of forearm

→ **Flexor digitorum profundus > flexor pollicis longus**

→ Order of N. involvement: "AMU"

Anterior interosseous>median > ulnar

Turn Buckle Splint

Management

→ Turn buckle splint

→ Max page muscle sliding operation

(Proximal muscles are released & Distal muscles are fixed→ to release the contracture)

Myositis ossificans

→ Hx of massage often present

→ Unilateral

→ Elbow

→ **Brachialis > Biceps**

→ Mgt: (1) Immobilization = 1st 3 weeks

(2) only active exercises (no passive exercise) =3 weeks to 1 yr.

(3) surgery => 1 yr.

→ Growth where density is more at periphery

→ Differential diagnosis- Osteosarcoma

- Grows centre to out (In→out)
- Uniform

Myositis ossificans → Occurs out→in

Active exercise → Patient on his / her own

Passive → Doctor does it

Pulled elbow (Traction injury)

→ History of traction

→ Radial head pulled out of annular ligament

→ **"Nursemaid elbow"**

PrepLadder

→ Radial head – responsible for 85% of pronation & supination
→ Position → forearm is pronated.
(supination is lost)
→ Age: 1 – 4yrs (mean = 3yrs)
→ X- rays – insignificant
→ Treatment→ forceful supination + flex it to position the head back
→ Self- resolving condition
→ As supination can be gravity assisted.

Ossification at elbow:

C R I T O E

Capitulum→ 2

Radial head →4

Int. epicondyle → 8

Trochlear → 8

Olecranon → 10

Ext. epicondyle→ 12

PrepLadder

UPPER LIMB 3

Fractures of lower end of radius

→ Lateral view →1st Metacarpal is anterior.
→ fracture breaks the joint → intra-articular
→ Away from joint → extra-articular

Barton fracture

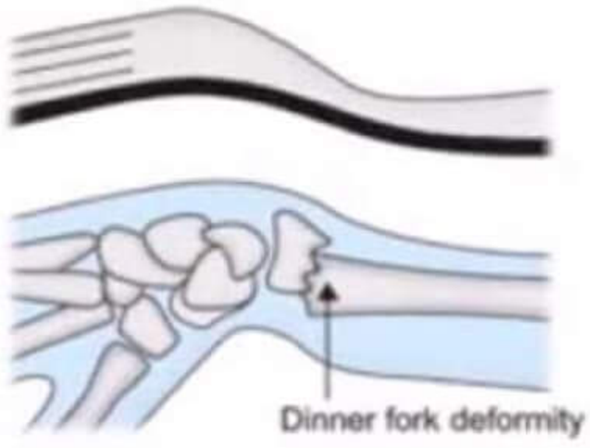
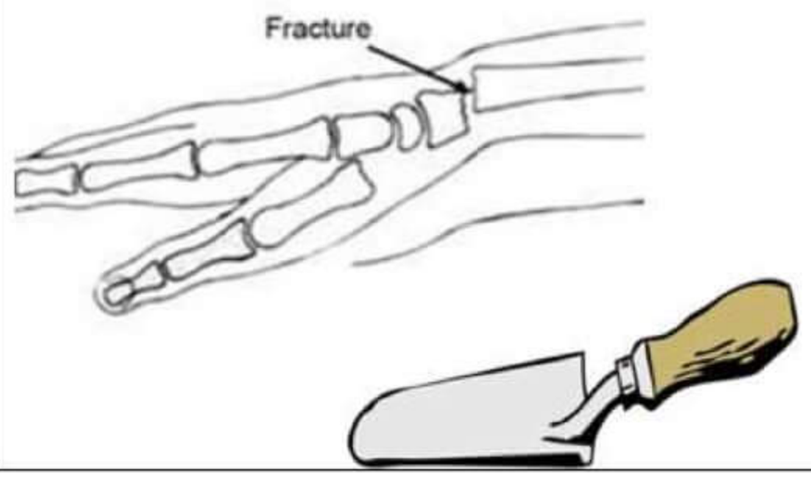
→ Intra-articular fracture
→ Fracture of articular surface of radius with Volar(anterior) subluxation of wrist.
→ **treatment:** fixation by plating Volar Barton → anterior

Volar Barton > Dorsal Barton

Dislocation→ complete loss of contact of 2 joint structures

Subluxation→ partial loss of contact of 2 joint structures

Extra-articular fracture of lower end of radius

	Colle's Fracture/ PC (Bone goes posterior)	Smith fracture/Reverse Colle's fracture AS (Bone goes anterior)
Displacement	Supination Lateral displacement of lateral tilt angulation Impaction(Proximal shift) Posterior displacement/tilt/angulation **SLIP**	Pronation Palmar angulation Ulnar deviation **Pro-Pag-Unda**
Position of Cast	Pronation Palmar angulation Ulnar deviation **Pro-Pag-Unda**	Supination Lateral displacement of lateral tilt angulation Impaction(Proximal shift) Posterior displacement/tilt/angulation **SLIP**
Extent of cast	Below elbow	Above elbow
Complications	**Mal-union** leads to **Dinner fork deformity**  	**Mal-union** leads to **Garden spade deformity** 

PrepLadder

Complication

(1) Finger stiffness – most common
(2) Mal union →dinner fork deformity
(3) Rupture of extensor pollicis longus
(4) Carpal tunnel syndrome
(5) Sudeck's dystrophy

Colle's #
Colle's cast
Aka hand shaking cast
Below elbow
Pronation – palmar
angulation – ulnar deviation

Sudeck's dystrophy

→ Complex regional pain syndrome
→ Sympathetic over-activity
→ Lankfort's Triad:

Stimulus (injury)

Response Activity (sympathetic)

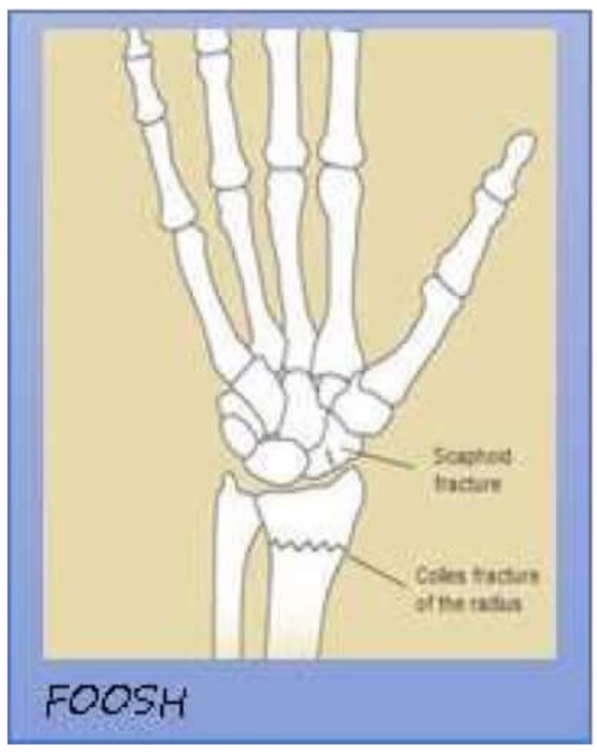
Inflammed skin Patchy osteopenia

→ Response: (1) red hot shining skin (due to sympathetic overactivity)
(2) patchy osteopenia / hyperemic osteopenia

→ **Types**:
Type 1 = post – traumatic (after Colle's #) ~ sudeck's
Type 2 = nerve injury (usually medial nerve)~causalgia
→ **Treatment**: exercises to continue
→ Results are poor

FOOSH: "Fall on outstretched Hand"

(1) Colle's #→ Most common; Seen in elderly, osteoporotic
(2) Scaphoid →young
(3) Supracondylar # of Humerus → In children



PrepLadder

Scaphoid→ Most common carpal bone to fracture

→ Bl. Supply is distal to proximal

→ fracture usually occurs in the waist (mid-point)

↓

Blocks bl. Supply distal to proximal

↓

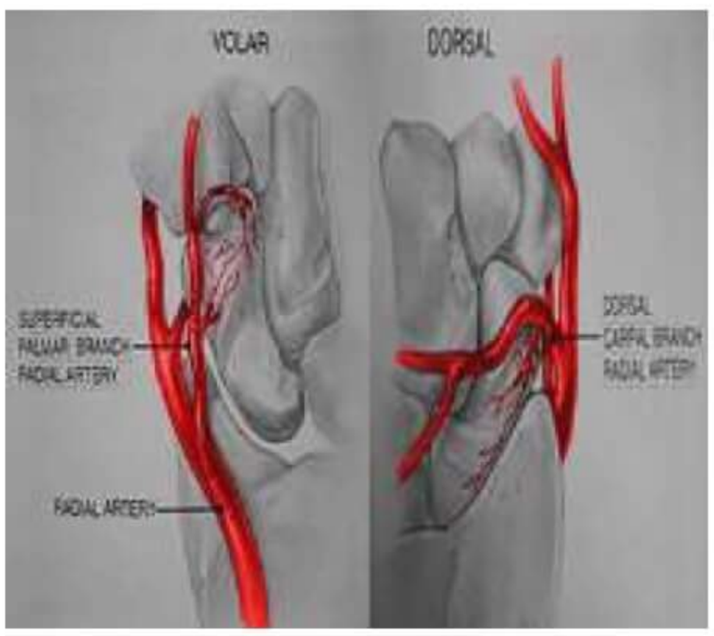
Avascular necrosis of proximal pole

→ In children, distal pole fracture is common

→ overall Most common site of #→ waist of the scaphoid

→ scaphoid # shows tenderness in anatomical snuff box.

Scaphoid fracture



Anatomical snuffbox

Management

Herbert screw(Headless screw)

Glass Holding cast(Thumb in line with radius)

AVN of scaphoid

→ **AVN of scaphoid**: AKA **Osteonecrosis**
occurs in **proximal pole**

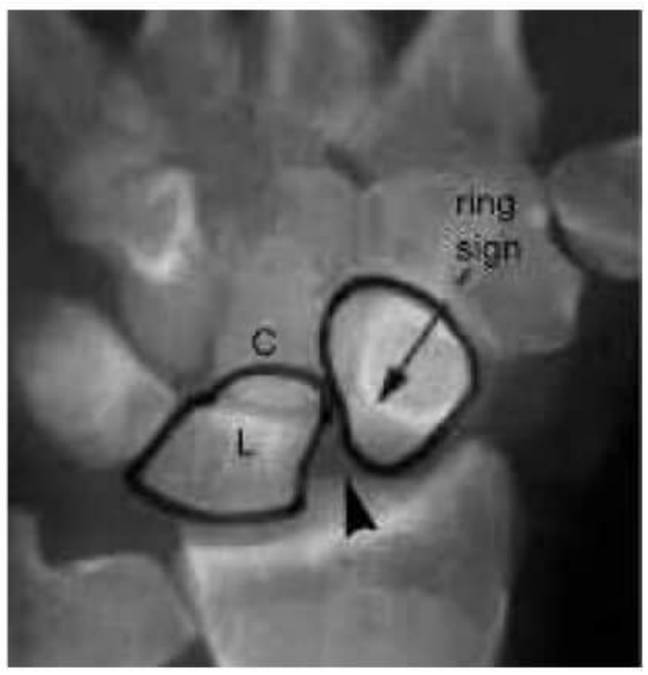
Scapho-Lunate dissociation

→ Gap between scaphoid & lunate

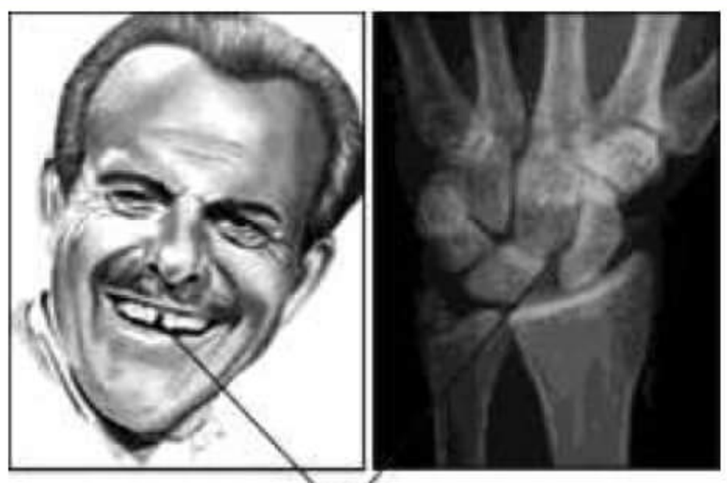
↓

Terry Thomas sign / David letterman sign

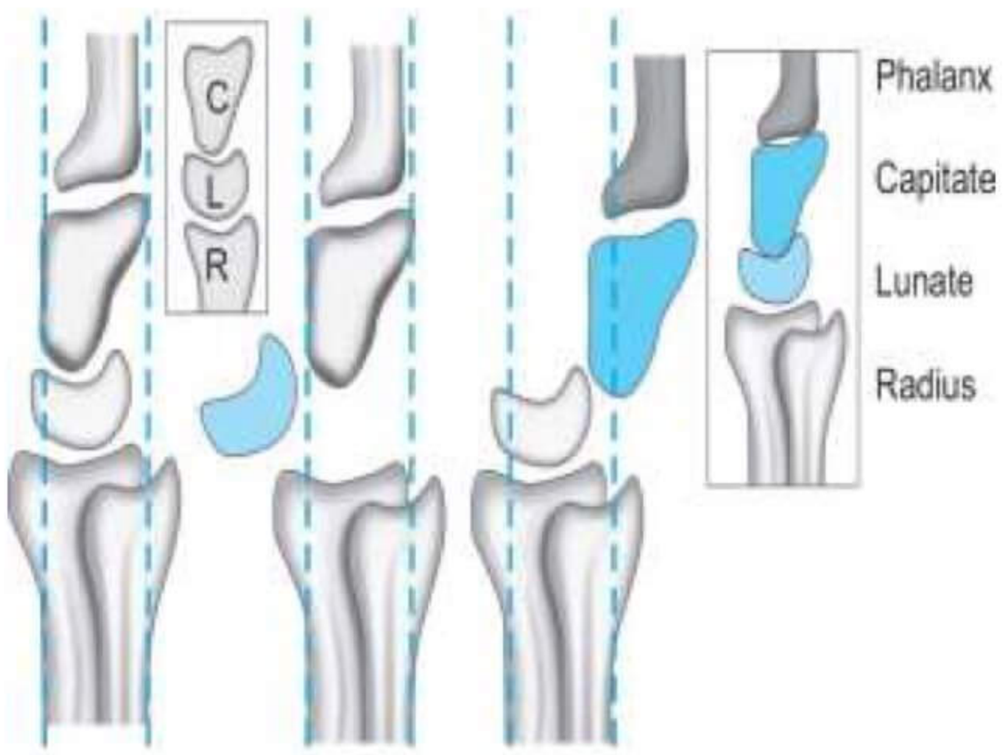
→ Ring sign→ scaphoid looks like a ring



Ring sign



Wrist dislocation



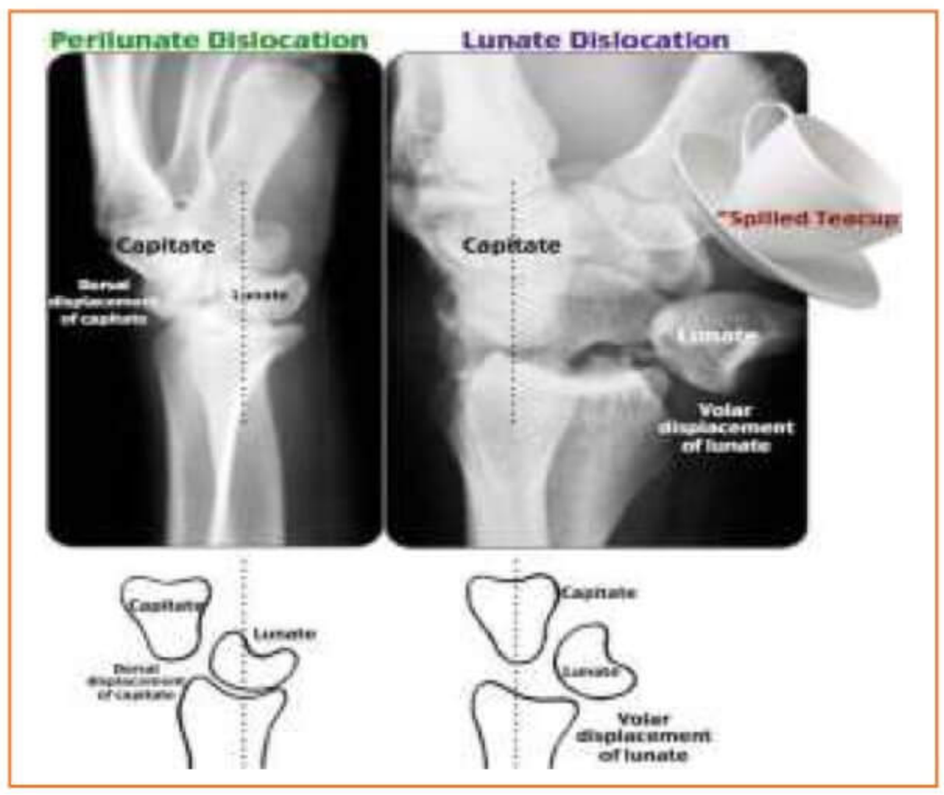
Normal | lunate dislocation | Perilunate dislocation

PrepLadder

Lunate dislocation

→ "Pie sign " in AP view

→ Spilled tea cup / Pot sign



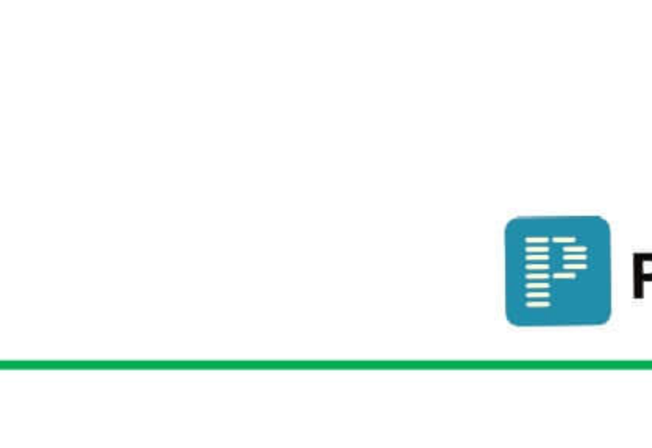
Pie sign

Fracture at base of 1st Metacarpal

Rolando fracture→ Only # at base of 1st MC, No dislocation

Bennett's Fracture dislocation (common in boxers) → # at base of 1st MC due to pull off a muscle

- "**Abductor pollicis longus tendon**" displaced

1. Bennett's Fracture	2. Rolando Fracture
→ Fracture dislocation → At base of 1st MC due to pull of a muscle causing dislocation → Intra – articular joint 	→ Intra – articular fracture (as it involves base of 1st Mc) → Fracture at base of 1st MC → No dislocation 

PrepLadder

Classification of joint / fracture

1. Allman's: Fracture clavicle	11. Judet &Lectournel: Acetabulum
2. Campbells/ Rockwood: AC Joint	12. Thompson & Epstein: Posterior dislocation
3. Neers: Proximal Humerus	13. Pipkins: Head of femur
4. Gartland: Supracondylar Humerus	14. Gardens/ Pauwels/ Anatomical: Neck Femur
5. Milch: Lateral Condyle Humerus	15. Boyd & Griffith/ Evans: Intertrochanteric Fracture
6. Masons: Head Radius	16. Winquist & Hansen's: Shaft femur
7. Bados: Monteggia	17. Schatzkers: Proximal tibia
8. Frykmanns/ Fernandez: Colles	18. Ruedi and Allgower: Distal tibia
9. Dennis: 3 Columns of spine	19. Hawkins: Neck talus
10. Young & Burges/ Tiles: Pelvis	20. Essex Lopresti (X-ray) / Sanders (CT Scan):

NEER Classification for Proximal Humerus:

Type
1. #shaft
2. #head
3. # G. tuberosity
4. # lesser tuberosity

NEER classification

Articular & Extra-articular injuries

	Articular	Extra-articular
Definition	# at articular surface	# at shaft, ligament / tendon / Muscle / Nerve
Restricted movements	Active & passive	Active

Eponymous fracture upper limb

Bankart's fracture

- → Tear in the anterior glenoid labrum of the shoulder due to anterior should dislocation;
- → If bony part is involved = Bankart's fracture

Hill Sach's fracture (Harold Arthur hill & Maurice David Sach)

- → AKA **impression fracture**
- → Cortical depression in the postero-lateral head of the Humerus
- → Head against anteroinferior glenoid rim
- → In anterior shoulder dislocation

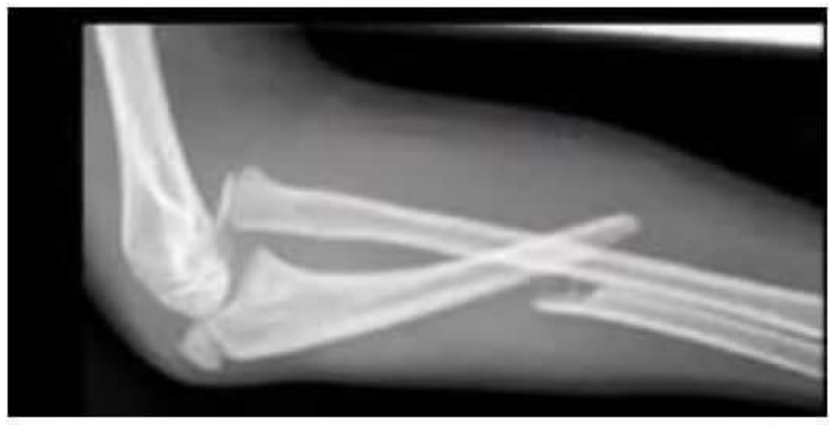
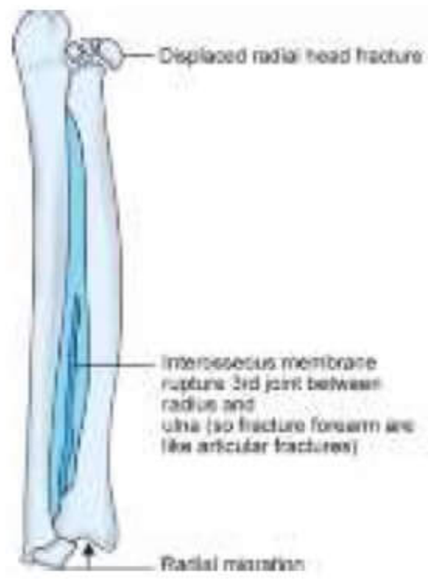
Holstein- Lewis fracture (Arthur Holstein & Gwylim Lewis)

- → Fracture of distal third of Humerus resulting in entrapment of redial nerve.

Galeazzi fracture

- → Fracture of distal radius
- → dislocation of radio-ulnar joint
- → Triangulo-fibro cartilage damage
- → damage to interosseous membrane
- → Mech of injury → blow to forearm

PrepLadder

Monteggia Fracture → Fracture of proximal of Ulnar with dislocation of radial head → **Most common** = Type 1 (anterior displacement of proximal Ulnar) → Mech of injury = blow of forearm	
Hume fracture → Injury involving olecranon fracture with dislocation of radial head → Variant of Monteggia fracture → Occurs in children	 
Essex – Lopresti fracture → Fracture of radial head with dislocation of the interosseous membrane (entire interosseous) → Mech of injury - fall from height	
Moore's fracture → Distal radius # with Ulnar dislocation → Entrapment of styloid process under annular ligament	
Night-stick Fracture → Minimally displaced oblique fracture of Ulnar Without associated fracture of radius → Mech of injury: Direct trauma to forearm while in defensive stance	

PrepLadder

Green stick fracture

→ A fracture of bone, occurring typically in children, in which inside of the bone is broken and the other only bent

→ Mech of injury → Bending forces after fall

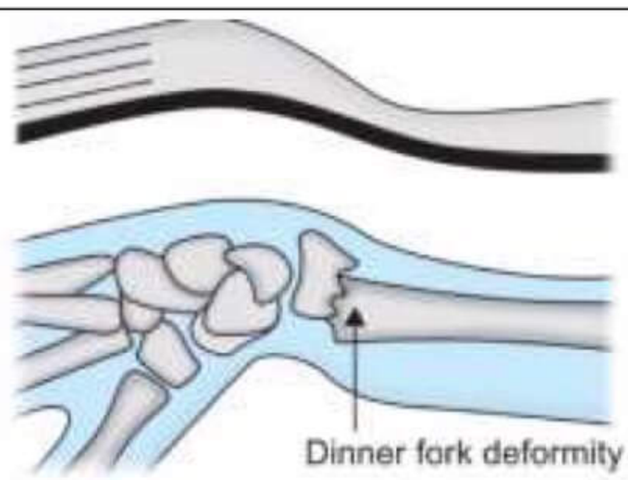
Colle's fracture (Poteau fracture)

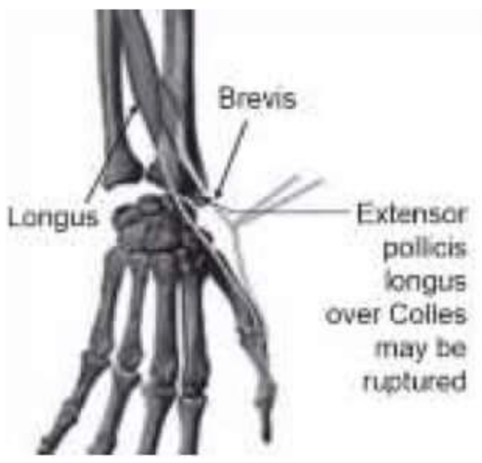
→ Fracture of elderly females

→ Fracture of distal radius in the forearm C dorsal (posterior) and radial displacements of the wrist & hand

→ "Dinner fork" / "Bayonet deformity"

→ Mech of injury = fall on outstretched hand

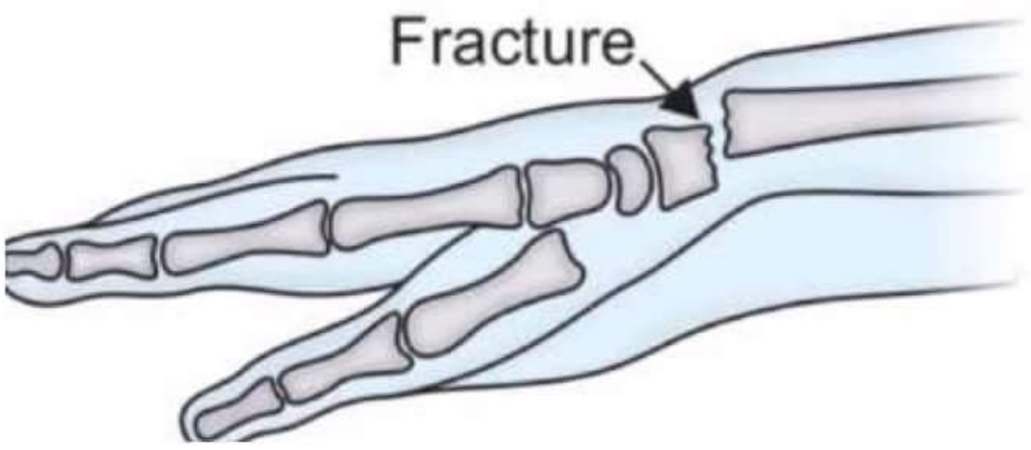




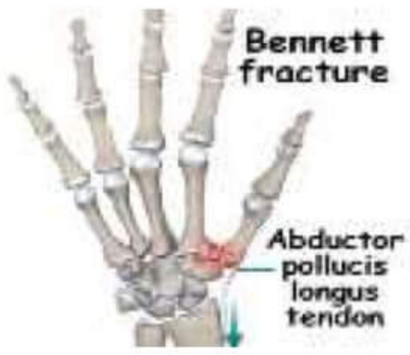
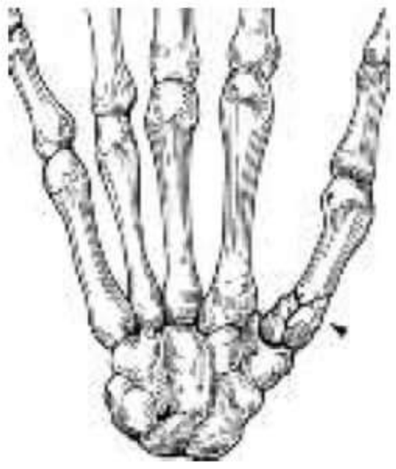
Smith's fracture

→ Fracture of distal radius in which the distal fracture fragment is displaced volarly (ventrally)

→ Mech of injury → fall on outstretched hand



PrepLadder

Chauffeur's fracture (Backfire fracture / Hutchinson fracture) → Fracture of forearm, specifically the **radial styloid process** → injury is caused by compression of the scaphoid bone of the hand against the styloid process of distal radius → Mech: forced Ulnar deviation of wrist causing of the radial styloid	
Bennett's fracture → Fracture of base of 1st metacarpal bone which extends into carpometacarpal joint → due to pull of the muscle "**Abductor Policies longus** "	
Rolando fracture → Comminuted intra-articular fracture through the base of 1st metacarpal bone → No dislocation	 

SPINE, PELVIS & LOWER LIMB

Lower limb

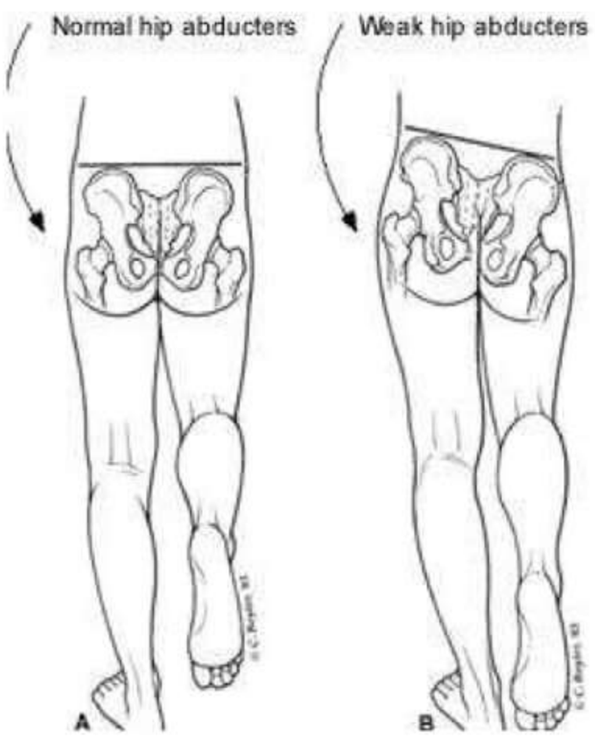
Trendelenburg test

→ To check stability of the hip

→ Stability of hip depends upon

Normal hip

- Proper femur head and Acetabulum
- Hip Abductors-Normal G. Medius and minimus
- Superior Gluteal Nerve



→ Trendelenburg test is **normally negative**- muscles and nerve of hip are **normal.**

→ When stood on one leg, Despite the gravitational pull the pelvis doesn't drop drown due to the pull of the muscles, the hip is kept straight.

→ This is called as "**normally negative**".

→ In the same scenario, If the side of the hip is not normal or there is a damage in hip muscles and nerves the pelvis will drop and cannot be elevated on the opposite side known as **POSITIVE TRENDELENBURG SIGN**

→ The **DROP** is on opposite side to the damage.

→ **Bilateral Positive- Waddling Gait**

Mnemonic-

DROP

DR-DROP

O- Opposite side pelvis

P- POSITIVE

PrepLadder

Thomas test

→ Done for hip flexion deformities

→ When the hip of the opposite side is flexed **lumbar lordosis** is obliterated

→ Lumbar lordosis is compensated up to a 30° Hip flexion.

→ If flexed >30°, the flexion deformity of the abnormal side of the hip will be prominent which was hidden by Lumbar lordosis

NOTE:

THOMAS TEST: Hip

THOMPSON TEST: Tendoachillies tear

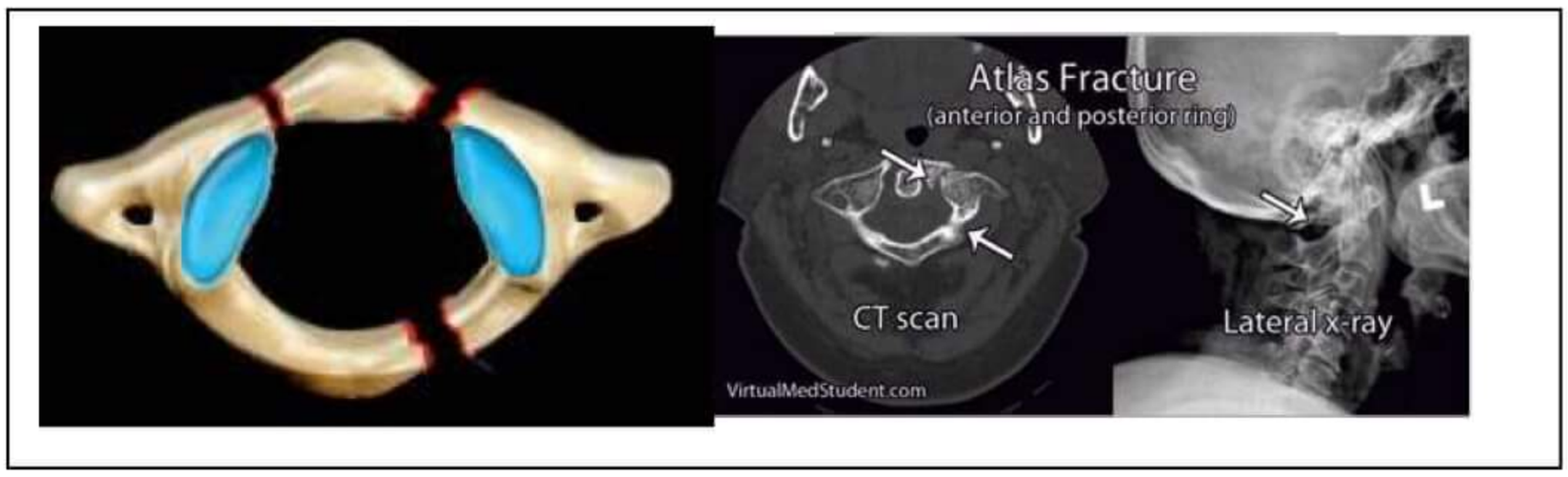
*Mn: Note the length of the word

Fractures of Spine

Jefferson's Fracture

→ Fracture of **Atlas** (C_1) *Mn: - JAT

→ Occurs due to **vertical force**, causing the disruption of the ring of C_1 known as the BURST FRACTURE

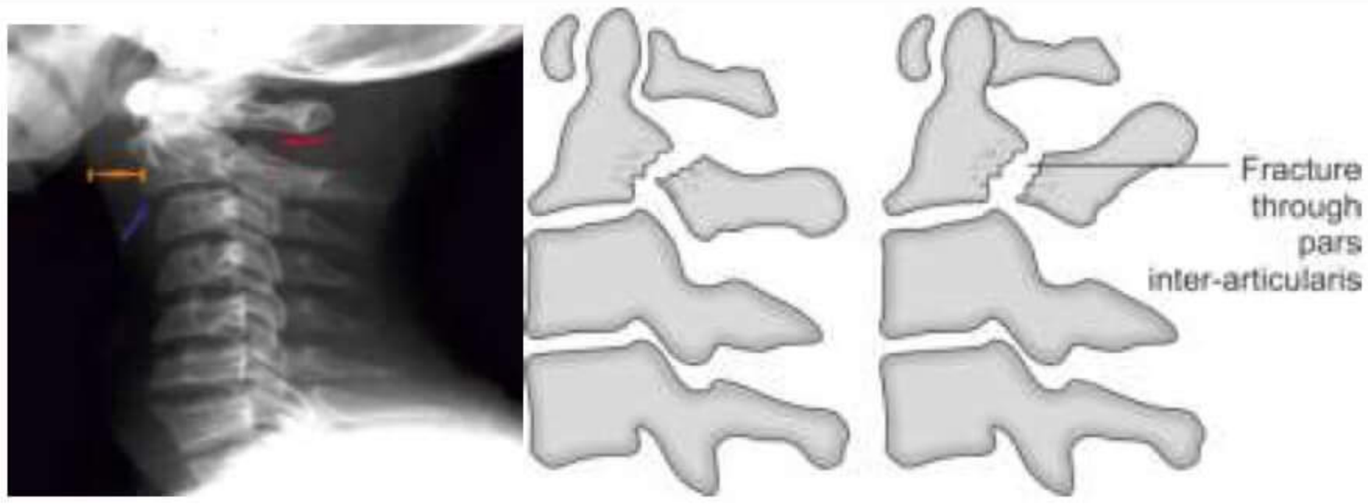


Hangman fracture

→ Traumatic spondylolisthesis of C_2 (axis) over C_3 with fracture through pars-interarticularis

→ C_2 over C_3 slip of vertebra called as "**spondylolisthesis**"

PrepLadder



Clay-shoveller's fracture

→ Avulsion fractures of spinous process of C7 > T1

SCIWORA (Spinal Cord Injury Without Radiographic Abnormality)

→ In pediatric age group < 8 years

→ X-rays is normal but there is neural deficit due to lax ligaments permitting traction injury to cord.

→ MC affected-**Cervical Spine**

Burst Fracture

→ Vertical compression injury (Total disruption of ring)

Whiplash Injury / Railroad spine / Erichsen's disease

→ Sprained neck due to hyperextension followed by flexion

→ Eg- Happens when sudden breaks were applied in a fastmoving vehicle

Motor cyclists Fracture / Hinge Fracture

→ Transverse fracture across base of skull leading to separation into anterior and posterior half

PrepLadder

Undertakers fracture

→ Tearing of C_6-C_7 disc space causing subluxation

→ Caused during handling the dead body

Flexion Compression Fracture

→ Wedge compression

→ Tear drop i.e. bone fragment hanging from antero-inferior part of vertebra

Flexion-Distraction injury- Facet dislocation

CRUTCHFIELD TONGS

→ Applied on the parietal bone of the skull

→ Used for **Cervical spine traction**

CRUTCHFIELD TONGS

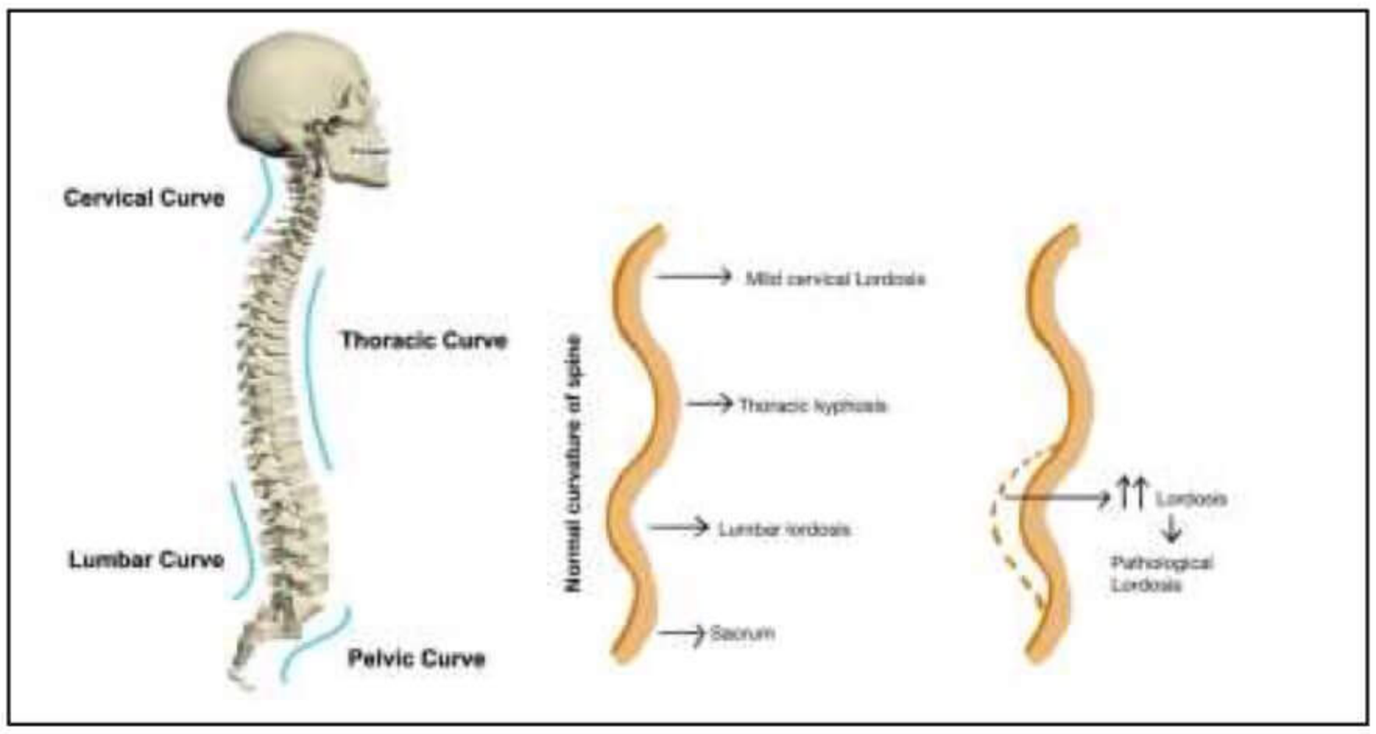
Lordosis

→ Excessive inward curvature of spine

→ Causes of Lordosis- SOAP

- S- Spondylolisthesis
- O- Obesity, Osteoporosis
- A- Achondroplasia
- P- Postural lordosis

→ Treatment- Cover the pose/postures and treat underlying cause



PrepLadder

SPL-2

Lower limb

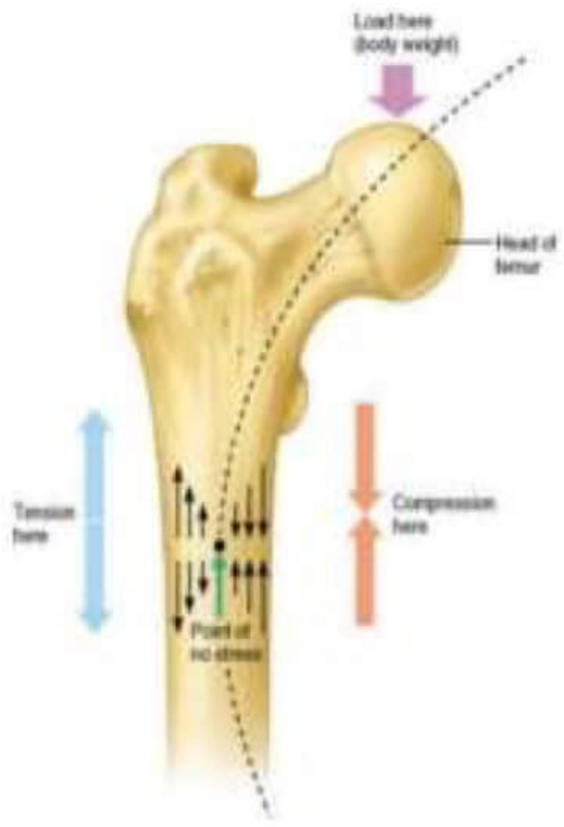
Upper end of femur

→ Mainly weight bearing
→ Body weight of spine, head and upper limb is transmitted to the ground through the proximal femur
→ The trabeculae of acetabulum→ weight bearing trabeculae

- Acetabulum
- Head of Femur
- Neck of Femur

} are in the same line

→ Continues at the Posteromedial aspect of upper end of femur known as **Calcar Femorale (Femoral weight bearing axis)**
→ Wolfe's Law(a)- It says that bone models along the lines of stress (or) the weight



Neck Of Femur

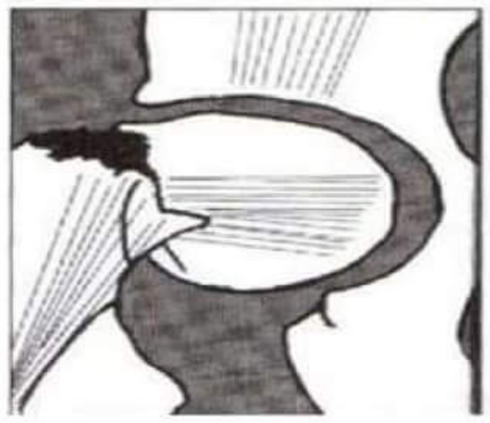
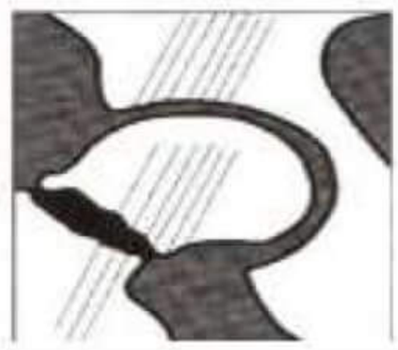
Types of classification of Fractures of Nek of femur

Garden's classification

→ Fractures of Neck of femur are classified along the relationship of trabeculae.

STAGE I	STAGE II	STAGE III	STAGE IV
Incomplete Fracture but trabeculae of Neck are lateralized	Complete fracture but undisplaced	Partially displaced	Fracture is completely displaced

PrepLadder

	No valgus / Varus is observed All trabeculae are aligned 	All trabeculae mal aligned 	Head aligns with the acetabulum but neck is not aligned 

Pauwels classification

→ **Fractures are classified along the Horizontal**

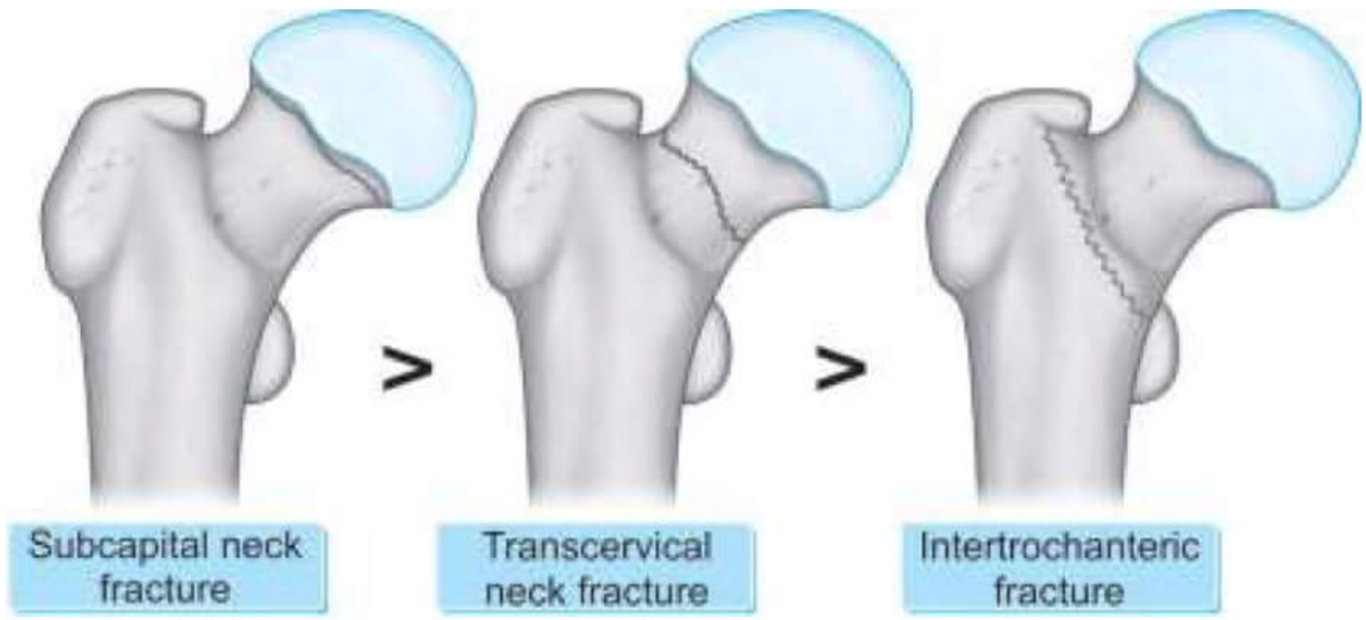
PAUWELS-I		PAUWELS-II	PAUWELS-III
Angle	< 30 °	30° -50°	>50%
Favorable			Unfavorable
Horizontal			Vertical
The more the fracture is horizontal the better it is for repair			
Better prognosis			Poor prognosis
More chances of compression			More chances of displacement

→ **Horizontal Fracture- Good Prognosis**

→ **Vertical Fracture- Poor Prognosis**

PrepLadder

Anatomical classification of fracture Neck of Femur

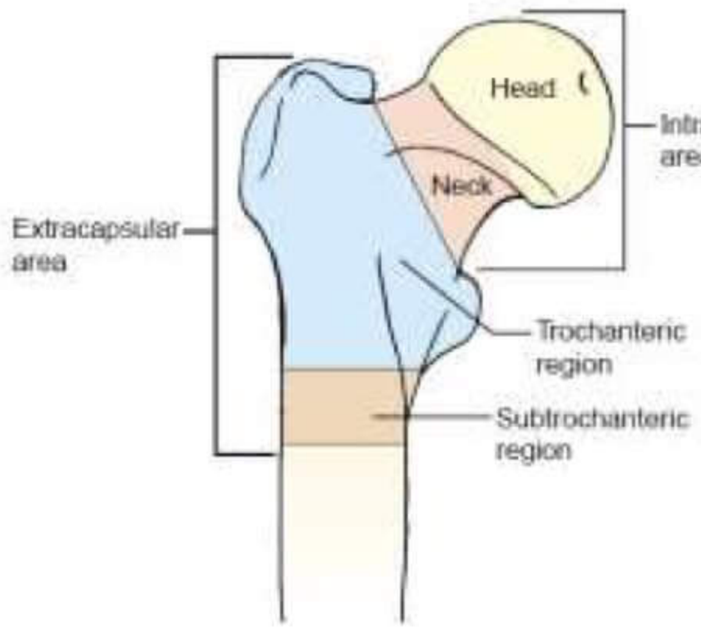


→ The more proximal the fracture is the poor the prognosis

Proximal – Poor

→ Sub capital fractures - Maximum risk of Avascular Necrosis (Death of a bone due to poor blood supply)

Intracapsular fracture of Neck of Femur vs Extracapsular Inter Trochanteric fracture



→ Capsule- Inserts along the Intertrochanteric line

→ Head & Neck of Femur – Intracapsular

→ Intertrochanteric area – Extra capsular

Fracture of Neck of Femur	Inter trochanteric fracture
Intracapsular	Extracapsular
Less common	More common
60 years	80 years
Ext. rotation < 45 °	↑Pain
	↑ swelling
	↑ Shortening
	↑ Ext. Rotation >45 °

PrepLadder

	Lateral border of foot touches bed

Treatment of Inter trochanteric Fracture

1. Proximal femoral nail
2. Dynamic Hip Screw

Mnemonic- Extra has everything Extra

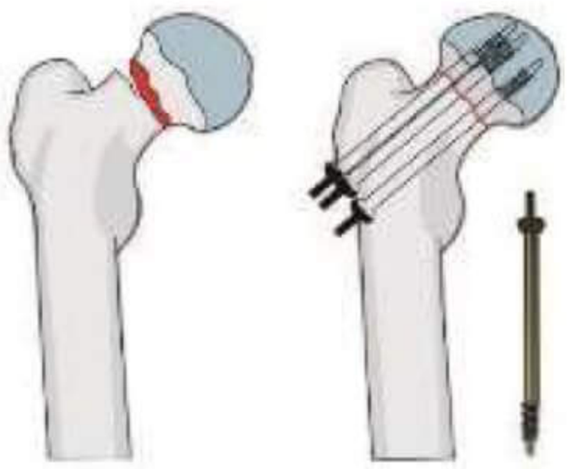
Proximal femoral nail

Dynamic Hip Screw

Fracture of Neck of Femur treatment

Case I Patient < 65 years old, ≤ 3 wk. fracture

→ TOC: **CRIF** (Closed reduction with Internal Fixation) along with multiple screw fixation(A)
→ Dynamic hip screw for basicervical fracture (or) cervicotrochantereic fracture
→ If CR is not possible **ORIF** with multiple screw fixation is preferred



Case II- Patient < 65 years, > 3wk. (22nd) fracture

PrepLadder

→ Osteotomy / bone grafting + fixation
→ To ↓ Pauwels angle
→ Bone grafting → In absence of cambium layer

Case III- Patient ≥ 65 years, No pre-existing arthritis

→ Hemiarthroplasty

Case IV- Pre-existing arthritis at any age

→ Total hip replacement

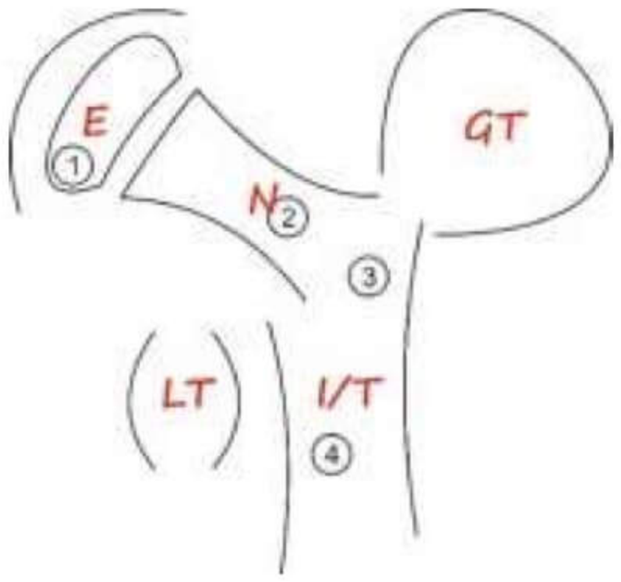
Complications- Osteonecrosis > Non-Union > Arthritis (AVN)

Delbert classification for Pediatric fracture of Neck of Femur

→ Done by anatomical levels

Types:

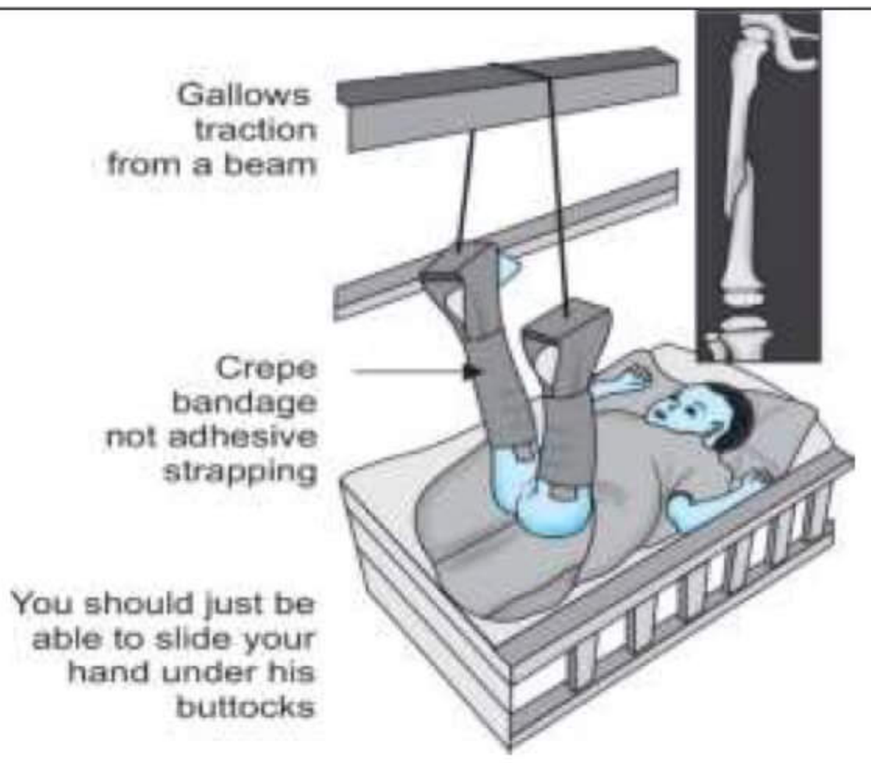
→ Trans epiphyseal
→ Transcervical (MC)
→ Cervicotrochanteric
→ Intertrochanteric



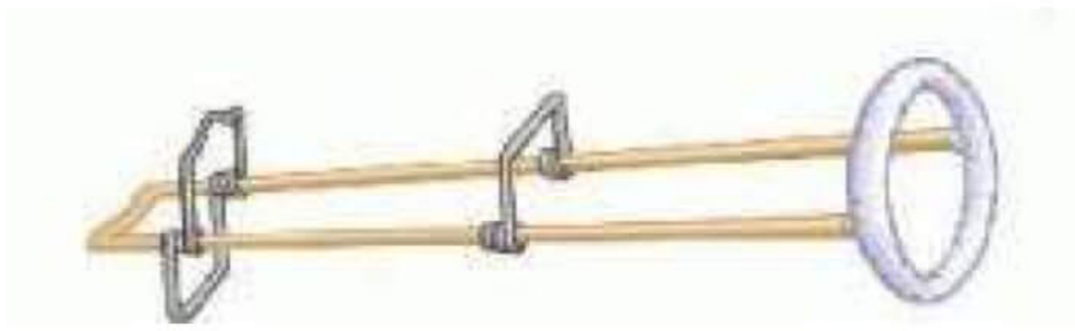
Incidence- **Transcervical > Cervicotrochanteric > Intertrochanteric > Transepiphyseal**

Gallows traction

→ Fracture of shaft of femur < 2 years age
SPICA > Gallow's
→ Hanged from the roof
→ Buttocks raised above the bed
→ Position maintained for 6W



PrepLadder

Thomas splint → Around thigh → Initially used for T.B knee → Now a days used for fracture of lower limb → Cons: Ring constricts the thigh	
Spica → Cast going around spine	 Unilateral Hip Spica Cast

Age wise treatment of Fracture of Shaft of Femur		
SPICA → < 5 year →Fracture S.O.F <2 yr. SPICA > Gallow's traction	**TENS**-Titanium Elastic Nail System →5-10 yrs.	**Interlocking Nail** → ≥ 10 years

K (küntschesr)-Nail

→ Fixes by 3 points principle
- Proximal
- Distal
- Isthmus (Narrowest point of femur)

→ Nail is placed in the femur and screws were implanted to lock the cortex with the nail known as interlock screws.

FAT EMBOLISM after fracture of shaft of Femur

→ **Mn- Fracture femur shaft + forty-eight hours = Fat embolism**

F + F→ F.E

→ Diagnostic criteria for fat embolism- **Gurd's Criteria**

Gurd's major criteria	Gurd's minor criteria
Axillary (or) Sub-conjunctival petechiae	Tachycardia
PaO_2 < 60 mmHg	Pyrexia
CNS depression	Anemia
Pulmonary Edema	Thrombocytopenia
	Fat globules in sputum
	Fat globules in urine (Gurd test)
	Emboli present in retina
	↑ ESR.
(1Major + 4 minor = Fat embolism)	

DOC- O_2 /ventilation - IPPV (Intermittent positive pressure ventilation)

Common Complications

→ **C-C** Cast-Compartment syndrome
→ **M-M** Myositis Massage
→ **S-S** Sympathetic overactivity-Suddeck's
} poor prognosis
→ **F-F** Fracture Femur -Fat embolism → worst prognosis

Case: Babu ram ,45 years male has a RTA is stabilized according to ATLS protocols taken to an emergency ward stabilized by an intern and gets the X-ray done which reveals fracture of shaft of femur. Patient is stabilized and supplied with O_2 & shifted to ward. After **4 hours** of injury patient suffers from breathlessness & PaO_2 < 60 mmHg & Then patient is shifted to ICU; ABG done and supplemented with O_2. What do you expect?

Ans: **ARDS**

→ It takes at least 48 hours for thromboembolic phenomena to occur
→ Hence, it is not a Fatty embolism

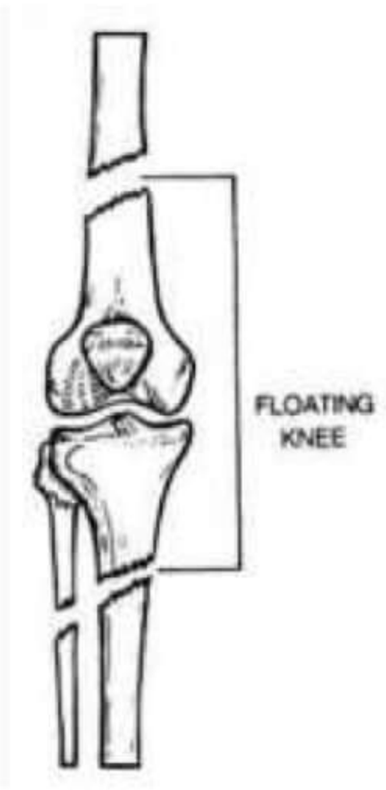
But Recently question came where we had to choose fat embolism in <48 hours as other options were quiet distant in the question and were not at all possible.

PrepLadder

Floating knee

→ Fracture of a bone above (Femur), bone below (Tibia/Fibula) near the joint making the joint unstable

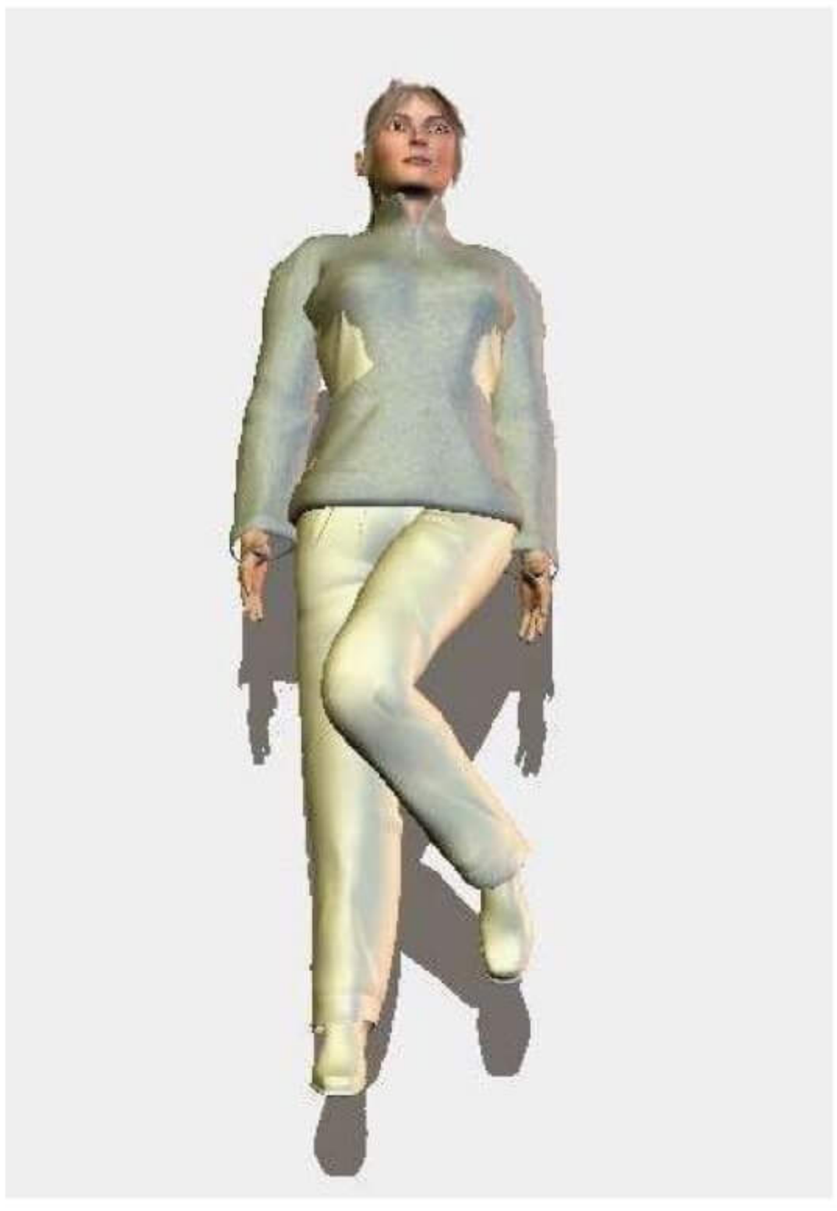
→ Management- Surgery

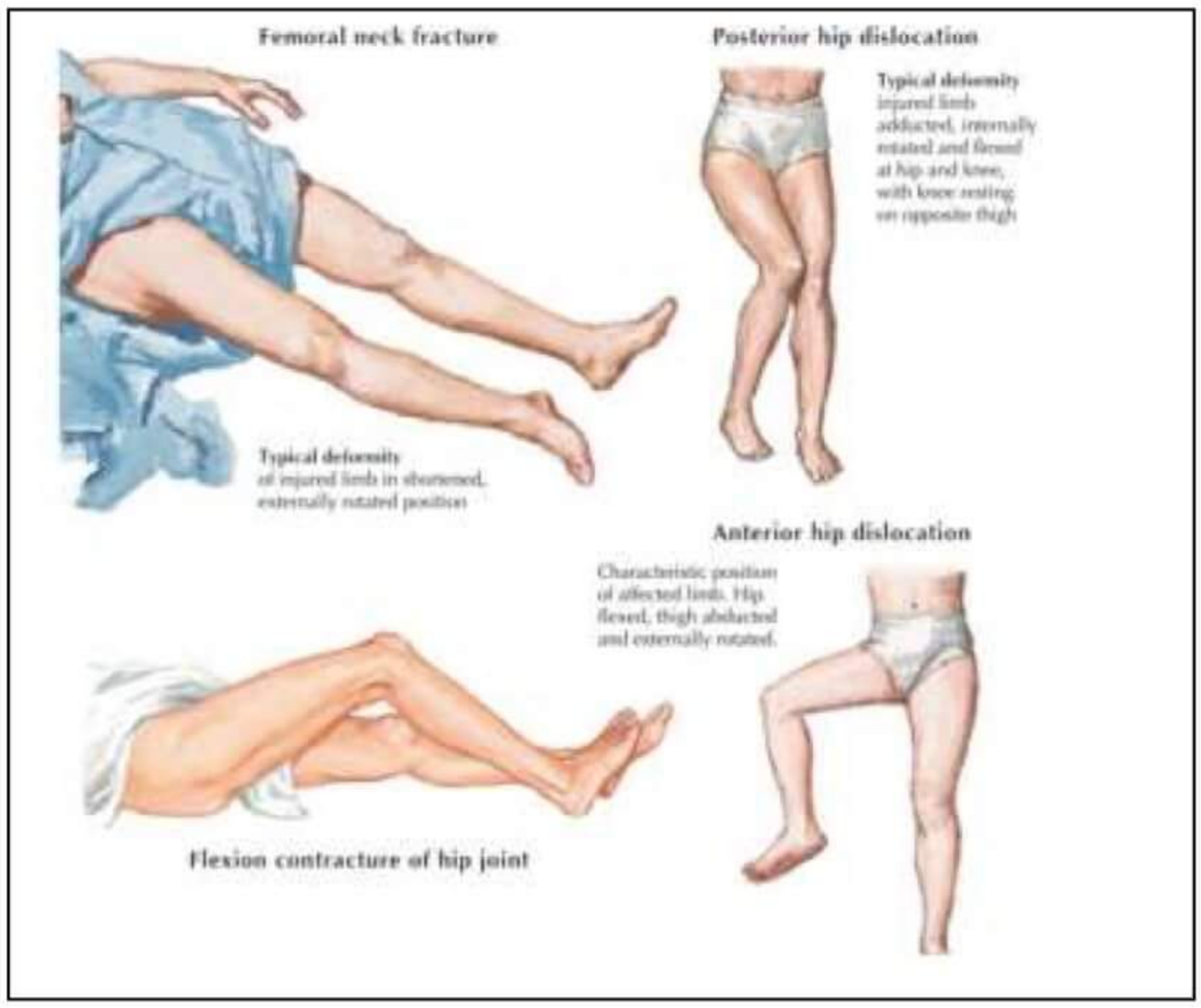


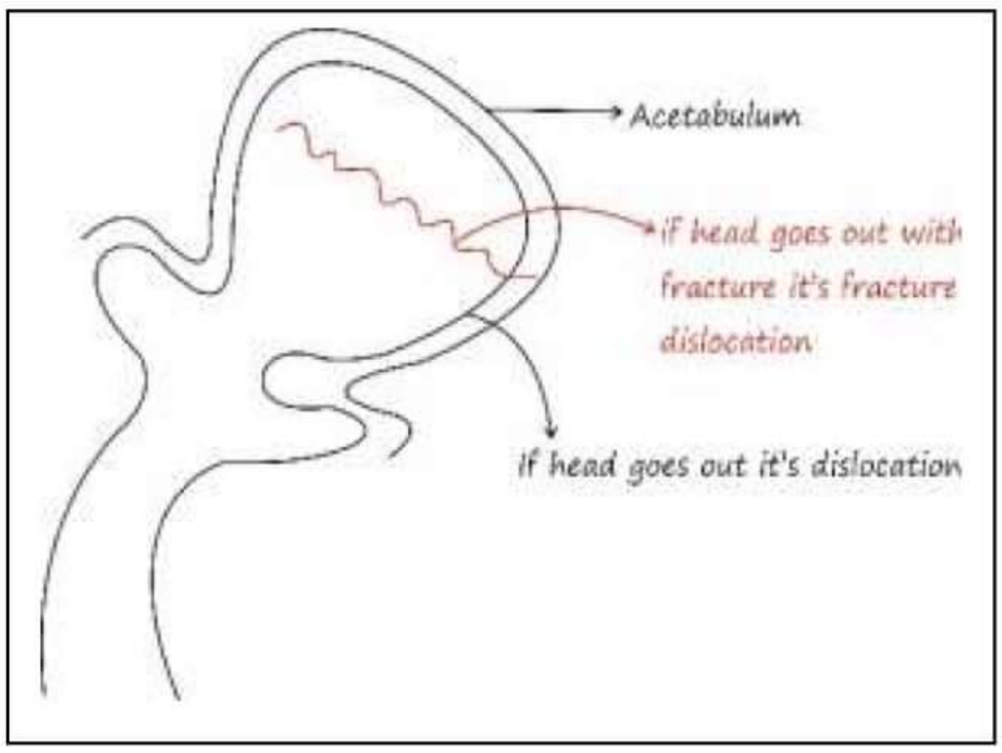
Hip dislocation

→ Dislocations of hip have typical presentations- either FABER or FADIR

→ Fracture dislocations have Atypical presentations

Anterior dislocation of hip	Posterior dislocation of hip
→ FABER	→ FADIR
→ Hip (femoral head) is lower than the joint in femoral area	→ Hip (Femoral head) is at the level of the joint
→ Limb-Lengthening	→ Shortening
 	





→ Dislocation → THIGH/ARM
- Anterior → Abducted
- Posterior → Adducted

→ Hip fracture → Foot

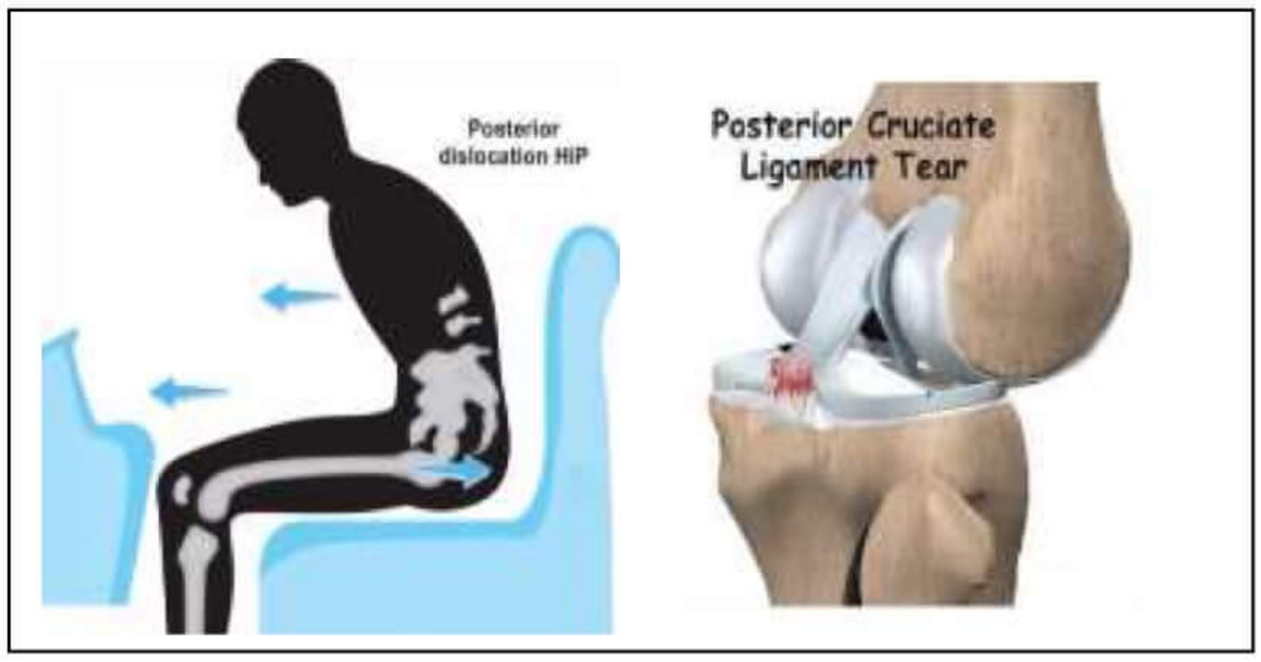
→ Fracture of Neck of Femur → Shortening + External Rotation

Dash board injury

→ MC - Posterior dislocation of hip with fracture of posterior lip of acetabulum.

→ 2nd MC - PCL (Posterior cruciate ligament) injury.

PrepLadder



Posterior dislocation of hip

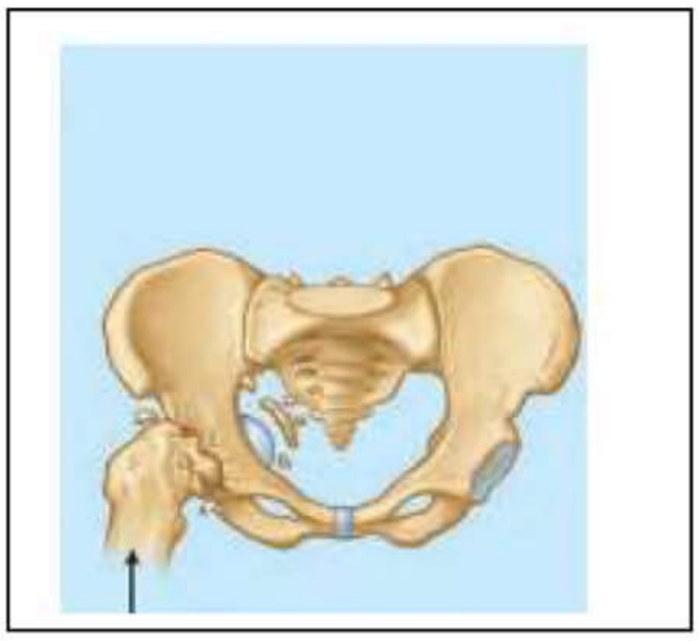
→ FADIR-Flexion, Adduction and Internal Rotation
→ Shortening
→ Thigh-Adducted
→ Head at/above the level of acetabulum (or) Gluteal area
→ Femoral artery pulsations are not felt → Positive vascular sign of Narath (NOT FELT)
→ If femoral pulsations are felt- Negative (Normal)

→ **Artery NOT Palpable**	→ Post dislocation of hip → Femoral Head not in acetabulum.
→ Artery pulsations Absent	→ Superior gluteal artery- MC artery to damage in hip dislocation → Artery is damaged.

PrepLadder

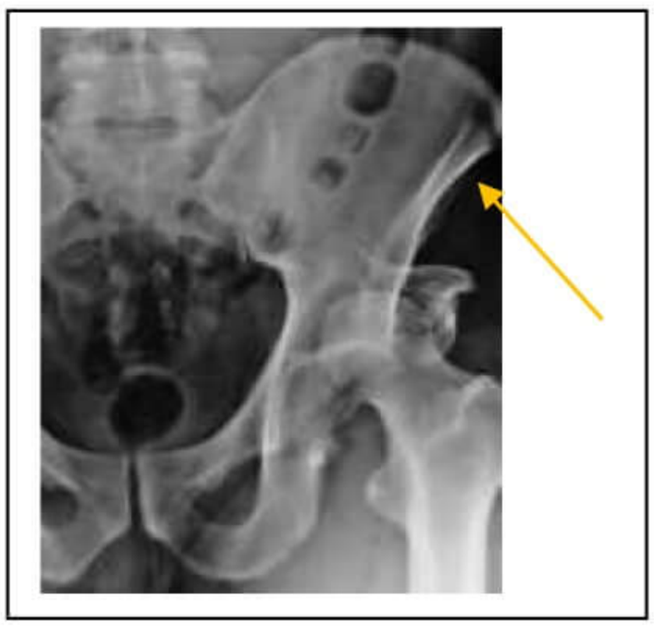
Central dislocation of hip

- → Head palpable in **Per rectal exam**
- → Shortening
- → Head breaks acetabulum & goes in
- → Fracture dislocation
- → Misnomer – No FABER/FADIR
- → Fracture dislocation – Always atypical

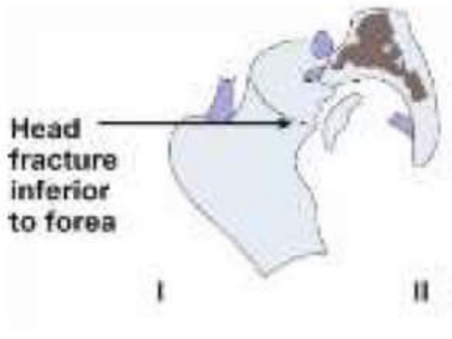
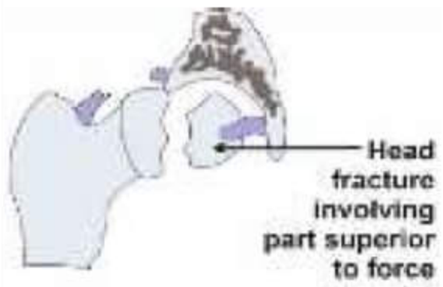
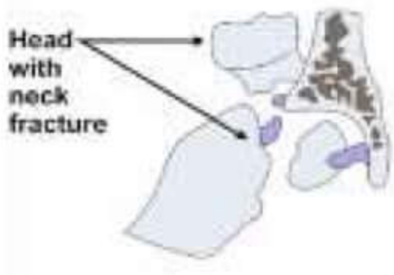
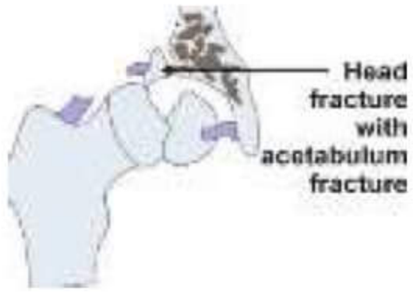


Head with acetabular fracture

- → Shortening
- → Classical deformities of posterior dislocation not present
- → Head posterior (gluteal area)
- → Pipkins Type IV (a)-Shortening and Gluteal mass with atypical features



Pipkin's classification

Type I	Type II	Type III	Type IV
Fracture of head below the joint 	Fracture above forea 	Fracture head with the neck 	Head Fracture dislocation with acetabulum fracture 

Note-Forea: Area where ligamentum teres attaches

PrepLadder

SUMMARY

Hip

Fracture dislocation

Usually posterior

-Head gluteal (Posterior)

-Clinical presentation of FADIR or FABER Lost in fracture dislocation

Dislocation

Position of headHead

Central

Head (Per-rectal) + shortening

Posterior 90 %

FADIR + Shortening

Anterior

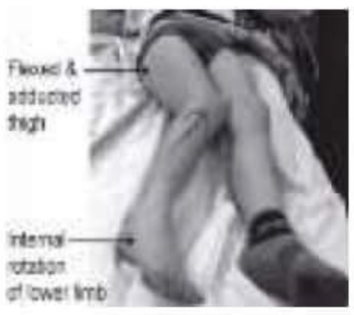
FABER + lengthening

Pipkins classifications for fracture head of femur

Flexion, abduction and external rotation (FABER)

Anterior dislocation

NOTE: Any mass that moves with rotation of thigh is femoral head



Flexion, adduction and internal rotation (FADIR)Q

Posterior dislocation of hip

Vascular sign positive

Closed reduction of dislocation

PrepLadder

OTTAWA Ankle Rules

→ Helps to decide when X-ray is needed- for ankle injuries

→ X-ray can be ordered if

- Pain around malleolus (Ankle)
- Inability to take weight immediately after injury
- Inability to take four steps in Emergency Dept.
- Bone tenderness

→ If x-ray is considered necessary can be done in the following views:

- Antero-posterior view
- Lateral view
- Mortise (30 ° oblique) view

Types of Fractures

1. **Night stick fracture**

→ Isolated fracture of ulna

→ No dislocation of proximal (or) distal joint

→ Eg: A thief defending the stick of the guard with the Forearm in front

2. **Chauffer's fracture**

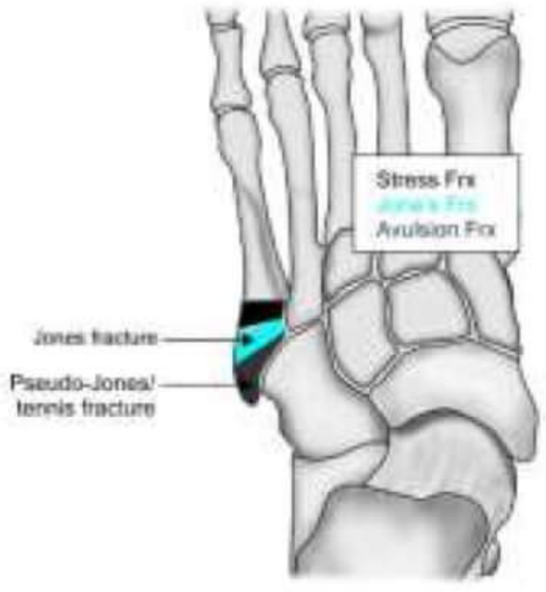
→ Intraarticular fracture Involving radial styloid

3. **Jones fracture**

→ Fracture of **base** of 5th metatarsal

4. **Pseudo Jones fracture**

→ Fracture of **Tip** of **base** of 5th metatarsal

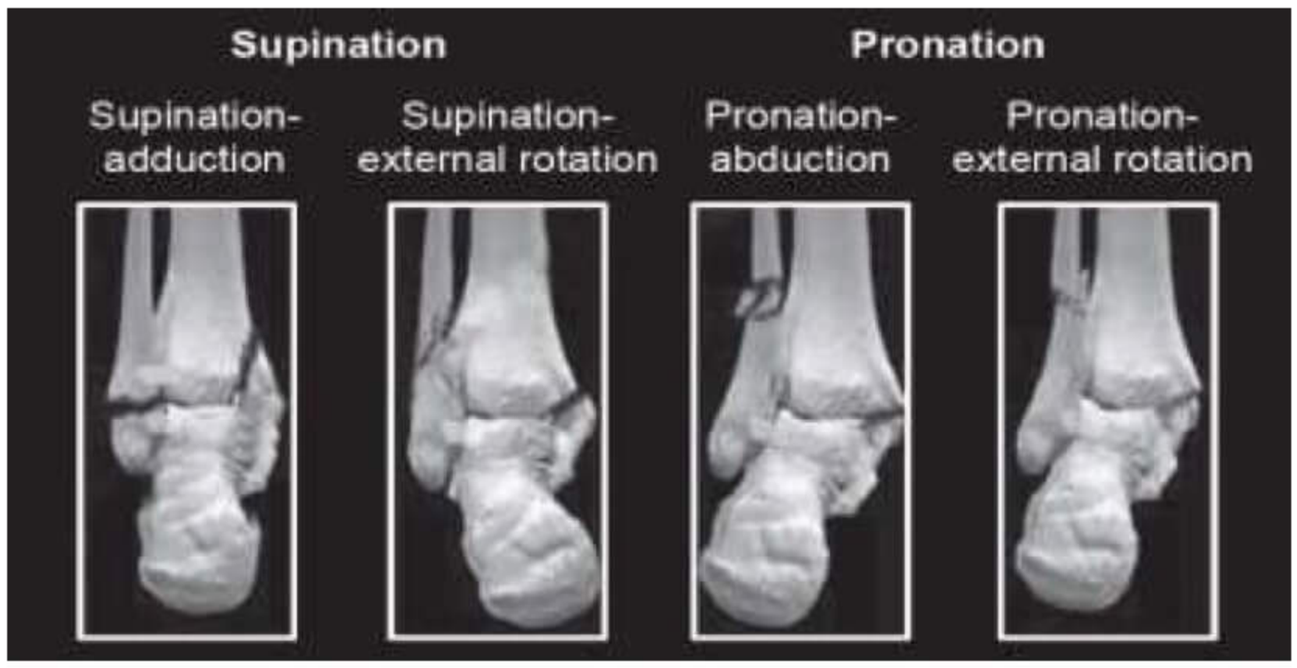


PrepLadder

5. Boxer's Fracture Q → AKA street fighters' fracture → Fracture neck of 5th metacarpal	
6. Bumper Fracture → Fracture involving the upper end of lateral tibial plateau	
7. Pott's Fracture → Bimalleolar fracture → Medial and lateral malleoli are fractured	
8. Cotton fracture → A.K.A Tri-malleolar fracture → Fracture involves 3 malleoli • Lateral Malleolus involving fibula • Medial Malleolus involving tibia • Posterior Malleolus involving tibia	

ANKLE INJURIES

Lauge- hansen classification of Ankle fractures



1. Foot	Supination	Pronation
2. Force	Adduction+Inversion	Abduction+Ext.Rotation
→ Supination – Adduction	Vertical fracture	Medial Malleolus
→ Supination – External Rotation → Pronation - Abduction → Pronation – External Rotation	Horizontal fracture	Medial Malleolus
→ Supination - External Rotation → Pronation - External Rotation	Oblique fracture	Fibula
→ Supination - Adduction → Pronation – Abduction	Horizontal fracture	Lateral Malleolus
→ External Rotation	Oblique fracture	Lateral Malleolus

Summary

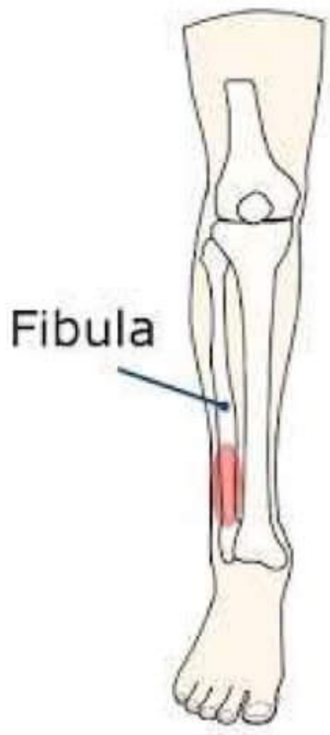
Foot	Force	M.Malleolus	L.Malleolus
Supination	Adduction	Vertical	Horizontal
	External Rotation*(MC)	Horizontal	Oblique
	Ext. Rotation	Horizontal	Oblique

PrepLadder

Pronation	Abduction	Horizontal	Horizontal (comminuted)

Runner fracture

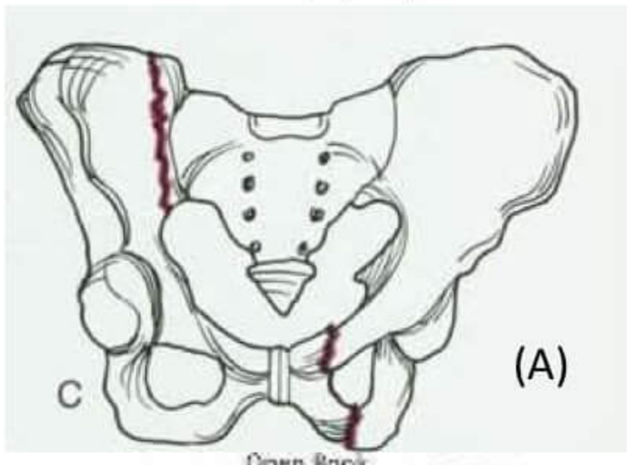
→ Fracture of lower end of fibula



PELVIS

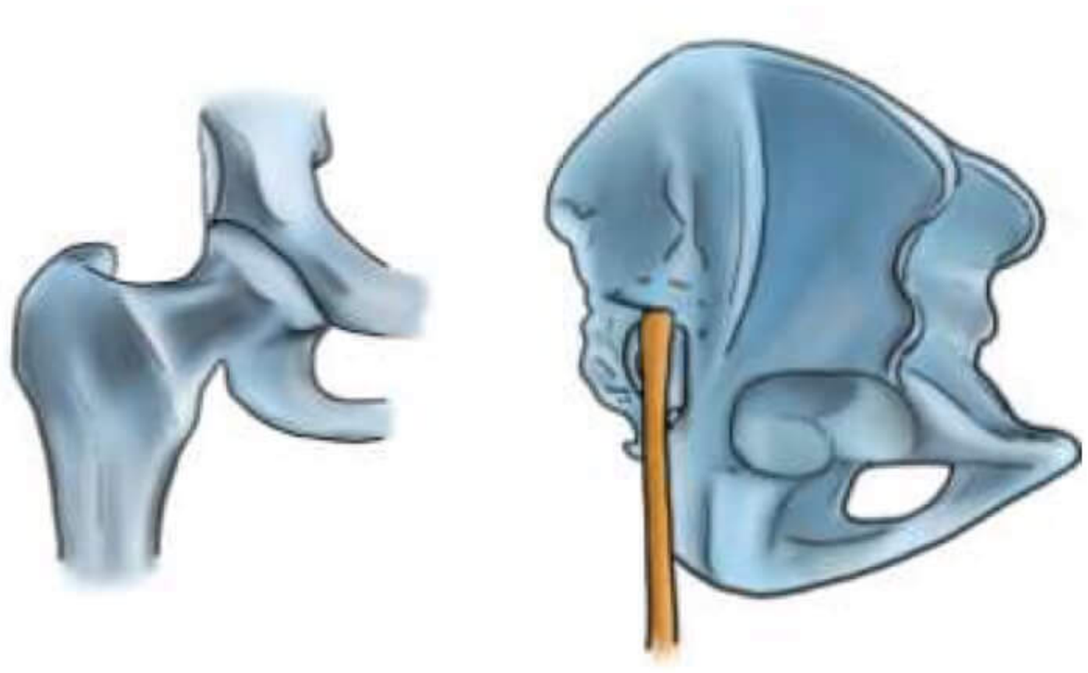
Pelvic Fractures

→ **Tiles** classified pelvic injuries into 3 types

TILES A	TILES B	TILES C
→ Stable injury both vertically & Rotationally	→ Rotationally unstable	→ Rotationally and vertically unstable
	→ **Known as Bucket Handle(A)/Open book** 	→ Always managed operatively

Acetabular fractures

→ Classification and Criteria for Fracture Acetabulum: **Judet**

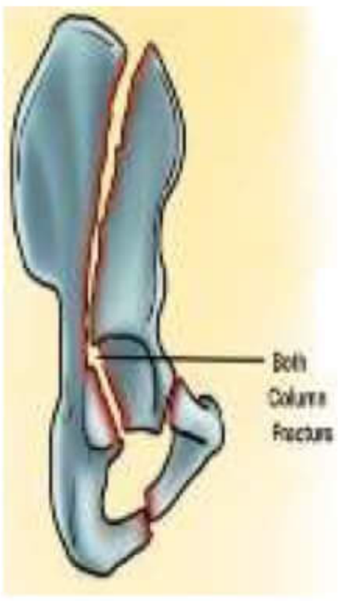


SCIATIC NERVE

PrepLadder

→ Hip joint is a ball & Socket joint where the femoral head is contained within the acetabulum
→ Acetabulum is round in shape and covered with cartilage which forms the articular surface of the hip joint
→ **Labrum**-ring of shock absorbing cartilage surrounding the acetabulum
→ **The sciatic nerve** is very close to the posterior margin of acetabulum and it can be injured
→ Acetabular fracture usually occurs due to high velocity trauma

Types of Acetabular Fractures

Anterior wall fracture	Posterior wall fracture	Transverse fracture	T-shape fracture
→ Anterior wall is fractured → If entire pelvis is disrupted anteriorly- Anterior column fracture 	→ Posterior well is fractured → If entire pelvis is disrupted posteriorly- Posterior column fracture → MC type → Best depicted on Judet view and obturator view 	→ When both the columns are involved 	→ Fracture goes down & disrupts both the columns called as Bi-columnar fracture → Spur sign is seen 

IOC- CT scan

Posterior wall fracture

→ Can be simple fracture-only the wall goes out
(OR)

→ Associated with dislocation of femoral head which is an emergency and need to be fixed immediately and the congruency of the articular surface has to be maintained.

Spur Sign - Seen in Bi-Columnar fracture of acetabulum

FRACTURE MANAGEMENT

Plastic cast and their uses

1. Minerva cast	Cervical spine disease
2. **Risser's cast**	**Scoliosis**
3. Turn buckle cast	Scoliosis
4. **Shoulder Spica**	**Shoulder immobilization**
5. U-Slab / Hanging cast	Fracture of Humerus
6. **Cylinder / tube cast**	**Fracture of Patella**
7. PTB / Patellar tendon bearing cast	Fracture of tibia
8. Hand shaking cast/ Colle's cast	Fracture lower end radius
9. Glass holding cast	Fracture scaphoid

Common splints / Braces and their uses

UPPER LIMB

1. **Cock-up splint**	**Radial N. Palsy**
2. **Knuckle bender splint**	**Ulnar / Median N. palsy – claw hand**
3. Volkmann's splint (or) Turn buckle splint	Volkmann's Ischemic contracture
4. Aeroplane splint	Brachial plexus injury
5. **Dunlop traction**	**Supracondylar Fracture of Humerus**
6. **Smith's traction**Q	**Supracondylar fracture of Humerus**
7. Fig of 8 bandage	Clavicle Q
8. Velpau sling and swathe	Acromio clavicular dislocation > shoulder dislocation
9. Gutter splint	Phalangeal and metacarpal fractures
10. Thumb Spica splint	Scaphoid Fracture / Metacarpal Fracture / Game keeper's thumb
11. Sugar tong	Humeral Fracture
12. Distal sugar tong / reverse sugar tong	Distal forearm Fracture
13. Double sugar tong	Elbow Fracture
14. Buddy strapping	Phalangeal Fracture
15. Mallet splint (6-8 W)	Avulsion of extension tendon from distal phalanx

NOTE

TURN-BUCKLE
- CAST → SCOLIOSIS
- SPLINT → VIC

PrepLadder

LOWER LIMB

1. Thomas splint	Fracture femur, knee immobilization
2. Bohler-Broun splint	Fracture femur, Fracture knee and fracture tibia
3. Dennis-Broun splint	CTEV (Congenital Talipes Equino Varus)
4. Toe-raising splint	Foot drop splint
5. Gallow's traction	Fracture S.O.F in children < 2 years / 12 kg body weight
6. Bryant's traction	Fracture shaft of femur in children < 2 years / 12 kg body weight
7. Russel's traction	**Trochanteric fractures (skin traction)**
8. Buck's traction	Conventional skin traction
9. Perkin's traction	Fracture shaft of femur in adults
10. 90° - 90°	Fracture shaft of femur in children
11. Agnes hunt traction	**Correction of hip deformity (flexion)**
12. Well-leg traction	Correction of abduction deformity of hip
13. Palvik harness, Von-Rossen splint (Ilfeld splint / Craig splint or bachelor cast)	**Developmental Dysplasia of hip**
14. Broom stick (Petrie) cast	Legg-calve -perthes Ds.

PrepLadder

SPINE

1. Four-post collar	Neck immobilization
2. SOMI Brace (Sternal occipital mandibular immobilization brace)	Cervical spine injury
3. ASHE (Anterior spinal hyper extension) Brace	Dorso-lumbar spinal injury
4. Taylor's Brace	Dorso-lumber immobilization
5. Milwaukee Brace	**Scoliosis**
6. Boston Brace	**Scoliosis**
7. Lumbar corset	Back ache (Disc prolapse)
8. Goldthwaite brace	Lumber spine (T.B)
9. Head-halter traction	Cervical spine injuries
10. Crutch field traction	Cervical spine injuries
11. Halo-pelvic traction	Scoliosis
12. Minerva Cast-Halo device	Cervical spine
13. Risser's cast	Scoliosis (Usually idiopathic or Dorsal)

Images

Cockup Splint

Knuckle Bender Splint

Dunlop's Traction

→ Supracondylar fracture Humerus

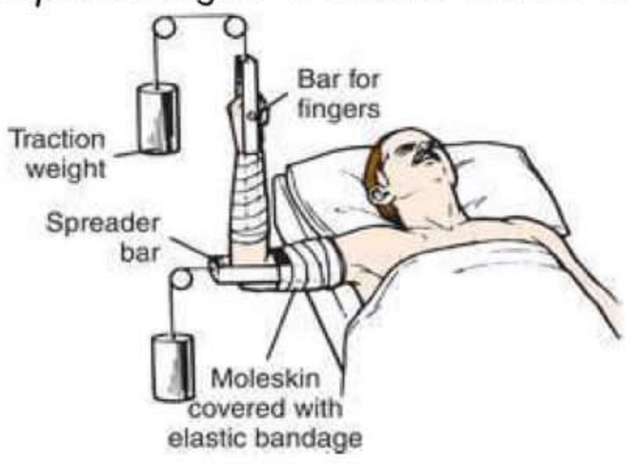
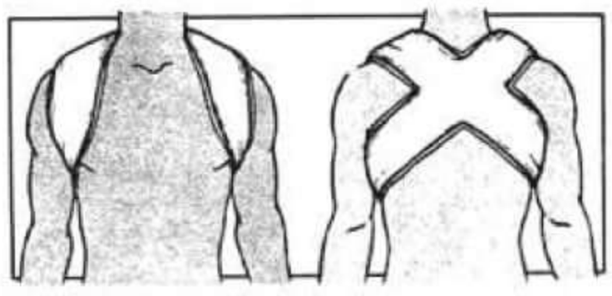


Fig of 8 bandage

→ Fracture Clavicle



PrepLadder

Velpau sling & Swathe bandage

→ Acromio clavicular dislocation>Shoulder dislocation

Mallet splint

→ Avulsion of extensor tendon from distal phalanx.

→ Used for Mallet finger.

→ For 6-8 Weeks.

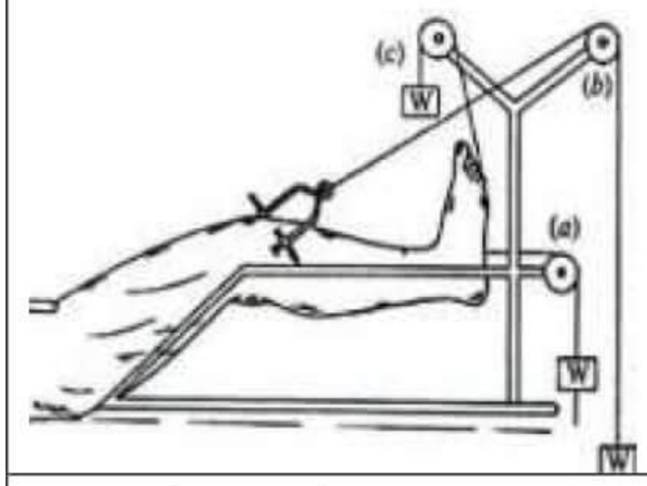
→ Managed Non-operatively

Bohler-Braun splint

→ **Fracture femur, Knee and tibia**

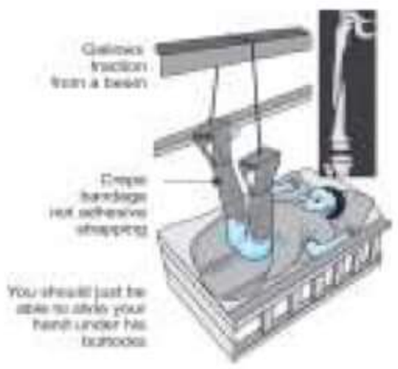
→ 3 Pulley mechanism

- Proximal- to prevent foot drop.
- 2nd Pulley- traction in line with the femur
- 3rd Pulley- traction in line with the leg.



Gallow's Traction

→ <2yr. old Fracture of Shaft of Femur

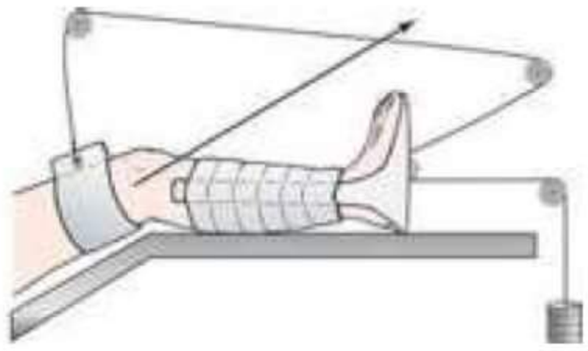


Bryant's Traction

→ <2yr old fracture S.O. F

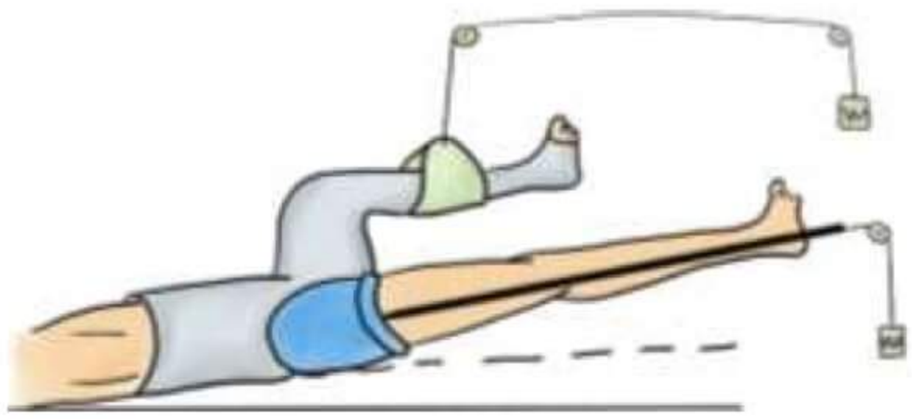
Russel Traction

→ Intertrochanteric fractures



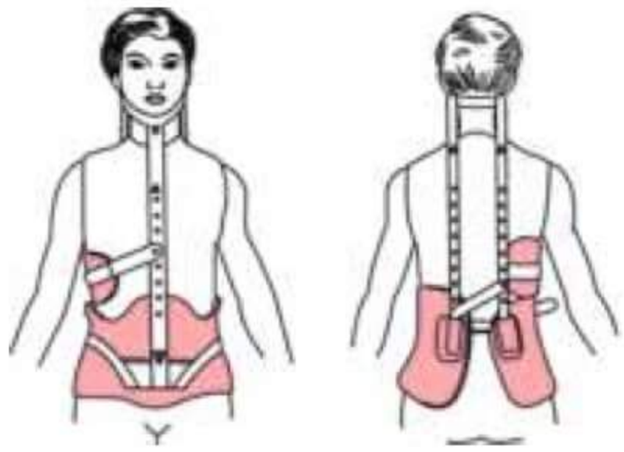
Agnes-Hunt traction

→ To correct the flexion hip deformity



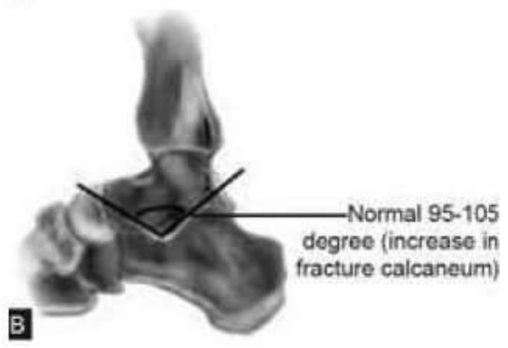
Milwaukee Brace

→ Scoliosis



PrepLadder

ANGLES

A) BOHLERS ANGLE	B) ANGLE OF GISSAINE
→ Angle between joint and imaginary line along the calcaneal tuberosity	→ Angle along the joint surface
→ Angle is 20-40°	→ Value of angle is 95°-105°
→ Further lowers in fracture calcaneum	→ Further gains angle in the fracture calcaneum
Mnemonic: **Bohlers-Lowers**	→ **Gissaine-Gains**
	

(C) Q- Angle

→ Q-Quadriceps

→ It is the angle between a line that starts from **ASIS to mid-point of patella** and a line that joins **tibial tuberosity to the mid-point of patella** and vector drawn up.

→ ↑↑ Q-Angle → lateral pull → Patellar subluxation / Dislocation

(C)

(D) Insall Salvati Ratio = Ligamentum patellae / Patellar length

(D)

→ < 0.8 = Patella Baja

→ >1.2= Patella Alta

→ Chances of dislocation is higher with patella Alta

(E) Cobbs Angle:

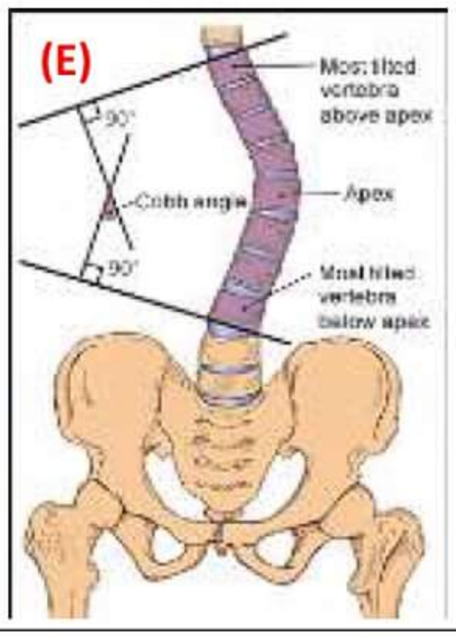
→ Cobbs angle is for scoliosis.

→ It is the line that is drawn along the lower margin of the curve in the normal curve and a line drawn in the superior border of the curve. And the angle between the two perpendiculars of both the lines is called as Cobbs Angle

→ Used to quantify scoliosis

→ If > 45° Curve → surgery is indicated.

(E)



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(F) Kites Angle

→ Used for **Clubfoot / CTEV** (Congenital Talipes Equino Varus)

Operative management of injuries

→ Extra articular fractures CR → Hematoma preserved

→ Intra articular fracture OR → Prevent the Arthritis

→ Small bone fracture screws / K wires

→ Children non-operative except peri articular fractures

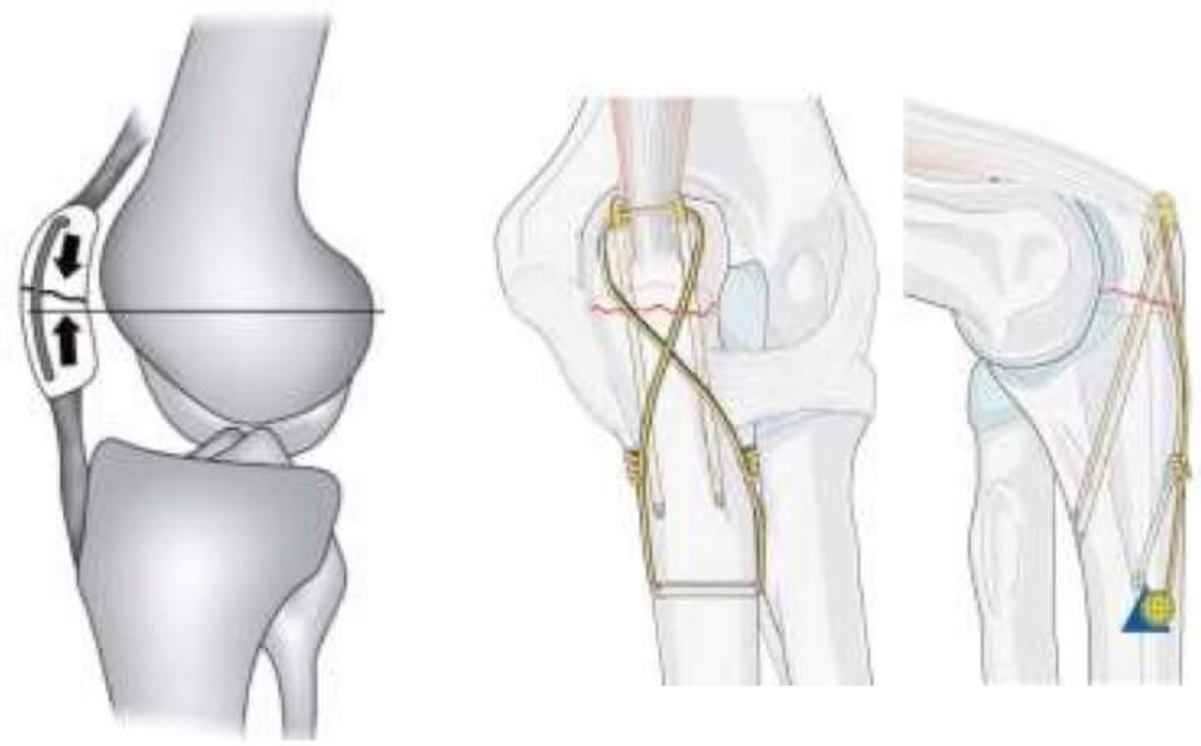
→ Children K (Kirschner wires)

KIRSCHNER WIRES

T & W: Tension Band Wiring

→ It is a correct position of implant which can be a wire/plate by which there is conversion of distractive forces into compressile forces on the tension surface.

→ Done for patellar, Olecranon and medical malleolus fractures.



Tension band Wiring

PrepLadder

External fixators:

→ Used for open injuries.

EXTERNAL FIXATORS

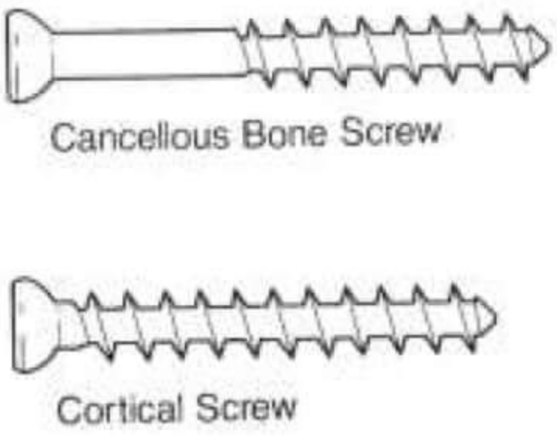
Types of plates

Dynamic compression plate: (DCP)

→ Used to fix the diaphyseal region and can be used as neutralization Buttress mode (or) compression mode and compress mode and compress the fracture site.

→ A drill is used to make hole into the bone and threads are made.

→ Screws are used to fix the plate



Limited contact -DCP (LCDCP)

→ It decreases the contact with bone surface. Hence preserving bone vascularity

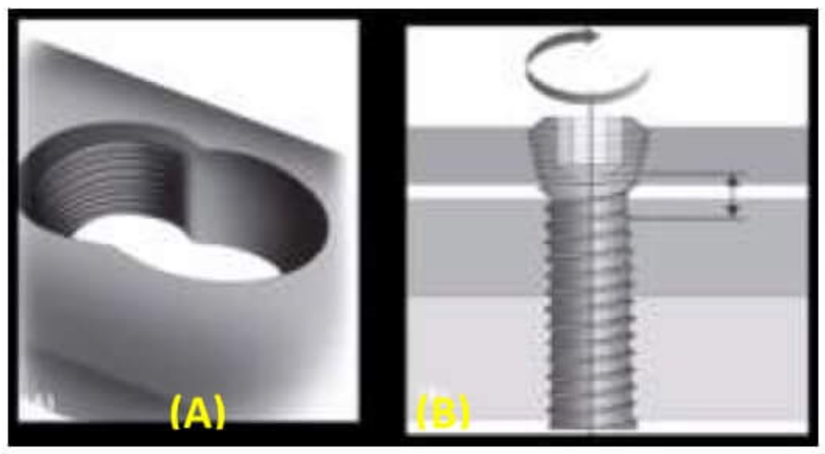
PrepLadder

Locking Compression plate

→ (A) Combi hole

→ (B) Locking screw (the threads in head of screw lock with the threads of hole in plate)

- Used in Osteoporotic patients, metaphyseal fractures, non-union, and around periprosthetic space



PrepLadder

Other instruments

Osteotome

→ Used for cutting by the both cutting edges / sides

Curette

→ Used for scooping out the dead necrotic material

Bone cutter

→ Used to freshen the margins and prepare the grafts to be placed at any place.

Bone Nibbler

→ Used to nibble out pieces of bone to freshen the margins.

Bone holding forceps

→ Always have dentations

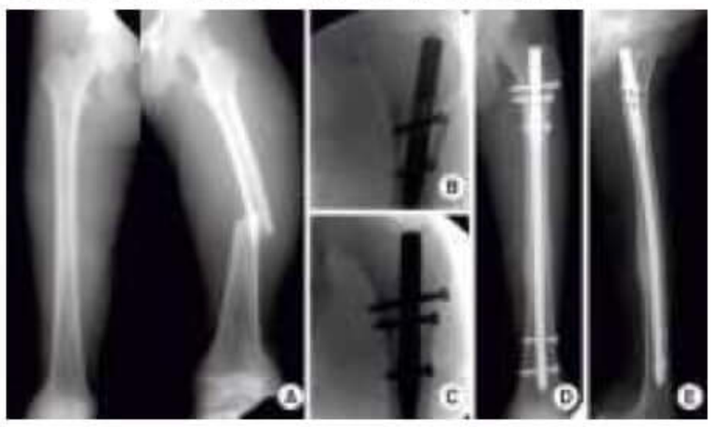
Bone plate holding forceps

→ One side is toothed and the other side is smooth

→ Toothed side is for bone holding and smooth side for plate

Interlock nailing

→ Used for lower limb fractures



Ilizarov external fixator

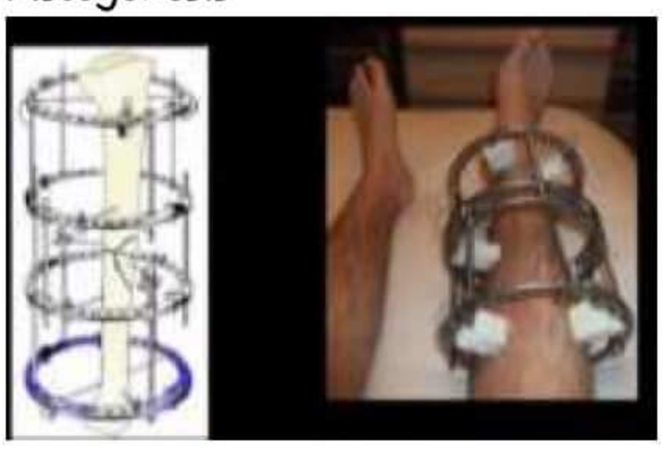
→ Used in cases of non-union.

→ In case of shortening.

→ Gap which needed to be filled such as osteomyelitis.

Concept:

→ Works on the principle of "**distraction histogenesis**"



Anterolateral approach to tibia

→ Anterolateral approach is more preferred because:

- Extended to entire extent of the leg
- Vascularity is preserved
- Less wound dehiscence

PrepLadder

INSTRUMENTS

Bone nibblers

→ Nibbles bone or soft tissue

→ Used for

- Debridement in malignancies
- Curettage
- Non-union

It can be of **two**-types

- Straight
- Curved

Bone cutter

→ Used for cutting bone

→ Also used for removing osteophytes

Chisel

→ One edge is beveled

→ Used to chip bone

→ Chisel has only one cutting end while the osteotome has two

Bone mallet

→ A hammer with a metallic handle

Periosteal elevator

→ Smooth end helps in stripping off the periosteum form the bone for the better alignment of the bone.

Bone curette

→ To curette out dead necrotic material from a cavity such as the cancellous graft from iliac crest

PrepLadder

Bone gouge

→ Used to remove muscles from the field while dissecting the bone to fix a fracture.

Bone Lever

→ To remove muscles from the field while dissecting the bone to fix a fracture

Bone tap

→ Used for making holes & threads in the bone

PrepLadder

Pins and nails

K Wires

→ Normal stainless-steel wires

→ Used to fix small bone fragments and pediatric fractures

Steinmann pin

→ Sharp towards the end and No threads in between the pin

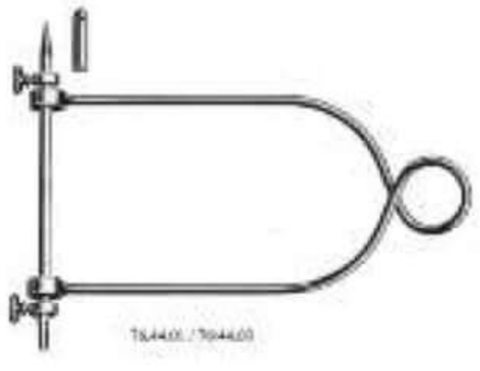
→ Used for **skeletal traction** osteoporotic elderly

Denham Pin

→ To provide **skeletal traction** for cancellous bone & osteoporotic elderly

Bohler Stirrup

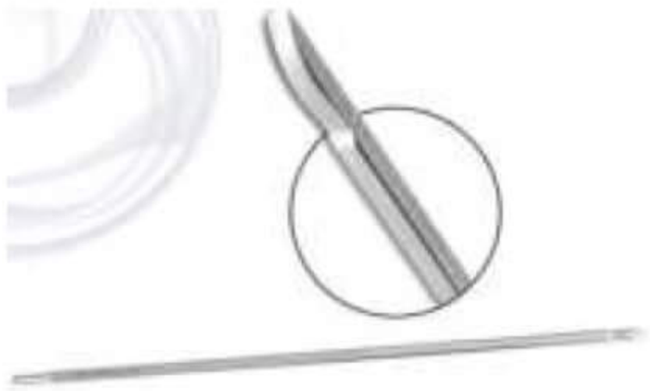
→ Used for holding Denham/ Steinmann pin Together



PrepLadder

Radius nail

→ Mid beveled nail used for fracture radius



Ulna Nail

→ Straight nail without beveling

→ Sharp at end

Rush nail

→ Used in pediatric long bone Fracture

→ Bend at the end

→ Used in intramedullary fixation of pediatric fracture

K nail

→ Kuntscher clover leaf intramedullary nail

→ One open end, Has an eye at the edge

→

→ Used to fix shaft of Femur/Tibia/Humerus

→ Can be introduced by

- Anterograde method
- Retrograde method

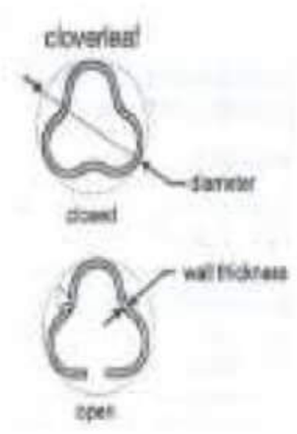
→ Fixes by 3-point fixation- Distal, proximal and narrowest point of isthmus

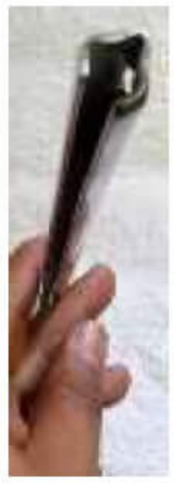
→ Clover leaf shape to prevent rotation

Cons

→ Loose in the medullary canal

→ May rotate in the foot/limb if the 3-point fixation is not proper





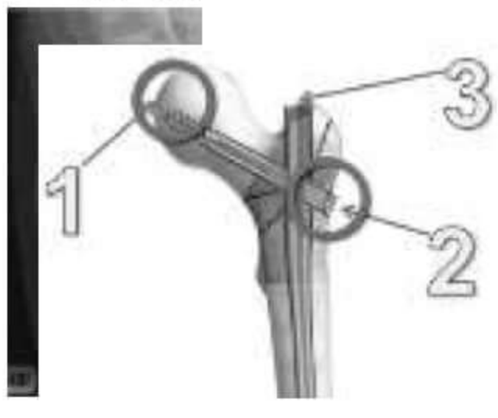
Interlocking nail

→ Used to minimize the disadvantages of K nail

→ Placed in femur / tibial diaphyseal fractures

Proximal Femoral Nail [PFN]

→ Used in inter/ sub trochanteric fracture of proximal femur



PrepLadder

Austin Moore pin

→ Used for fixation of neck of femur # in pediatric patients.

→ Not used now a days

Bone holding forceps -Q'AIIMS

→ Toothed, more commonly used

→ 2 types

- Fergusson bone holding forceps
- Lane bone holding forceps

Fergusson bone holding forceps

Lane bone holding forceps

Lowman's clamp

→ Used for holding fractured ends of bone

Sponge holding forceps

→ Useful for draping

Allis tissue holding forceps

→ Used for spreading out the tissue

→ Has a lock

Toothed Forceps

→ **Used for holding tissue**

Non-Toothed forceps

→ Used for holding skin

→ Less traumatic

Right angled Retractors

→ For retracting different tissue layers

PrepLadder

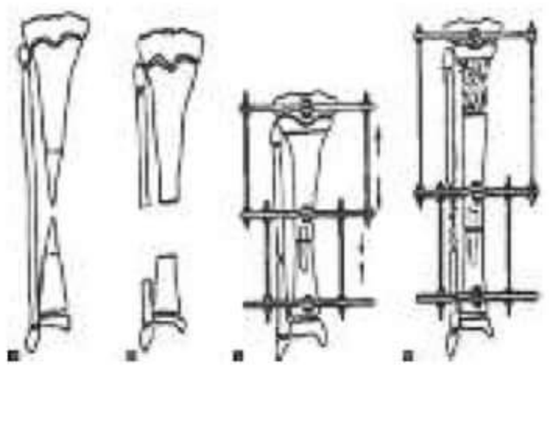
Traction systems

Crutch field tongs

→ Applied in the skull to give traction for cervical spine

Ilizarov fixators

→ Ring fixators in which distance between rings can be adjusted to shorten or lengthen the bone

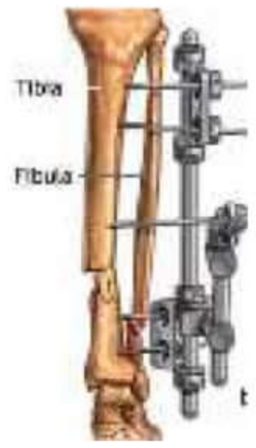


Jacob chuck

→ Used while doing external fixation to put the schanz screws

External fixator

→ To treat open fractures



Prosthesis

Replacement prosthesis

→ Used in Fracture of neck of femur.

1. **Austin Moore**

→ Stem has two fenestrations

2. **Thompson**

→ Prosthesis without fenestrations

3. **Bipolar hip prosthesis (Modular)**

→ Size of the head can be altered so that the movement of femur head inside the acetabulum is **free** and independent.

PrepLadder

Hemiarthroplasty

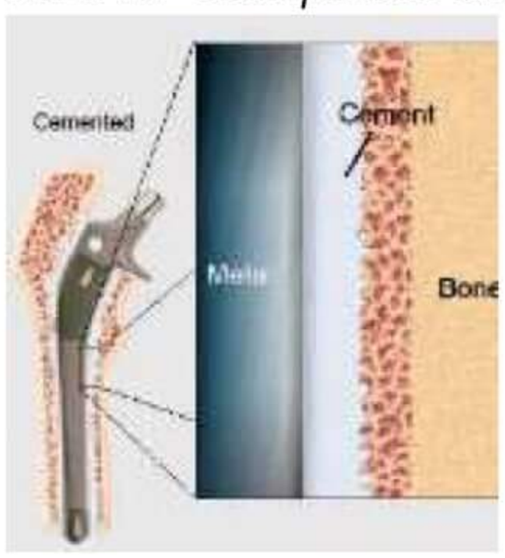
→ Fracture of neck of femur > 65 years

→ Only head of femur is replaced.

1. Cemented Joint replacement

→ Implant fixed with cement

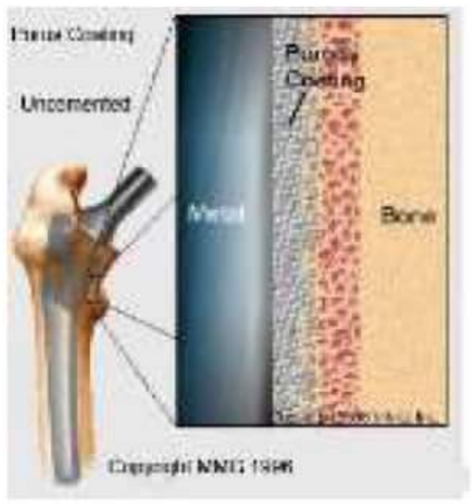
→ Done for Osteoporotic elderly.



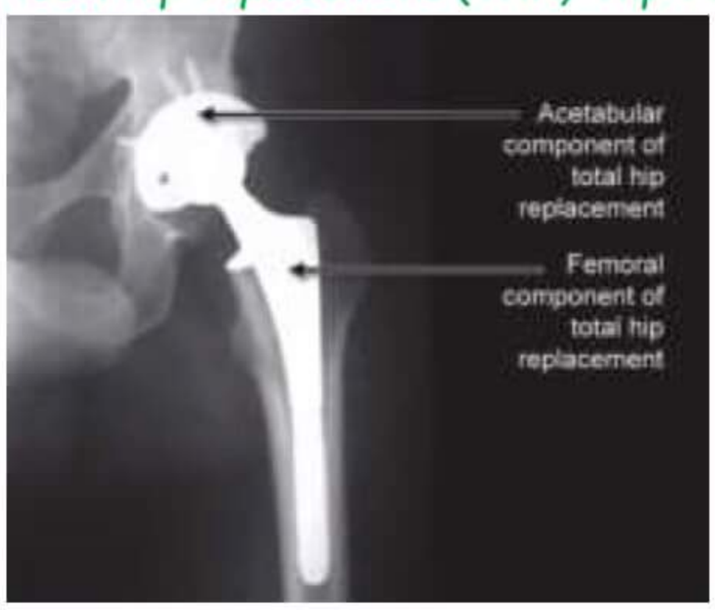
2. Uncemented Joint replacement

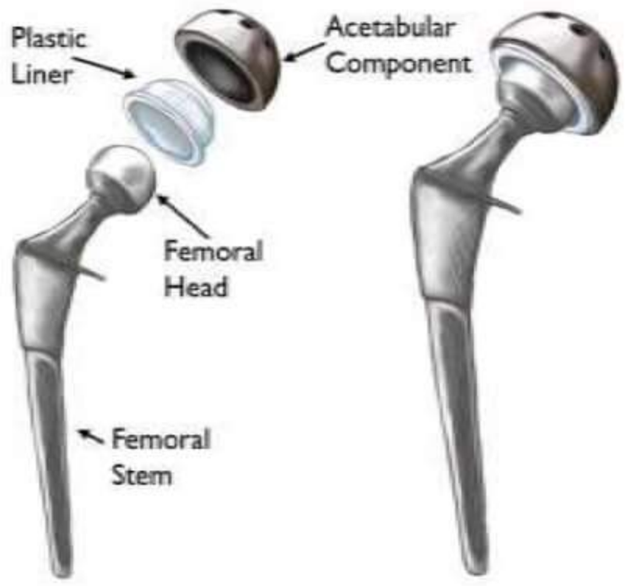
→ Better

→ Requires Normal bone



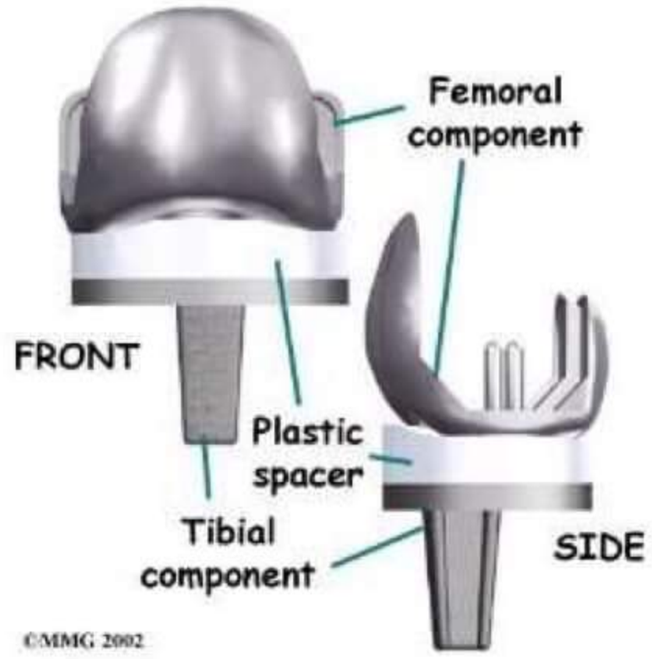
Total hip replacement (THR)-Hip Prosthetic





Knee replacement prosthetic

→ Most commonly done in India



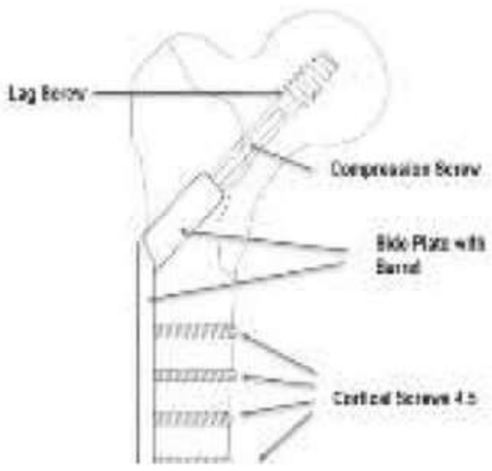
Ankle replacement prosthetic

Elbow replacement prosthesis

Plates and Screws

Dynamic Hip screw

→ Sliding screw with an angled plate
→ Used in fixation of displacied inter trochanteric fracture
→ But PFN is considered better than dynamic hip screw



Dynamic compression plate (DCP)

→ No grooves beneath the plate
→ Used in fixation of diaphyseal fracture of long bones
→ Provides compression if the screws are fixed at the edge of the plates

Limited Contact Dynamic Compression Plate (LCDCP)

→ Grooves for vessels
→ Better
→ More vascular

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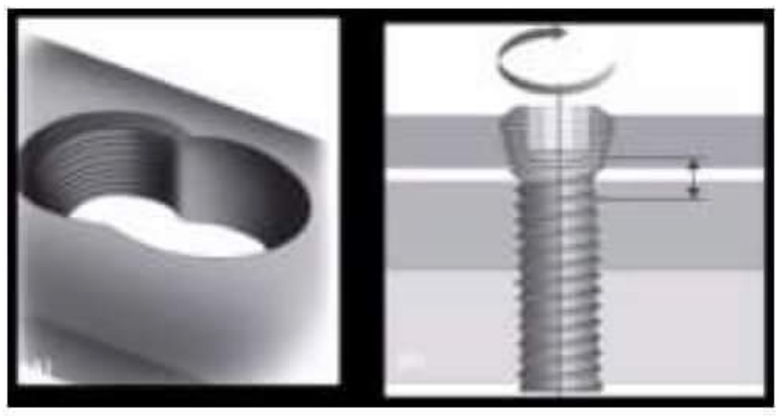
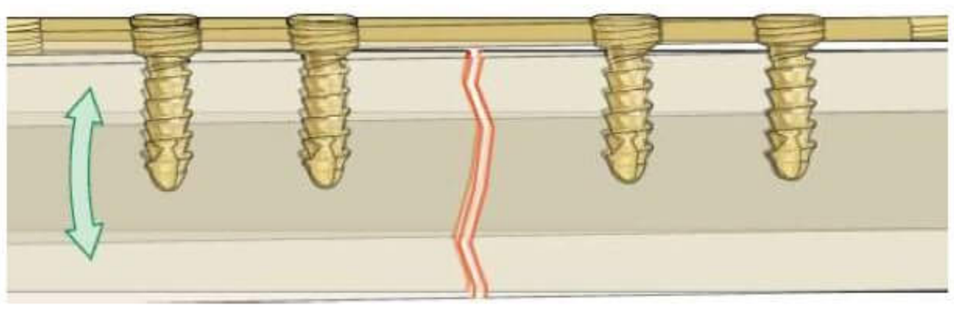
Locking plate

→ (A) Combi hole
→ (B) Locking screw (the threads in head of screw lock with the threads of hole in plate)
→ Used in Osteoporotic patients, metaphyseal fractures, non-union, and around periprosthetic space
→ MC used type of plates





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Reconstruction Plate

→ Can be remodelled specifically for acetabular areas

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Screws

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1.Cancellous Bone Screw

→ More distance between threads

Cancellous Bone Screw

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2.Cortical Bone Screw

→ Threads throughout the screw

Cortical Screw

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PrepLadder

AMPUTATIONS & SPORTS INJURY

Mangled Extremity severity score (MESS)

→ Tells about survival of a limb after crush injury

→ Includes 4 parameters:

- S - Shock
- I - Ischemia
- V - Velocity of trauma
- A -Age of the patient

→ Total score = 11

→ ≥ 7 → limb cannot survive, requires amputation

Amputation

→ Overall most common cause in world → **Peripheral vascular disease**

→ Most common cause in India → **Road Traffic accidents** (RTA)[Q]

Important types of amputation

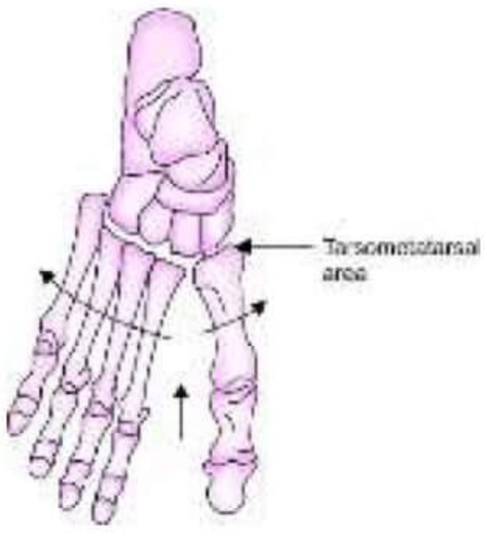
1. **Choparts Amputation**

→ Inter-tarsal area

→ Inter-tarsal amputation

2. **Lisfranc's Amputation**

→ Tarso-metatarsal area



3. **Symes amputation**

→ Through the ankle 0.6 cm above the talar dome

Amputation neuroma

→ Occurs due to amputation of a limb

→ **Treatment**- Excision (surgery) & Control the pain

→ **Pain can be controlled by**: -

1. TENS (Transcutaneous electrical nerve stimulation)
   ↓
   Inhibits pain gate pathway

PrepLadder

2. IFT (Interferential therapy) – uses same principle
3. Ultra-sonic therapy

Pain management- TENS > IFT > US

Prosthesis

→ **To replace amputated foot**

1.**Sach Foot** - Western lifestyle foot

2.**Jaipur Foot** – Indian foot/ natural looking foot; created by Dr.P.K. Sethi

Prosthesis	Sach foot (Western) (Solid ankle cushion heel)	Jaipur foot By Dr. P k Sethi
Appearance	Does not look normal Requires shoe	Looks normal Can walk barefoot
Keel	Long Keel restricting movements	Small keel allowing all movements
Ankle movements	Not present Squatting not possible	Present Squatting possible (sit on ground)
Inversion / Eversion (subtalar joint movements)	Not present Hence difficult to walk on uneven grounds	Present So can walk on uneven grounds
Cost	High	Low
		

Re-implantation of amputated digit-According to Greens textbook, BE FAN VS

→ B-Bone "**Bone is repaired first**"

→ E-Extensor tendon } **Functional**

→ F- Flexor tendon }

→ A- Arteries

→ N- Nerves

→ V- Veins

→ S- Skin coverage " **Skin is preserved first but repaired last**"

PrepLadder

Arthroscopy

→ Inserting a scope into joint

Arthroscopy:

→ 4 mm diameter

→ 30° (so all structures can be visualized)

Knee arthroscopy

Portals of Knee Arthroscopy

- Anterolateral portal
  - \- Most common approach
  - \- 1 cm above joint line and 1 cm lateral to patellar tendon
  - \- University see all structures except
    1. PCL
    2. Anterior part lateral meniscus
    3. Posterior Horn medial menicus
- Anteromedial portal
  - -Additional viewing of lateral compartment
  - -Instruments
- Superolateral portal
  - -Patello femoral articulation and excision of medial plicae
- Posteromedial portal
- Gillquist portal (Trans patellar portal

PrepLadder

Anterolateral portal

→ **Most common approach**

→ 1 cm above joint line & 1cm lateral to patellar tendon

→ Universally see all structures except

- PCL
- Anterior part lateral meniscus
- Posterior horn medial meniscus

Anteromedial portal

→ 1 cm medial to patellar tendon

→ Additional viewing of lateral compartment

→ Instrumentation

Superolateral portal

→ Above the patella

→ Patellar-femoral articulation & Excision of medial plicae

Posteromedial portal

→ Repair of posterior horn meniscal tear

→ Removal of posterior louse bodies

Gillquistportal

→ Passed through ligamentum patellae

Shoulder joint Arthroscopy

→ Posterior portal→most commonly used

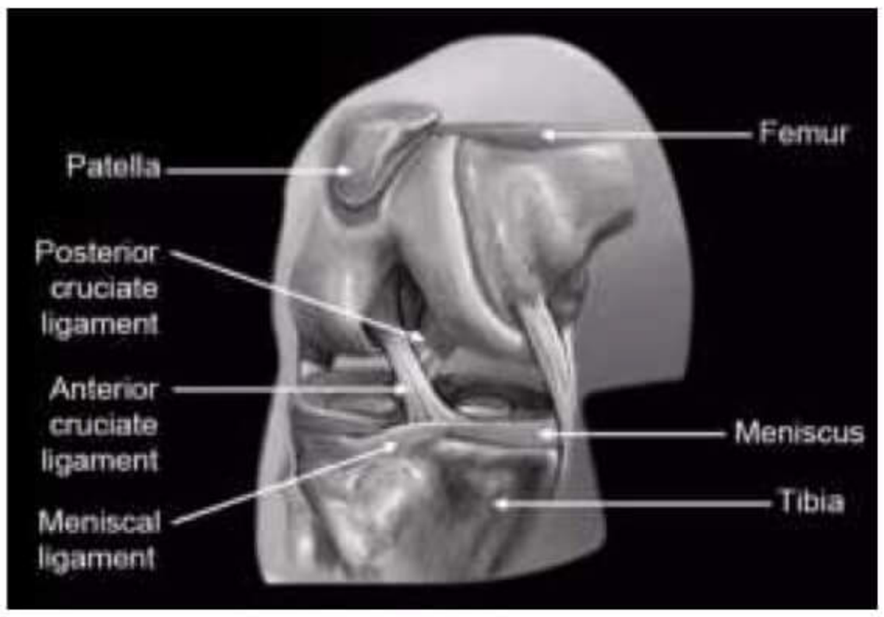
→ 2nd most common joint for arthroscopy

Knee joint → most common joint used in arthroscopy

Shoulder →2nd most common joint

PrepLadder

Knee joint



→ Lateral Collateral Ligament → Varus force
→ Medial Collateral Ligament →Valgus force
→ Medical & lateral menisci → Torsion & rotation
→ Torsion - happens only when the knee is flexed
→ In extension, knee is locked

LCL - Varus

MCL - Valgus

MM / LM- Torsion (in flexed knee)

PCL - Posterior force

ACL - Torsion + Valgus

→ Anterior Cruciate Ligament → found inside the joint + goes medially →**Torsion + Valgus**
→ Posterior cruciate ligament → Posterior force

PrepLadder

Dial test (rotate laterally the knee)→ **PCL/ PL corner**

Pivot shift test (Internal rotation) AL corner/ ACL/LCL/Lateral half joint capsule

PCL restricts External Rotation

ACL restricts hyperextension and Internal

Anterior Cruciate Ligament

Anterior drawer test

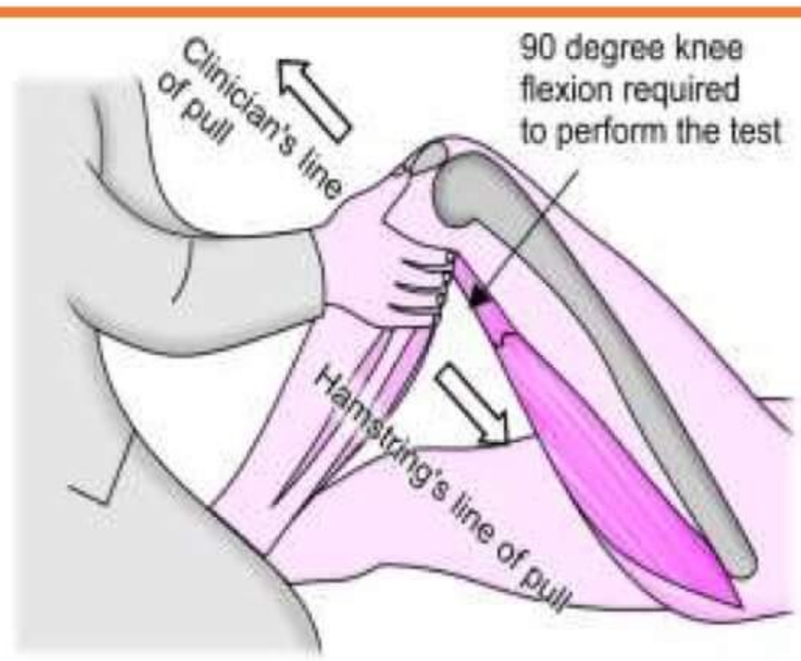
→ Knee 90° flexed, then pulled anteriorly, ACL restricts the pull

Lachman test

→ Bend knee at 20 flexion

→ **Best test for ACL**

Lelli test → New test



Anterior Drawer test

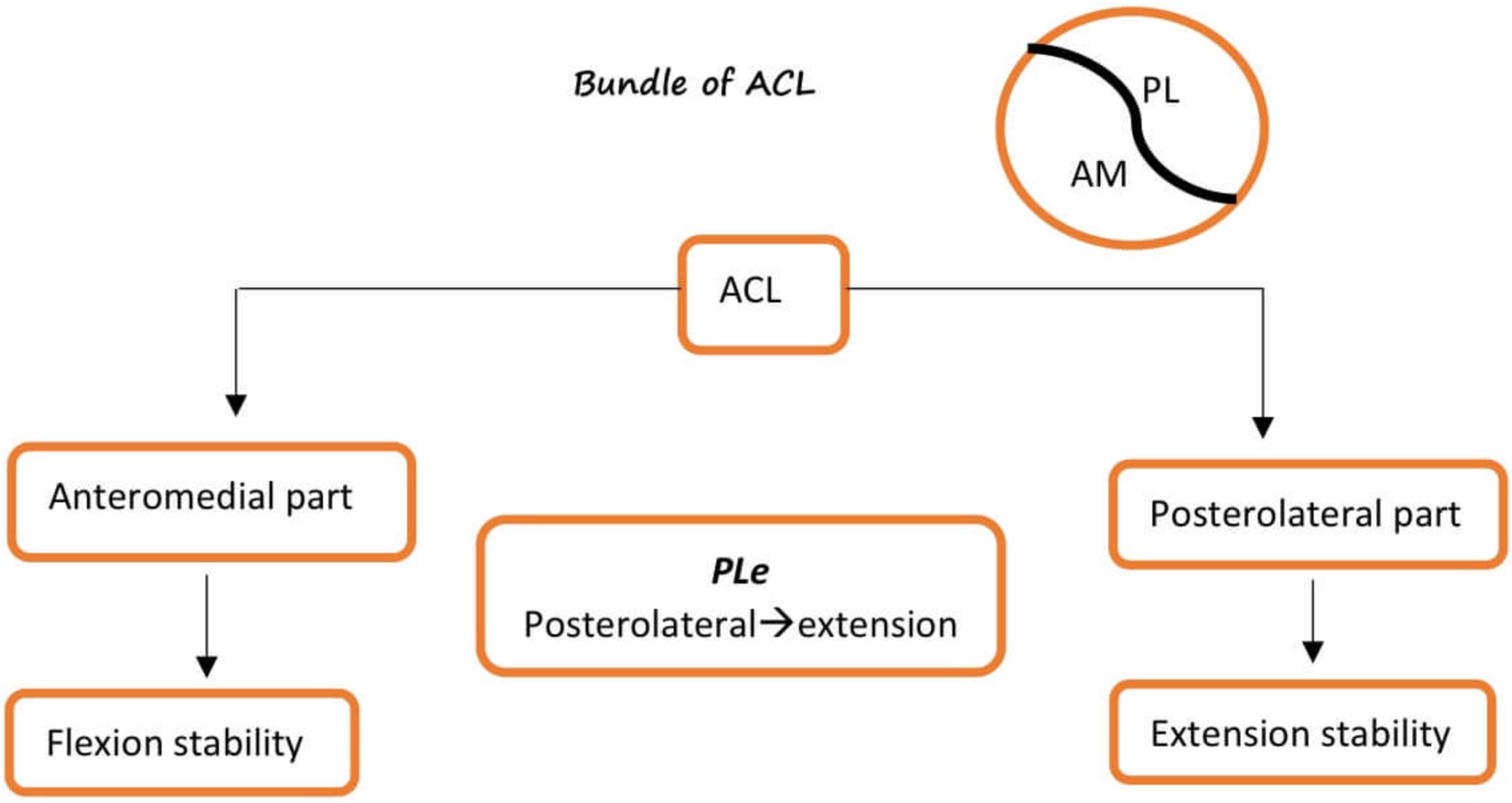
Tests for ACL: *P Le AD*

Pivot shift

Lachman

Anterior drawer

PrepLadder



O' Donoghue triad MAM

→ 3 structures are damaged – dangerous

1. M- Medial collateral ligament
2. A- Anterior cruciate ligament
3. M- Medial meniscus

O' Donoughe test → to differentiate cervical spine strain (muscle) & sprain (ligament)

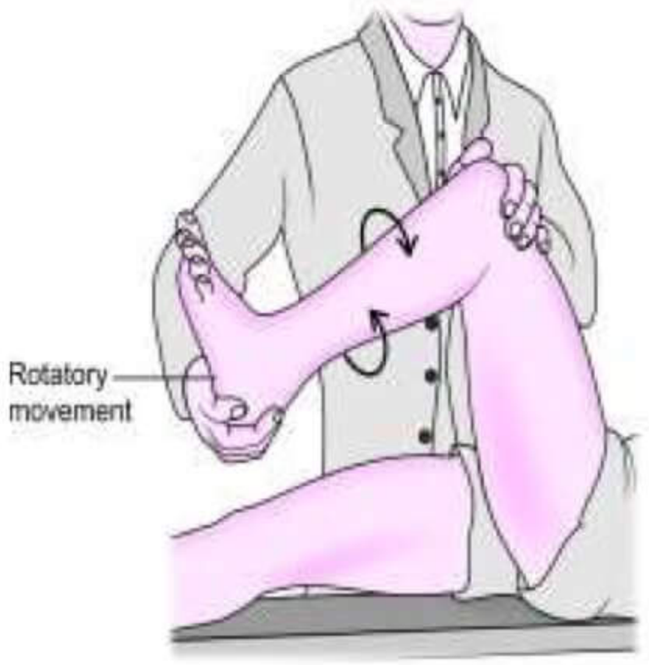
Menisci

→ McMurray test (Rotational test)- Can hear the sound of tear

→ Receives blood supply from periphery. So, Peripheral 1/3 is vascular.

→ Hence it can be repaired (inner 2/3rd→ excised if damaged)

PrepLadder



Mc Murray Test

Tests for menisci:

M- MC Murray

A- Apley grinding test

T - Thessaly

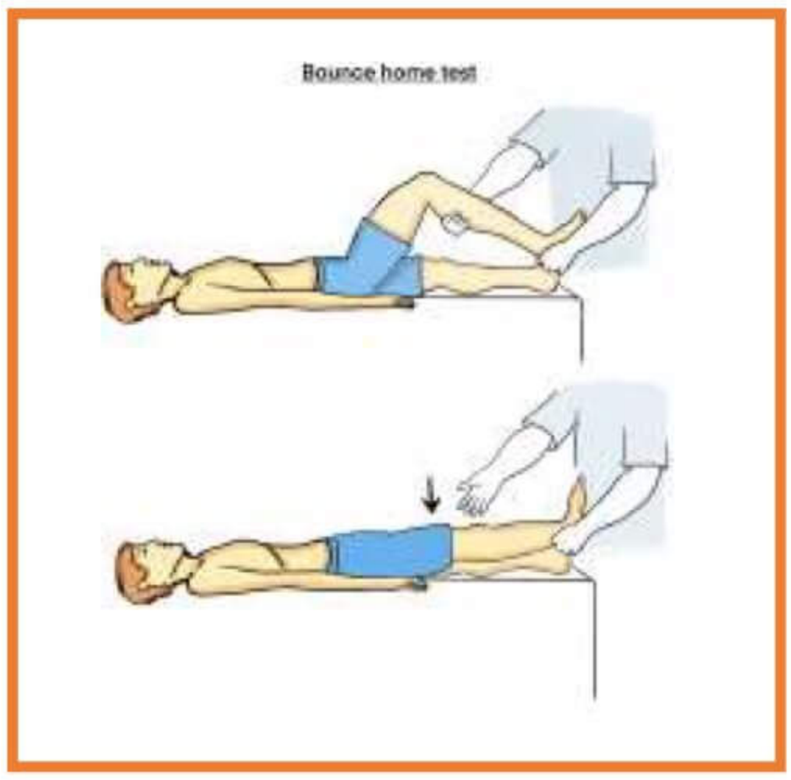
E- Ege' s test

Bounce home Test

→ When knee is flexed as then suddenly extended, there is a feel.

→ Feel on Knee extension:

- Hard - If bone rubs on bone – Normal
- Firm - If cartilage rubs
- Rubbery-Torn ACL or menisci is present-abnormal
- Empty feel is never felt- There will always be a feel



Upper end of tibia

Structures Anterior to posterior:

MCL-LMC

M → Anterior horn of Medial meniscus→ most anterior

C → Anterior Cruciate ligament

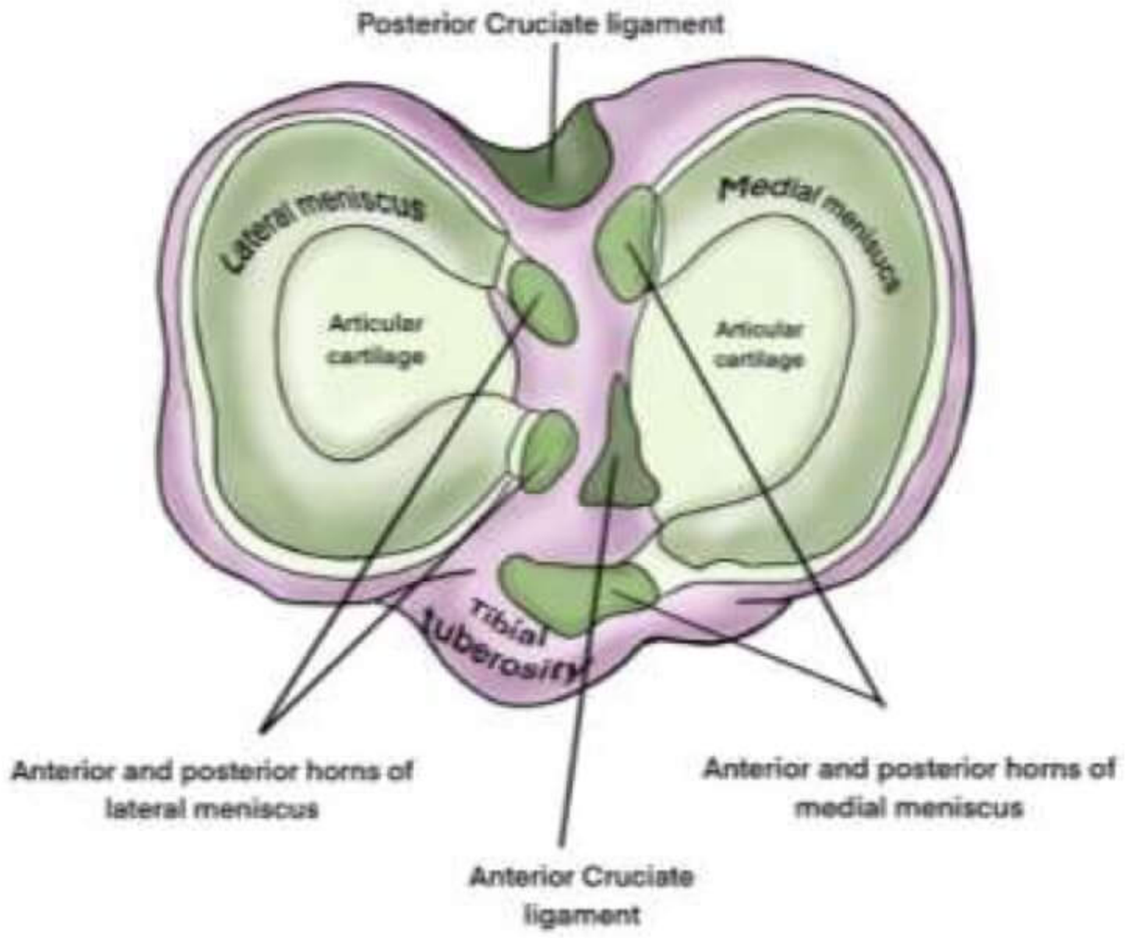
L→ Anterior horn of Lateral Meniscus

PrepLadder

L→ Posterior horn of Lateral meniscus

M→ Posterior horn of Medial meniscus

C→ Posterior Cruciate ligament→ Most posterior

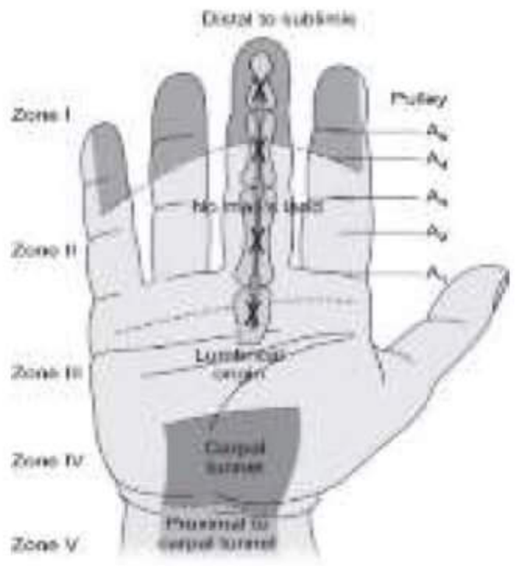


NEUROMUSCULAR DISORDERS -1

Flexor tendon injuries

→ Flexor tendons are derived into 5 zones base on their level.

- Zone I → FDP
- Zone II → FDS- called "No man's land" (as surgeries done in Zone II causes poor result)
- Zone III → Lumbricals
- Zone IV → carpel tunnel
- Zone V → Forearm



PIVD – Posterolateral (Prolapsed Intervertebral Disc)

→ Prolapse is more common in posterolateral than central.
→ Clinical presentation – lower back ache radiating to
→ IOC is MRI (T_2) weighted.
→ M/C site of relapse L_4 -L_5 > L_5-S_1 (as lumbar is usually dehydrated)
→ Lower nerve root compressed – L_5 (M/C)
→ In cervical spine C_5 C_6 > C_6 C_7

Myotomes

→ C_5 – Shoulder abduction + elbow flexion
→ C_6 - Wrist extension
→ C_7 – Elbow extension
→ C_8 - Finger flexion
→ T_1 – Intrinsic muscle of hand
→ L_2- Hip flexion
→ L_3 -Knee extension
→ L_4 - Ankle Dorsiflexion
→ L_5 – Extensor hallucis longus
→ S_1 – Flexor hallucis longus

Dermatomes of lower limb

→ L_4 – Medial border of leg + foot
→ L_5 – Lateral border of leg, dorsum of foot & great toe all around
→ S_1 – Sole of little toe all round

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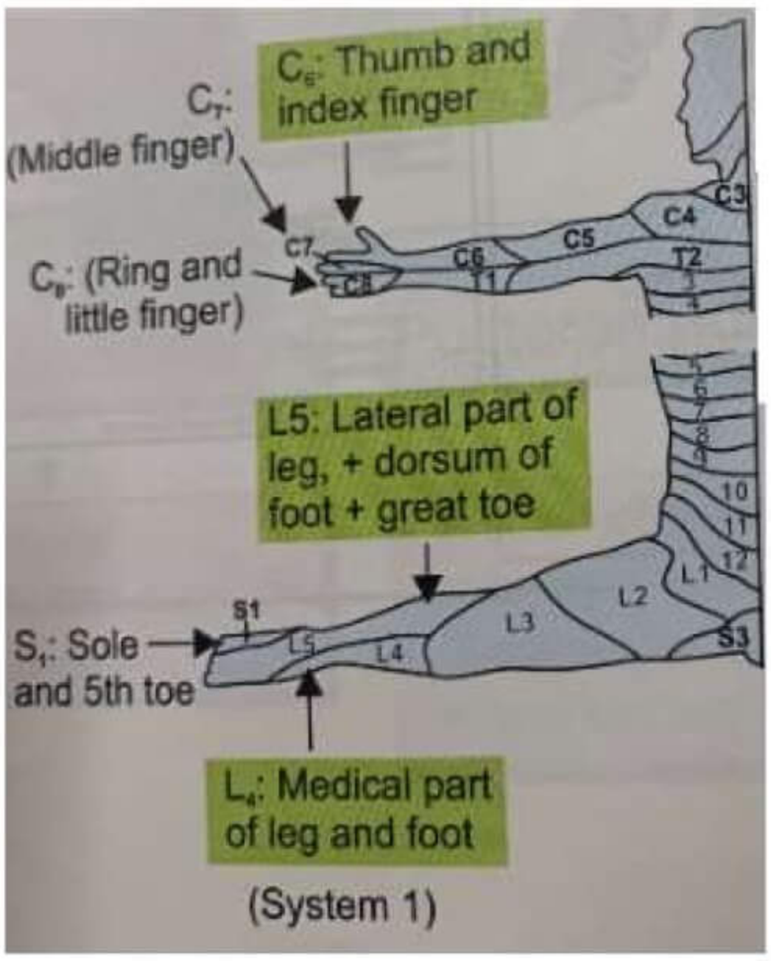
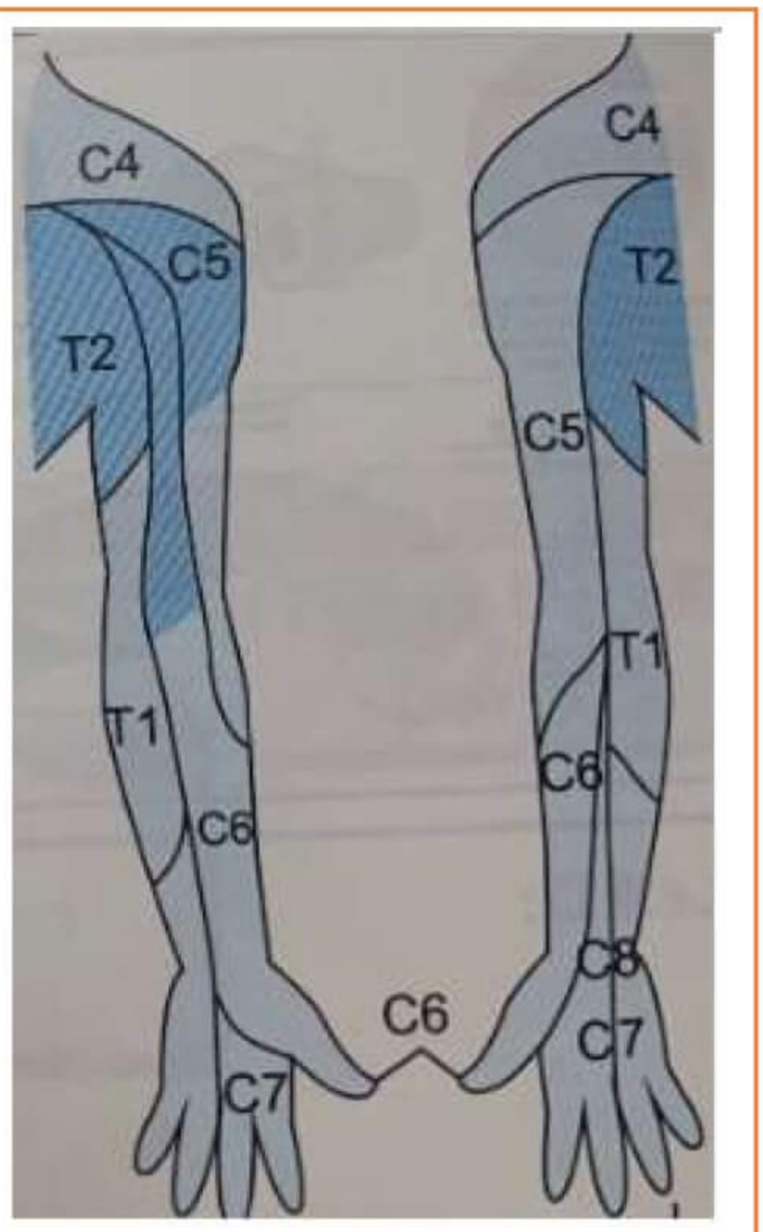


(System 1)



(System 2)

Yellow flag sign – Indicate psychosocial factors as a reason for pain

Red Flag sign – Indicates serious spinal pathology

- Bladder or bowel dysfunction
- History of carcinoma
- Progressive neurological defects
- Steroids > 4 weeks

Treatment of disc prolapse

→ Rest + NSAIDS + Physiotherapy (TENS)

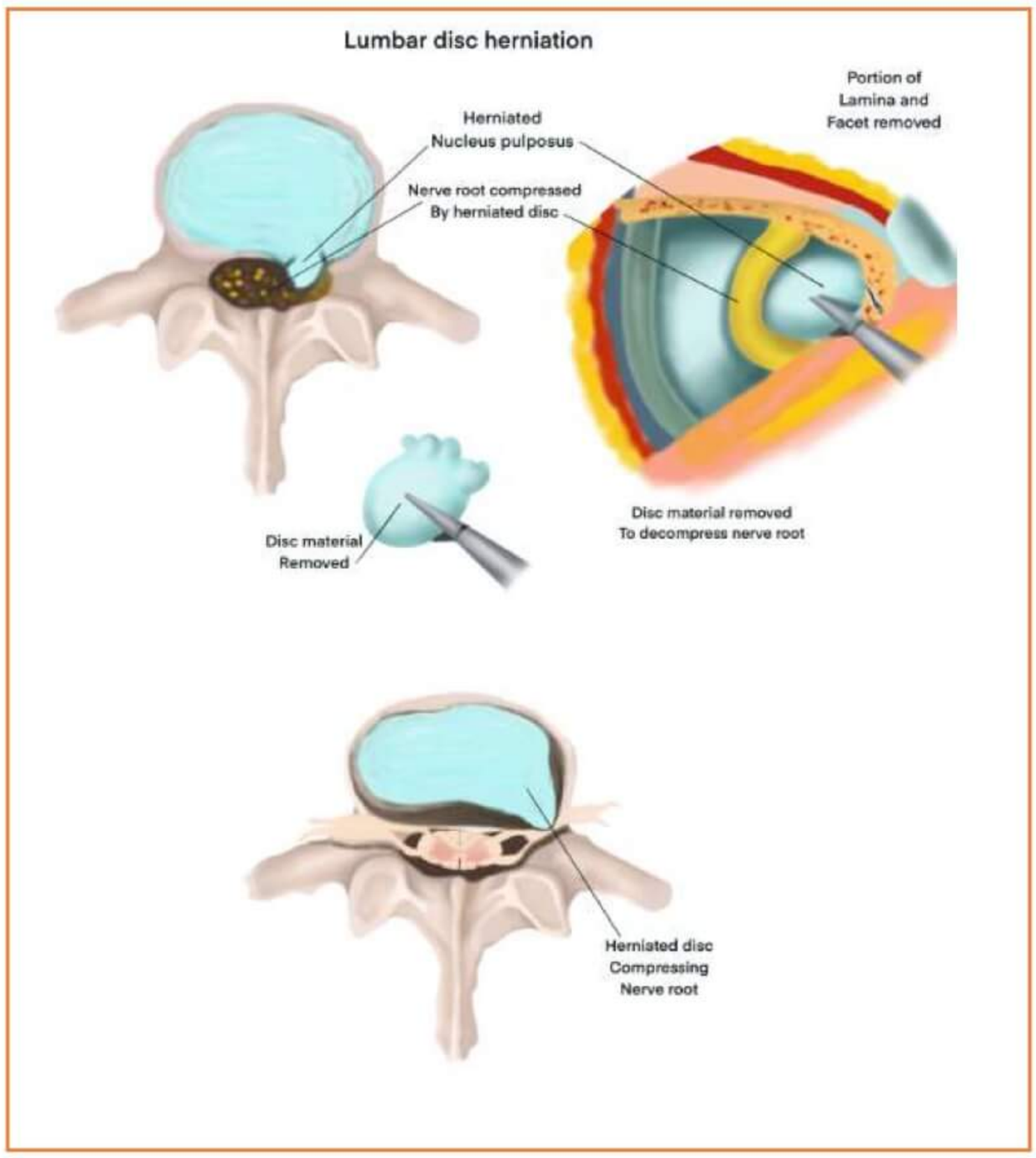
→ Local steroids

→ Surgical decompression

- Laminotomy

PrepLadder

- Laminectomy
- Hemilaminectomy



Lumber Canal Stenosis Syndrome

→ Narrowing of lumbar canal < 10 mm -> Neurogenic claudication

→ Narrowing can be due to thickening of tissues like ligamentum flavum & fibrosis all around.

→ Tx: laminectomy / laminoplasty

Note:

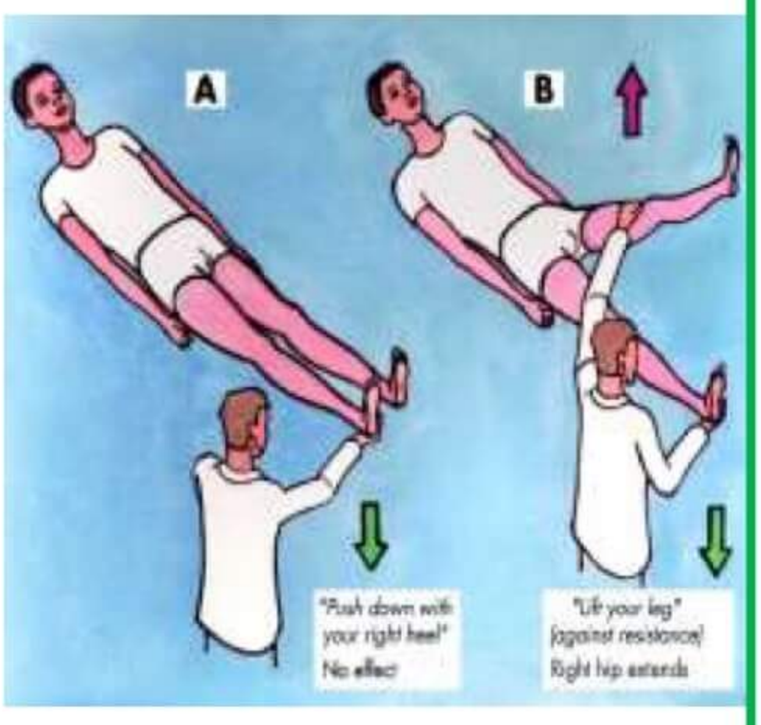
Hoovers sign

→ Maneuver aimed to separate organic from non-organic paresis of leg.

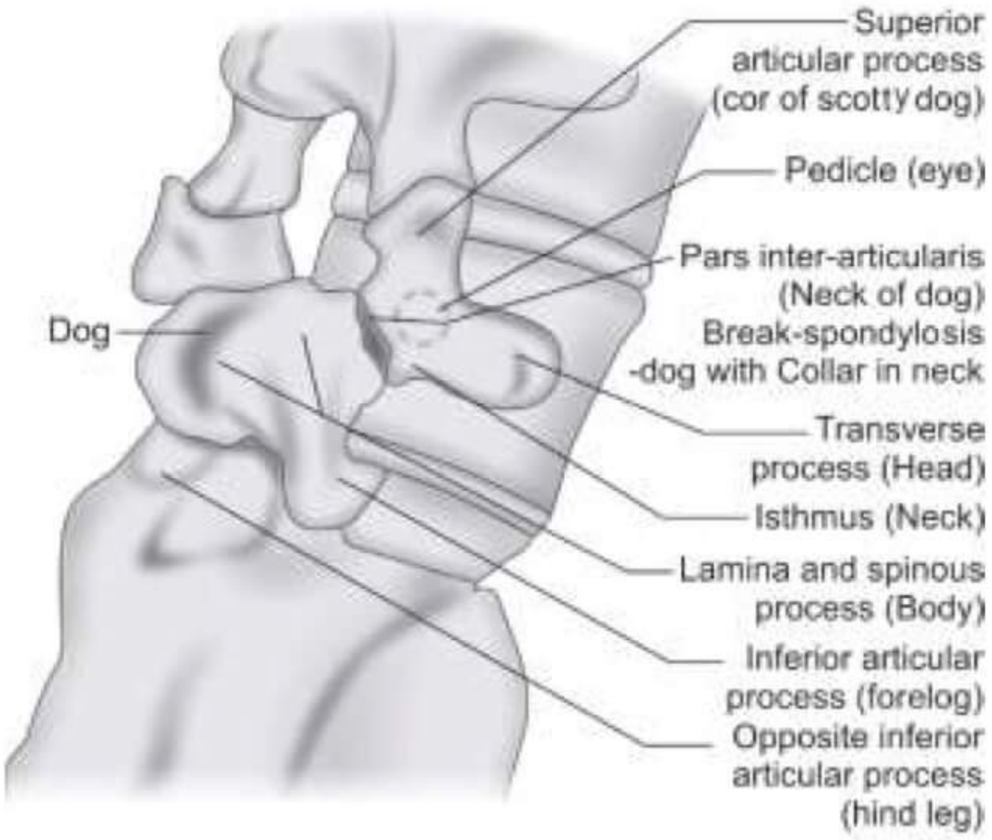
→ Relies on the principle of synergistic contraction.

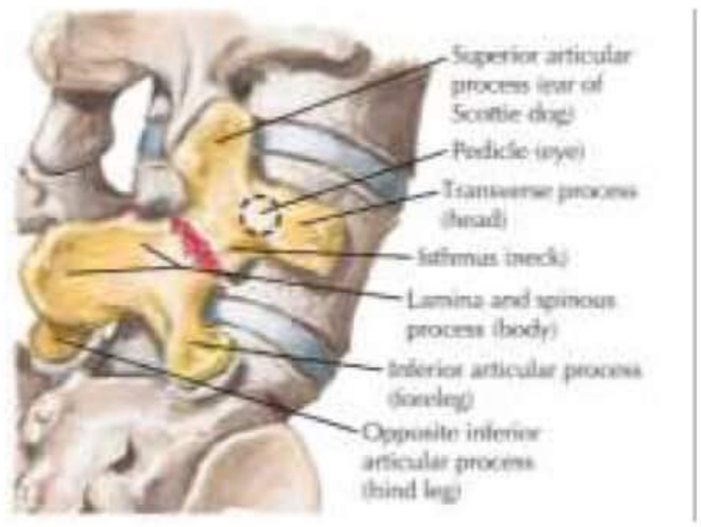
- Normal → Hip flexion on right side; heel pressure felt on left side.
- Paralyzed right leg → Paralyzed right side, can't flex but effort present.
- Malingering → not able to lift right leg; No pressure at left heel.

→ Waddell test can also be done to detect malingering.



Pars interarticularis





→ Lumbar vertebrae in oblique view radiograph gives Scottish dog appearance

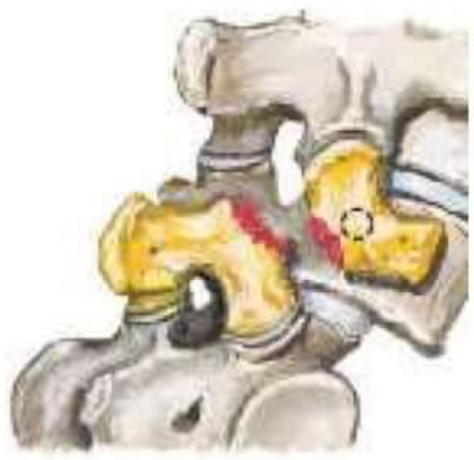
Spondylolysis

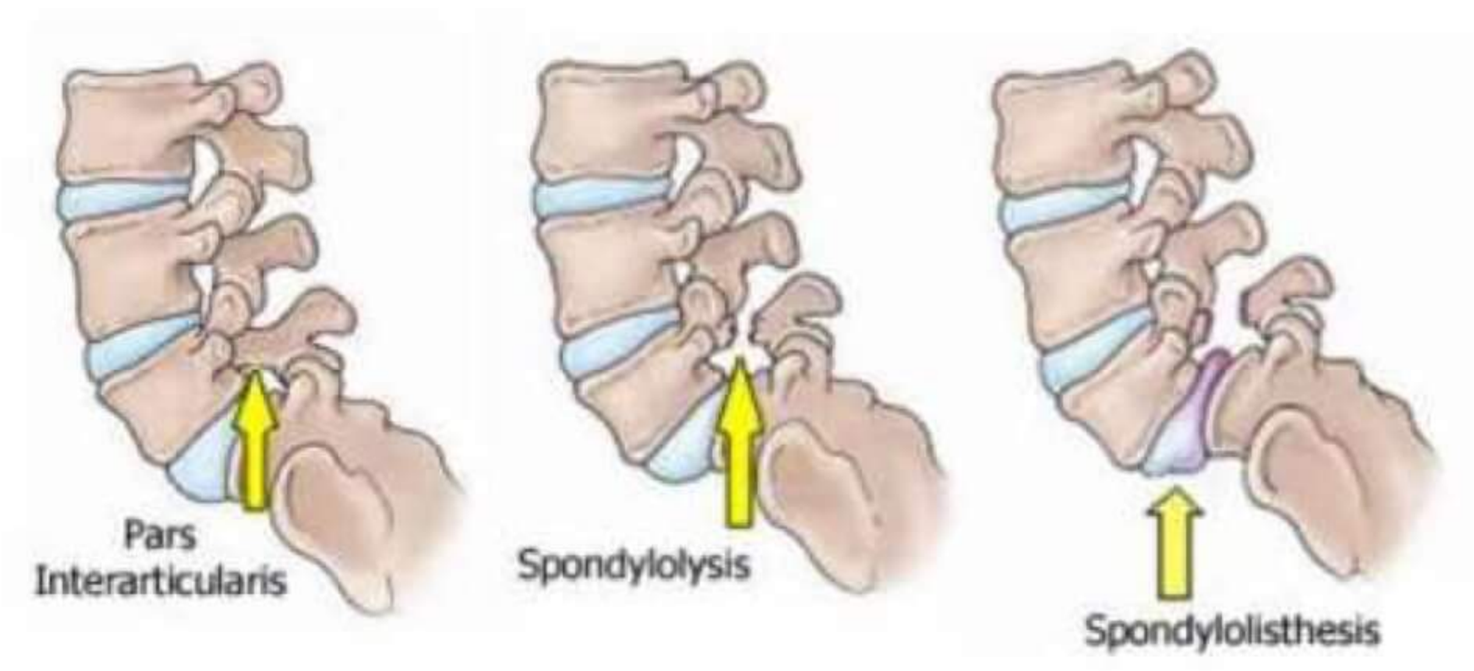
Fracture of vertebra of level L_5 in pars interarticularis (neck) gives dog with collar in neck / broken neck / elongated neck appearance.

Spondylolisthesis

→ Separation of fractured pars interarticularis gives beheaded Scottish terrier sign appearance.

→ M/C at the level of L_5 -S_1.





PrepLadder

Note:

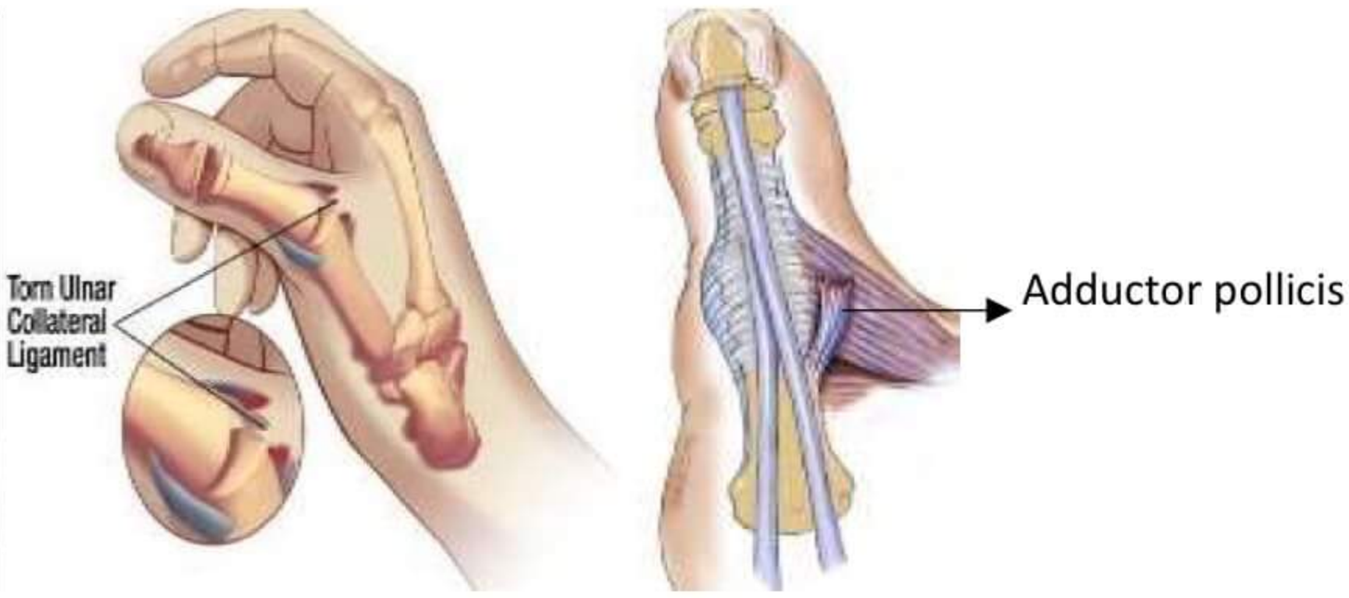
Spondylolisthesis on AP view in "**Inverted Napoleon hat**" appearance.

Inverted Napoleon hat

NEUROMUSCULAR DISORDERS II

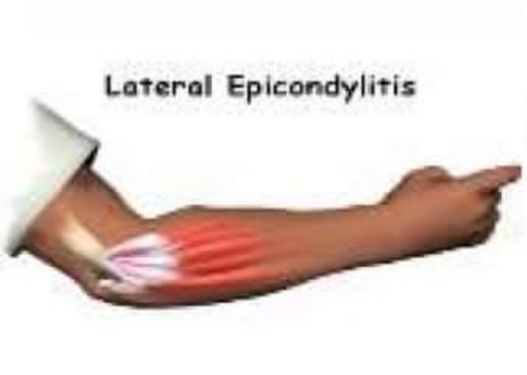
Game keeper's thumb

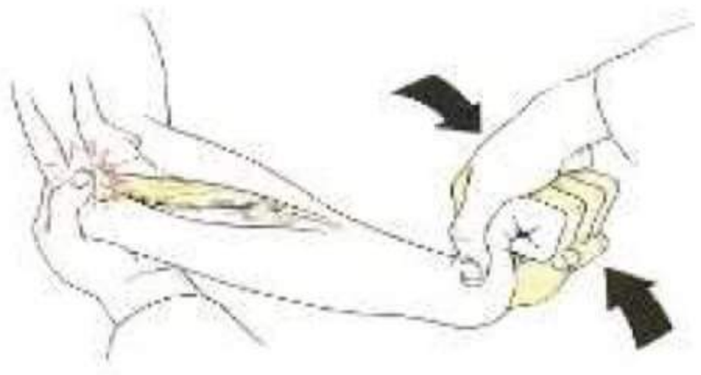
→ Aka skiers' thumb
→ M/C injury of Metacarpophalangeal joint
→ Ulnar collateral ligament tear due to forced radial deviation.
→ Injury most commonly involves the phalangeal insertion of Ulnar collateral ligament.
→ **Tx:**
  → Cast
  → Surgery is done when fibers of adductors policies interfere with healing of ligaments known as **Steners lesion**



Tennis elbow

→ AKA lateral epicondylitis
→ Inflammation of common extensor origin – ECRB > ECRL
→ Tx: Cozen Test-Wrist dorsiflexion resisted by causing pain





Note:

→ Tennis elbow – lateral epicondylitis
→ Golfers elbow – Medial epicondylitis
→ Students elbow – Olecranon bursitis
→ House maids' knee – prepatellar bursitis

PrepLadder

Dequervain's tenosynovitis

→ Inflammation of abductor pollicis longus / extensor pollicis brevis.
(both muscles enter 1st extensor compartment of wrist)

→ **Finkelstein test** is done for diagnosis

→ Treatment for all the above conditions- Plan **A**:
Rest+NSAID's→steroids→Surgery

Haglund's deformity

→ Prominent calcaneal tuberosity + an overlying bursitis

→ Treatement- Plan A:
Rest+NSAID's→Steroids→Surgery

Dupuytren's contracture

→ Contracture of Palmar aponeurosis – flexion deformity

→ Joint involved: MCP > PIP > DIP;

→ Ring finger > little finger

Treatment

→ Wait & watch

→ If > 30° deformity at MCP or > 15° at PIP – then subtotal fasciectomy is done.

→ Collagenase has also been used which was taken from Clostridial.

→ **NOTE**: These patients usually always has history of DM / alcoholism

Mallet finger

→ Avulsion of extensor tendon from distal phalanx

→ AKA baseball finger

→ Treatment- Mallet splint → 6-8 weeks

Jersey finger

→ Avulsion of FDP from distal phalanx

→ Treatment- Operative since it is in Zone I

PrepLadder

Bowler's thumb

→ Perineural fibrosis during bowling of ulnar digital nerve of thumb.

→ Treatment- Plan A

Hallux Valgus

→ lateral deviation of great toe.

→ Bilateral involvement is also noted

→ Treatment

- Keller's Surgery
- Arthrodesis
- Arthroplasty

Rotator cuff syndrome

→ Includes:

- Subacute tendonitis (Painful arc syndrome – Pain on abducton between 60° -120°)
- Chronic tendonitis (Impingement syndrome – Neers test is used)
- Rotator cuff tears

→ Treatment

- Physiotherapy + NSAIDS.
- Local injection of steroids.
- Surgery if required for impingement syndrome or rotator cuff tears (especially in young individuals).

Frozen shoulder

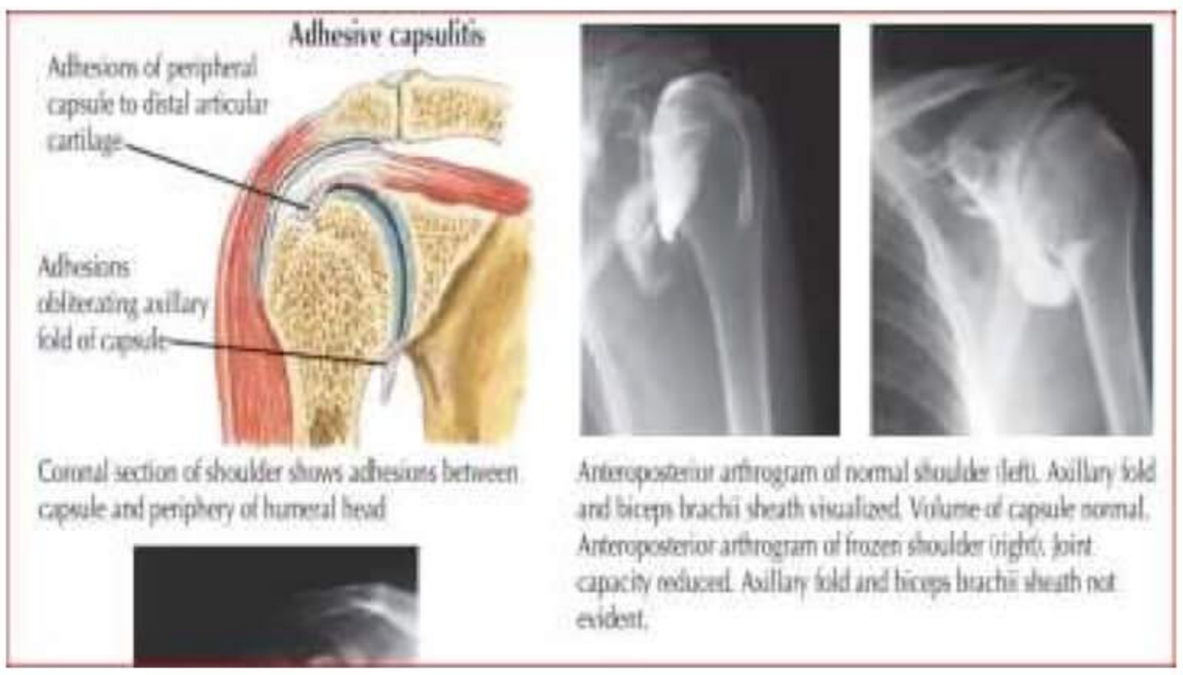
→ AKA adhesive capsulitis.

→ It is a feature of DM patients & they usually have night pain.

→ It is characterized by adherence of capsule to each other causing limitation of internal rotation and abduction.

→ Gradually all movements lost.

→ Tx: Plan A



NERVE INJURIES-1

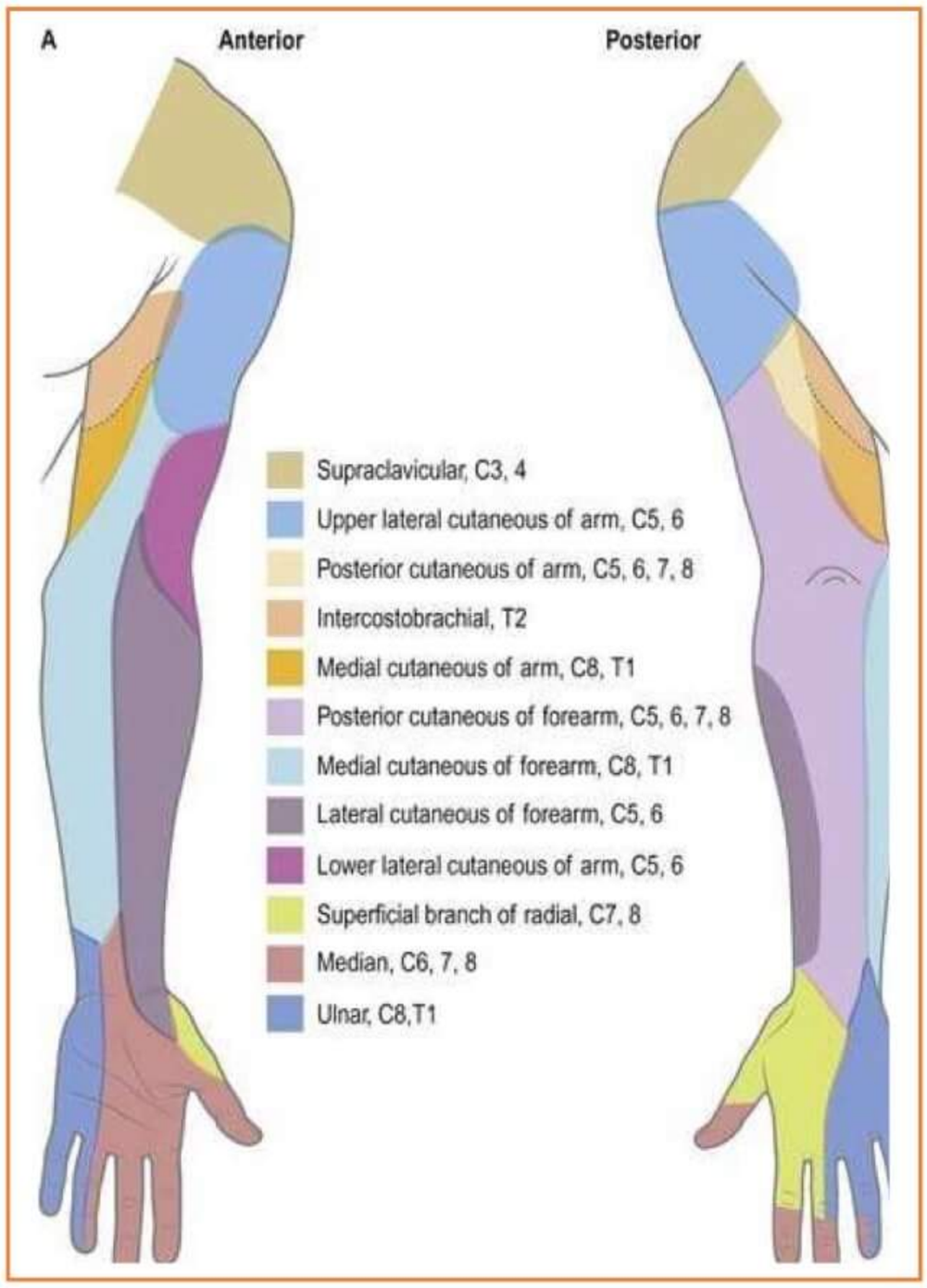
→ Most common nerve to be injured → **Radial Nerve**

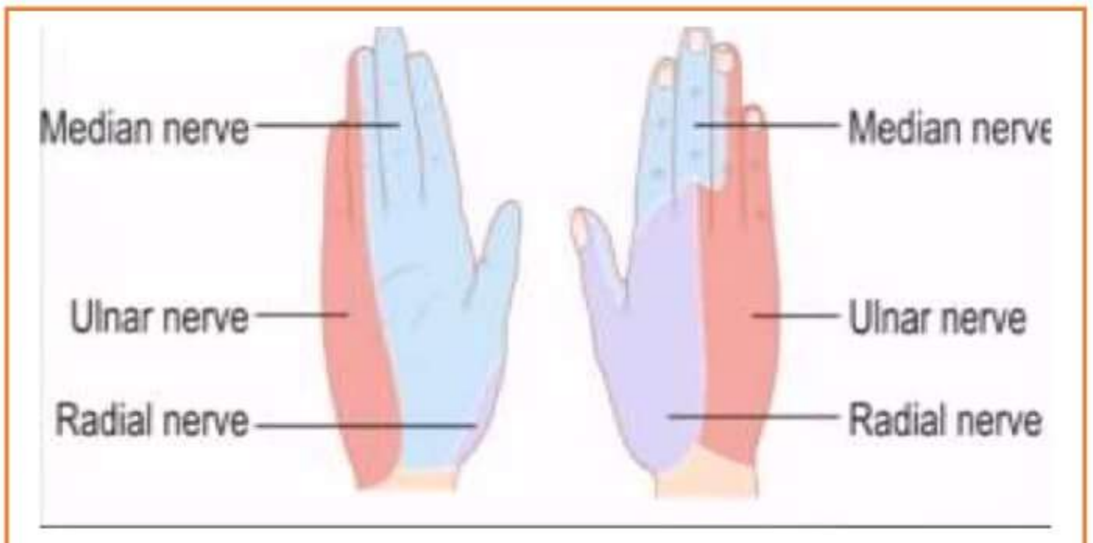
↓

Has best prognosis

No particular test

Sensory distribution of Upper limb





Nerve supply of Hand

Nerve roots for Hand → C6, C7, C8

→ **Neuropraxia**

- Physiological block in nerve conduction
- 100 % recovery (recovery at a moment)
- Tinel's sign negative

→ **Axonotmesis**

- Damage to axon sheath
- Recovery – **motor march** (Proximal to distal recovery subsequent)
- Tinel's sign positive & progressive

→ **Neurotmesis**

- Complete nerve transaction;
- No recovery without surgery
- Tinel's sign positive & Static

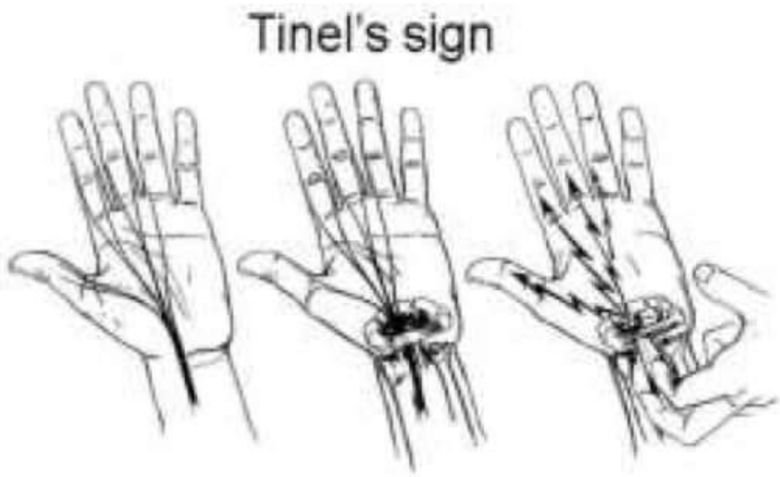
PrepLadder

Sunderland's classification of nerve injury

→ Seddon's Neuropraxia - Sunderland's Type 1
→ Seddon's axonotmesis - Sunderland's type 2, 3 ,4
→ Seddon's neurotmesis- Sunderland's type 5

Sunderland's Type 4 behaves as type 5 or neurotmesis

Tinel's sign



→ About regeneration of nerve
→ Follows **Law of projection**
→ Tingling sensation
→ **Law of projection** says that we can stimulate only damaged nerve (but not physiologically damaged ne
→ Hence Tinel's sign is negative in Neuropraxia.
→ Law of projection says when we stimulate anatomically damaged (demyelinated) nerve along its course by closing the eyes of the patient

↓

While we tap at the point of damaged nerve, the free nerve ending will be stimulated

↓

Brain will perceive that it came from the receptor although it is from nerve

↓

Tingling sensation

↓

Tinel's sign

Rest after 3 weeks

Normal stimulus → Receptor

Abnormal stimulus → Nerve

No Recovery

↓

Tingling sensation at some point

↓

Tinel Sign positive and static

Neurotmesis

Recovery

↓

Myelin covered at the free nerve Endings point is altered & speed of Regeneration is calculated.

↓

Tinel sign positive & progressive

Axonotmesis

PrepLadder

→ If asked only positive Tinel's sign, Axonotmesis > Neurotmesis

→ Tinel's sign cannot tell the site of lesion

↓

it helps in knowing the speed of regeneration & regeneration of a nerve(Normally 1 mm/day)

Axillary Nerve

→ Supplies Teres minor & deltoid

→ Sensation: upper arm

→ **Regimental Badge area- Loss of sensation at this site Known as Regimental badge Sign**

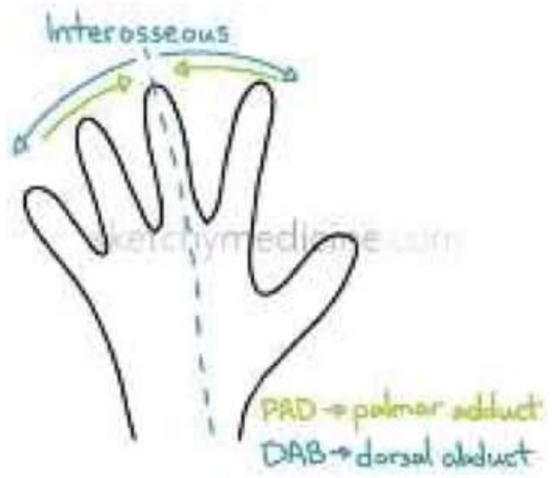
→ Damaged due to:

1. Shoulder dislocation-Anterior or Inferior
2. Fracture of upper end of Humerus
3. Injection into deltoid muscle

Ulnar Nerve

→ Palmar interosseous Nerve → Adduction

→ Dorsal interosseous Nerve→ Abduction

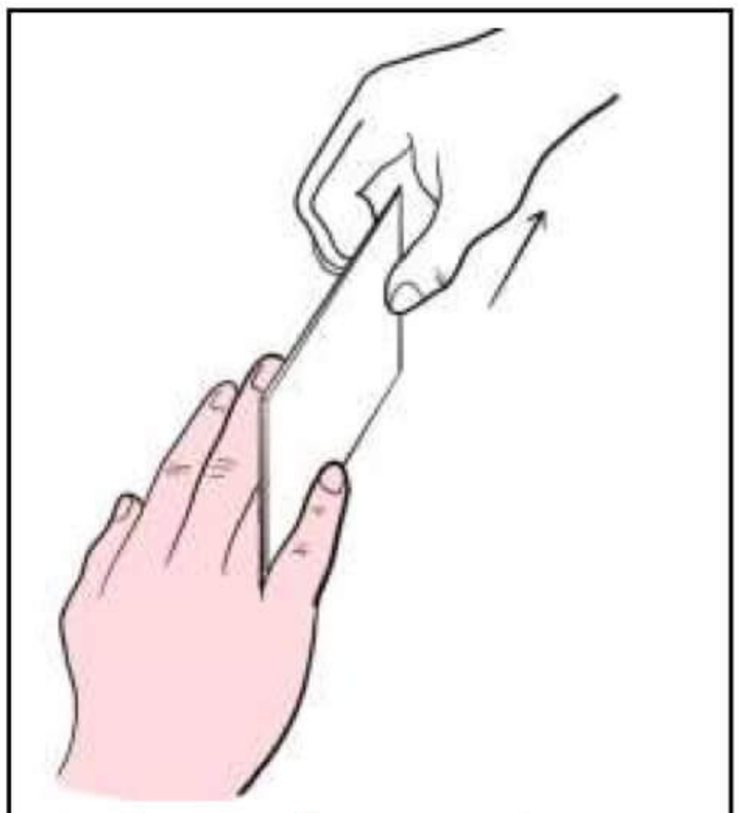


→ **Igawa Test**

- Middle finger has only **dorsal interossei** can move middle finger to either side ("Abduction")

→ **Card Test**: Holding a card between fingers (adduction) & trying to pull the card out. Test for Palmar interossei-Ulnar nerve

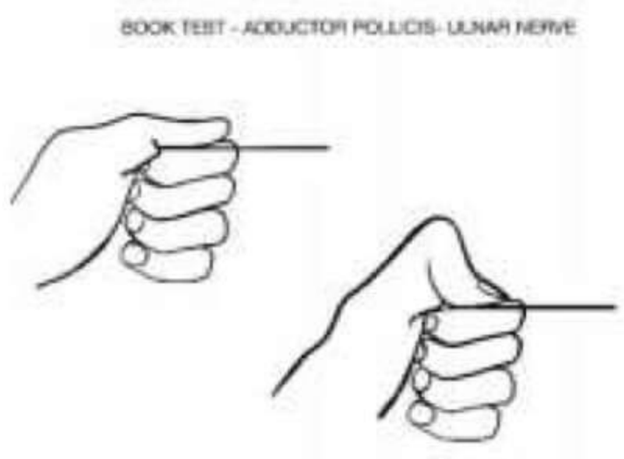
PrepLadder



Card Test – for PAD; Ulnar nerve injury

→ **Book Test**

- Ask patient to hold book between his thumb & finger
- All thenar muscles are supplied by median nerve except adductor pollicis which is supplied by Ulnar nerve

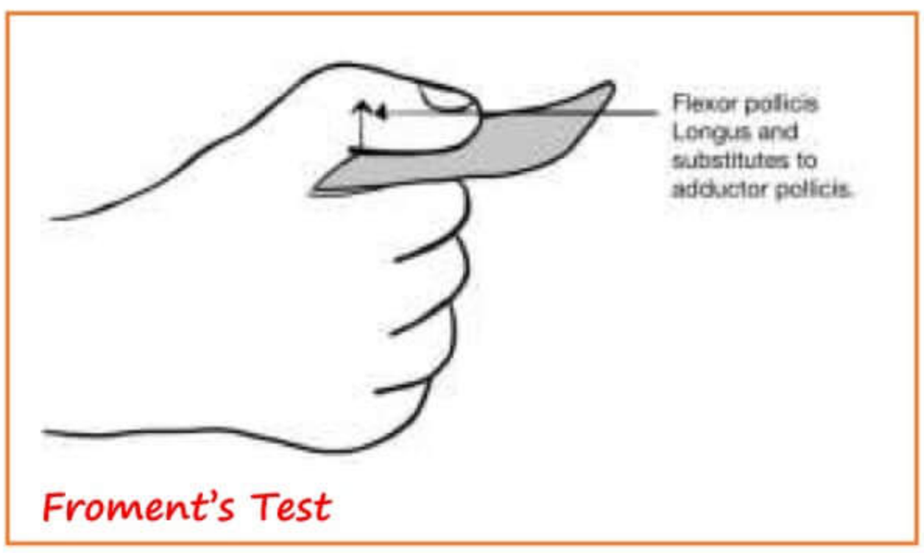


→ **Froment's sign:**

- If they hold book by flexing the thumb in an injury to ulnar nerve or paralyzed adductor pollicis

↓

- Flexion is due to flexor pollicis longus which is supplied by AIN, branch of median nerve



Froment's Test

PrepLadder

→ **WARTENBERG SIGN**

- Abducted 5th – Ulnar N. Palsy

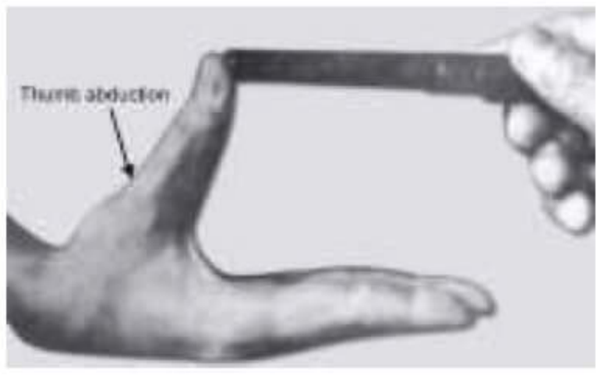
Wattenberg sign

Tests for Median nerve

→ **Pointing Index**

→ **Benediction Test or Pope's attitude**

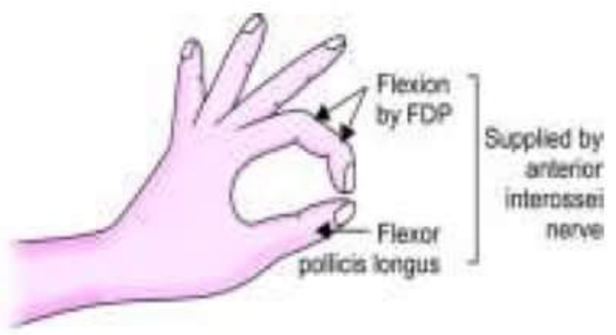
→ **Pen test**- Abductor pollicis brevis



PrepLadder

→ Ape thumb deformity

→ **Kiloh Nevin Sign** - Checks for AIN, branch of median nerve



Muscles supplied by AIN

1. Flexor Digitorum profundus (Lateral half)
2. Flexor pollicis longus
3. Pronator quadratus

AIN is commonly damaged in Supracondylar fracture of Humerus

Claw Hand

→ Medial 2 lumbricals - ulnar nerve

→ Lateral 2 lumbricals - median nerve

→ **Action of lumbricals:**

- Extension of interphalangeal joint
- Flexion of metacarpophalangeal joint

→ **Paralyzed lumbricals: Claw Hand**

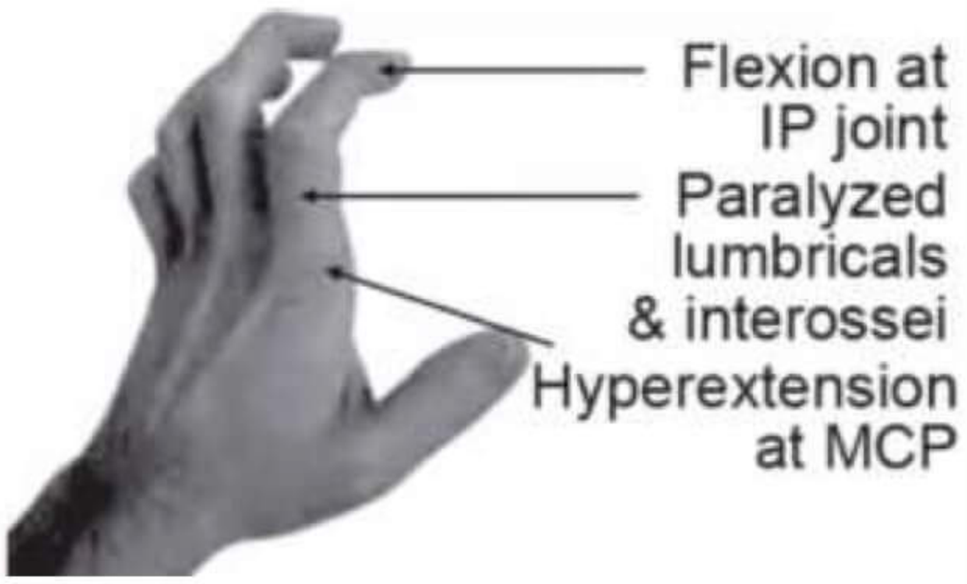
- Hyperextension of MCP
- Flexion of IP joint

→ Paralysis of ulnar nerve: Ulnar claw hand

→ Injury of ulnar nerve around elbow - "**High ulnar nerve palsy** "

↓

FDP & lumbricals are paralyzed → **Clawing is less**



PrepLadder

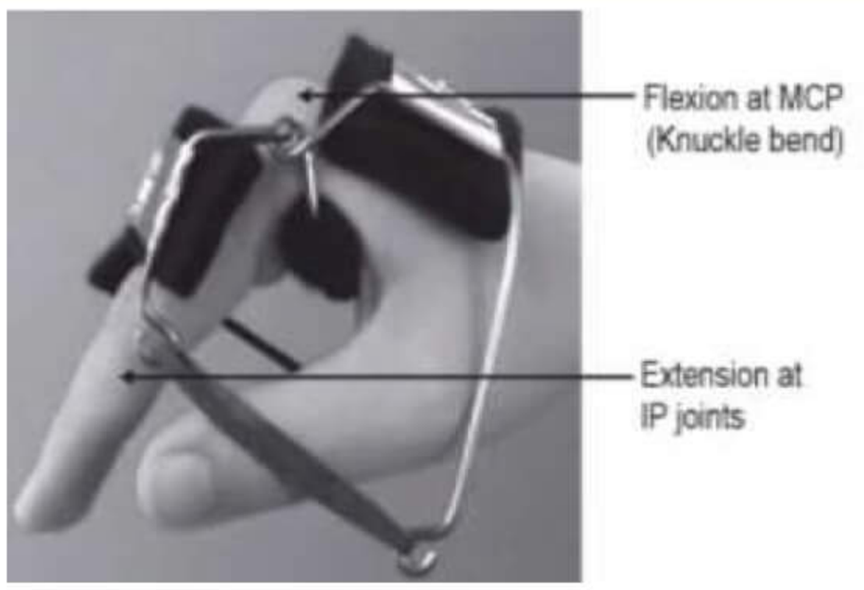
→ Injury of Ulnar nerve around the wrist

↓

Only lumbricals are paralyzed → More clawing

→ **Knuckle bender splint:** Used for Ulnar nerve > Median nerve

→ **Ulnar paradox-** High ulnar nerve injury (Around elbow) – less clawing



Knuckle bender splint

NERVE INJURIES 2

Radial Nerve

→ Principally motor nerve with little sensory (M > S)

→ Arises from brachial plexus, travels along the spiral groove.

→ At lower 1/3rd level, it pierces the lateral inter-muscular septum.

→ It divides into two parts:

- Superficial radial nerve → sensory
  Supplies Dorsum of 1st webspace
- Posterior interosseous nerve → goes close to radial head
  Supplies finger extensors

→ Direct branches to:

- Extensor carpi radialis brevis
- Extensor carpi radialis longus

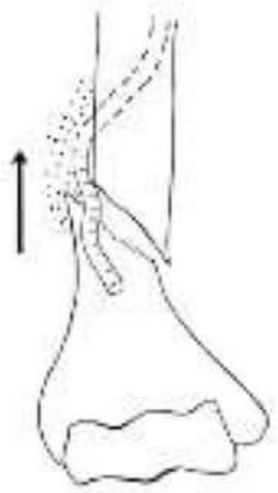
Fracture of shaft of Humerus

Shaft of Humerus divided into 3 parts

→ Upper 1/3rd

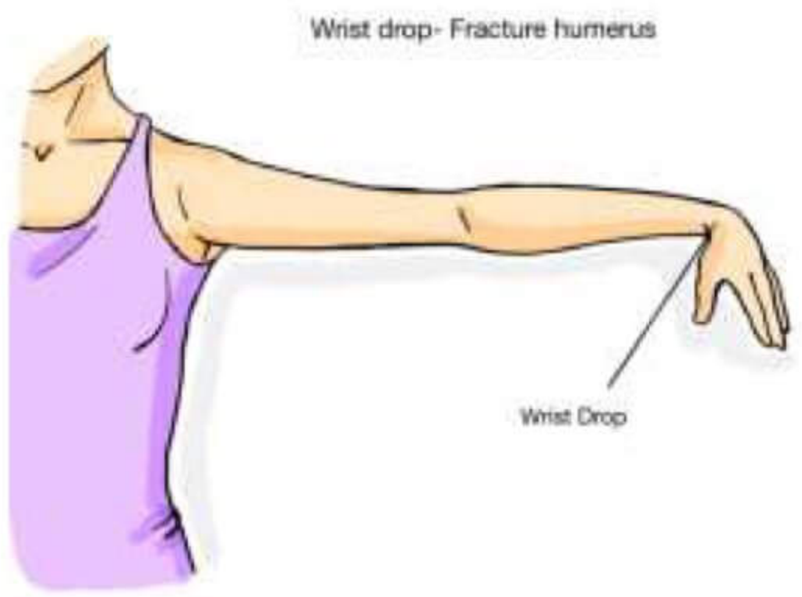
→ Middle 1/3rd

→ Lower 1/3rd - Radial nerve injured (50 %)



"**Holstein Lewis sign**"- Radial nerve injury in lower 1/3rd fracture of shaft of Humerus

→ Paralysis of ECRL & ECRB (radial N_1) will cause **Wrist drop**



→ Posterior interosseous nerve injury – Loss of finger extension called as **finger drop**

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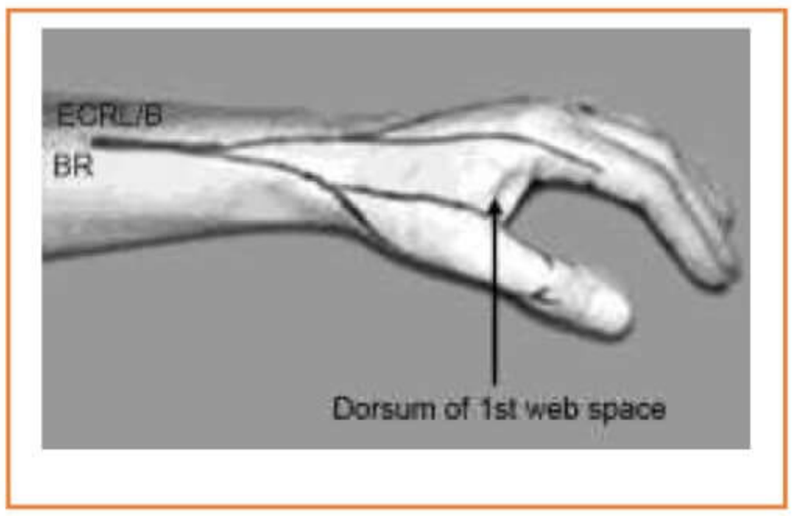
→ Sensory distribution of radial nerve is Dorsum of 1st web space.

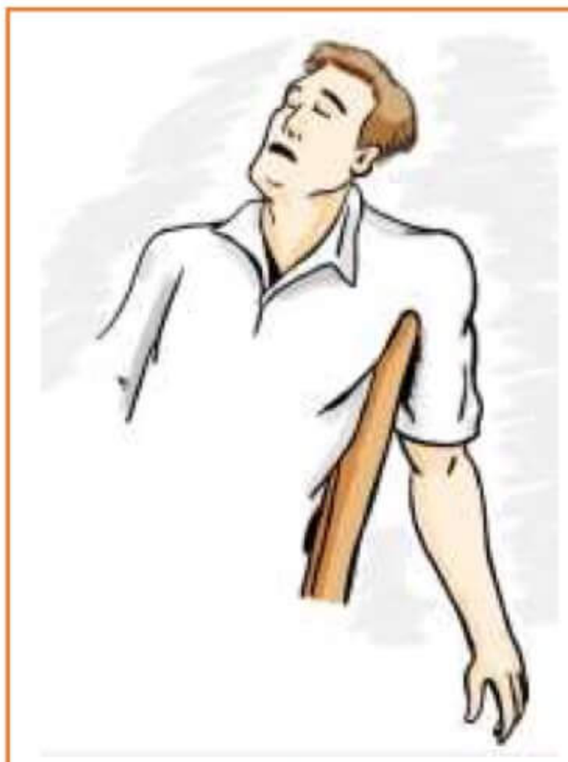


Saturday night / crutch palsy

→ Due to radial nerve palsy

→ Occurs due to compression of radial nerve

→ In radial groove while putting hand on chair or the crutch



Saturday night / crutch palsy

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RADIAL NERVE INJURY			
HIGH	**Low**	**PIN**	**SRN**
Wrist Drop Sensory loss + Finger drop + Sensory loss + Brachioradialis	Wrist drop + Finger drop + Sensory Loss	Finger drop Pure motor Nerve No sensory loss	Sensory loss ECRB

Posterior Interosseous nerve

→ Pierces **Arcade of Frohse** (area in supinator)

→ Causes **finger drop**

→ No sensory loss

→ Injury occurs at Head of radius

Clinical scenario

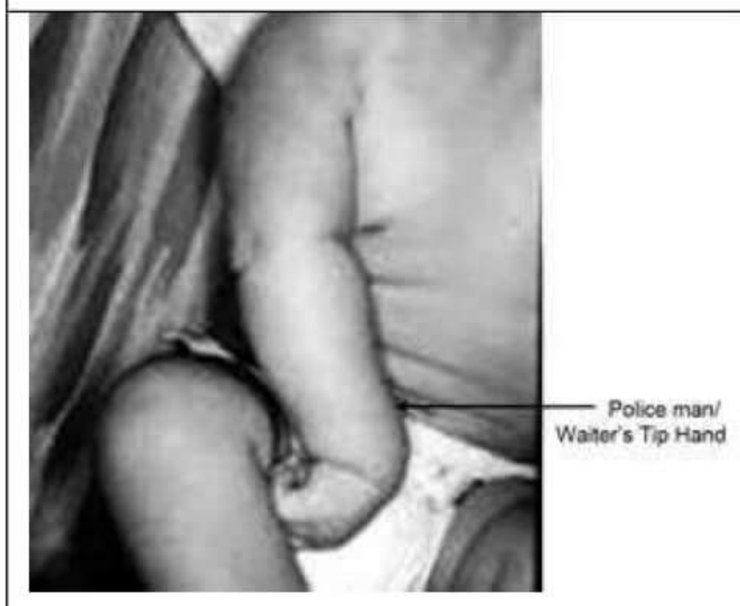
30 years old male – RTA – complains of injury of upper limb, no sensory loss + wrist drop Site of nerve injury?

→ May be around radial groove > spiral groove

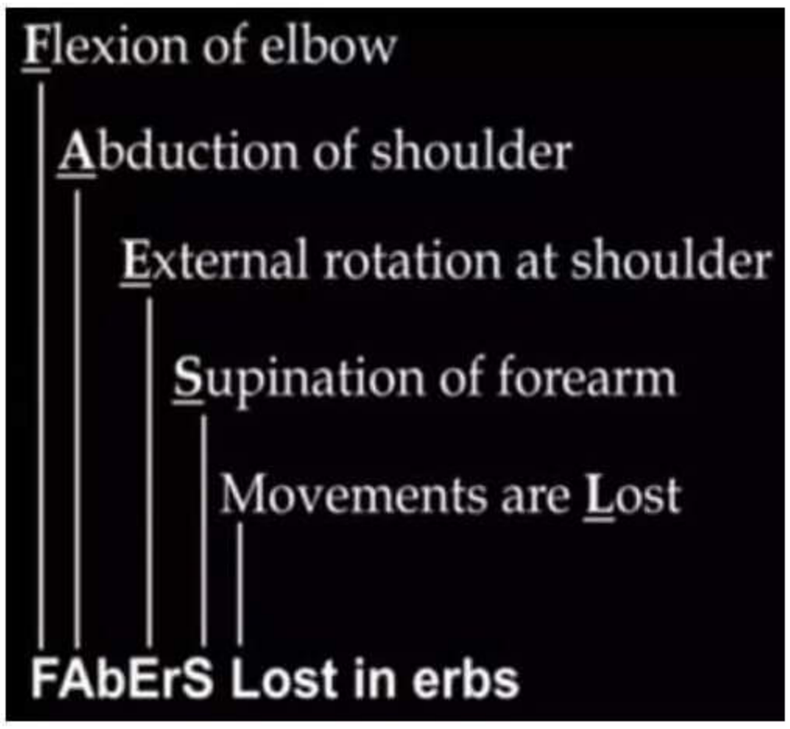
→ Sometimes, during nerve injury, only one components of the nerve is affected sparing the other component.

→ **Cock-up splint** - used for radial nerve palsy

Cock-up splint

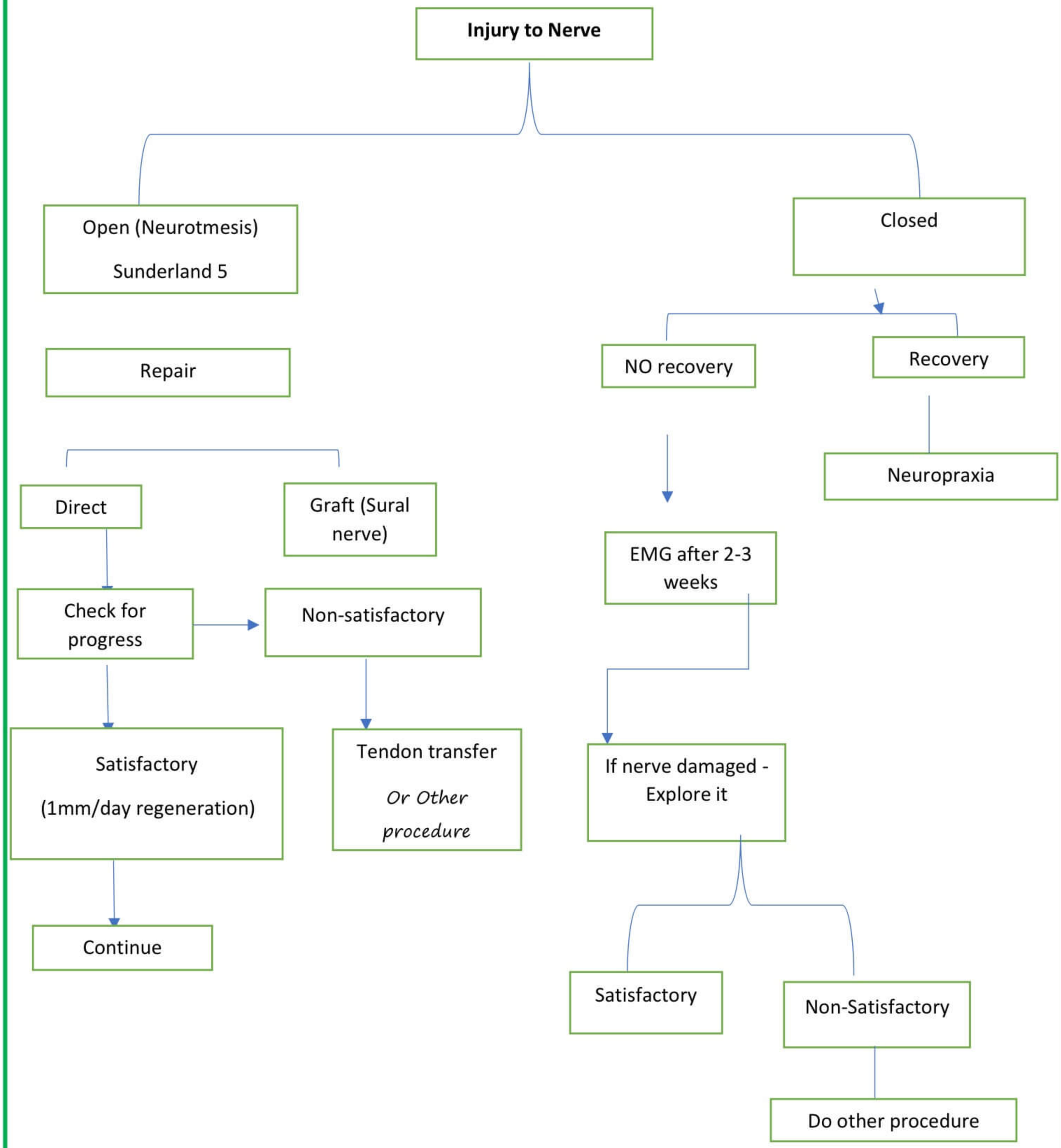
Erb's palsy	Klumpke's palsy (claw hand)
→ Upper trunk of brachial plexus → C_5 / C_6 → More common → Waiter tip deformity → Better prognosis	→ Lower trunk of brachial plexus → C_8 / T_1 → Claw Hand + Horner's syndrome → Poor prognosis
	

→ Movement lost in Erb's palsy



Flexion of elbow & abduction of shoulder → most important for upper limb movements

Approach to nerve injury



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Closed nerve injury

→ Apply Splint
- Radial nerve- Cockup splint
- Ulnar nerve/ Median nerve- Knuckle bender splint

→ Best test for nerve injury 2-3 weeks after injury → Electromyography

Management

→ Open injuries → Operate

→ Closed injuries → Splint

→ Closed → most advise initially → Expectant management or recovery

→ Most common nerve to be used for graft → **Sural nerve**

→ Most common tendon to be used for graft

1. Palmaris longus (bridges gap between hand and fingertip)
2. Plantaris (Bridges gap between forearm & fingertip)

Good prognosis factor for nerve injury

Important good prognostic factors

→ Neuropraxia

→ Radial nerve

→ End to end repair

PrepLadder

Radial nerve injury

↓

Sutured

↓

Non-satisfactory recovery (< 1 mm / day regeneration)

Or

Stop in recovery

↓

Utilize the tendons of median & ulnar nerve for recovery of Movements of radial nerve

↓

Modified jones transfer

1. Pronator teres to wrist extensor
2. Flexor carpi ulnaris to finger extensor
3. Flexor carpi radialis to thumb

Compression Neuropathy

→AKA **Nerve entrapment syndrome**

→It refers to nerve being compressed in some anatomical area.

→ Most commonly compromised nerve - Median Nerve

→Most common entrapment syndrome - Carpal Tunnel syndrome

Entrapment Syndrome	Nerve Involved
Carpal tunnel syndrome	Median Nerve (at wrist Common) – Phalen's / Reverse Phalen's Test
Pronator syndrome	Median nerve (proximally compressed beneath ligament of Struthers, bicipital aponeurosis or origin of pronator teres or FDS)
Cubital tunnel Syndrome	Ulnar nerve (between two heads of flexor carpi ulnaris)
Guyon's Canal syndrome	Ulnar nerve (at wrist)
Thoracic outlet syndrome	Lower trunk of brachial plexus (C8 and T1) and subclavian vessels (between clavicle and first rib)
Piriformis syndrome	Sciatic nerve
Meralgia paraesthetica	Lateral cutaneous nerve of thigh

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Tarsal tunnel syndrome	Posterior tibial nerve (behind and below medial malleolus)
Morton's metatarsalgia	Interdigital nerve compression (Usually of 3rd, 4th toe)
Cheralgia Paraesthetica	Superficial radial nerve

Femoral nerve very rarely involved in Nerve entrapment syndrome

Carpal tunnel syndrome (Median nerve)

Causes: more common in females

- → Idiopathic (most common)
- → Pregnancy
- → Hypothyroidism
- → Hyperparathyroidism
- → RA
- → Colle's (fracture of distal radius)
- → Females

Tests

→ Phalen's test 	→ Straight hand test/Reverse Phalen's test

Thoracic outlet syndrome

- → Clinical diagnosis
- → Presents with C_8 & T_1 Symptoms

  T_1 → more common
- → Tests:
  - Adson's test
  - Wright's test
  - Roos test

Management of compression neuropathy

PLAN A

- Rest + NSAIDS

  ↓ if not treated
- Local steroids

PrepLadder

↓ if not treated

- Surgery

→ If a Person is lying on lateral position - There is a **Risk of compression of common peroneal nerve** at neck of fibula

Popliteal entrapment syndrome

→ Compression of **popliteal artery** at medial head of gastrocnemius
→ Exercise induced claudication
→ Decreased pulses on ankle flexion

→ Popliteal artery - Most common artery to be damaged in trauma (anterior knee Dislocation)
→ Brachial artery - Most common artery to be damaged in upper limb (supracondylar fracture of Humerus)

PrepLadder

JOINT DISORDERS

Rheumatoid arthritis

– Young Female
– Bilateral hand Pain
– Morning stiffness
– AGE is NOT a criterion
– Most common area involved is upper cervical Spine (AKA craniovertebral junction)

Craniovertebral junction involvement: RA > AS > Gout

C1-C2 anomaly – spine flexion/extension view

Ankylosing Spondylitis

→ Young Male

→ Lower back ache: Sacroiliac joint involvement

→ Reduced chest inspection

→ Hands are spared

→ Less common

→ Controlled by swimming & cycling

Rheumatoid arthritis- DIP spared; wrist involved

Osteoarthritis -MCP spared; thumb involved

Bone tumors

→ More common in males

Except: Both are more common in females

→ GCT – Giant Cell Tumor

→ Fibrous dysplasia

	Osteoarthritis	Rheumatoid Arthritis	Psoriatic Arthritis (Caspar Criterion)
Involved	PIP, DIP and 1st CMC (carpometacarpal) joints	PIP, MCP, Wrist	DIP, PIP and any joint
Spared	MCP (Metacarpo-phalangeal), Wrist and Ankle	DIP joint usually	

Diseases and joints involved:

→ Gout – MTP or great toe joint

→ Pseudogout – Knee

→ RA – Metacarpophalangeal joint

→ AS – Sacroiliac joint

PrepLadder

→ Septic arthritis – Knee

→ HIV - Knee

Osteoarthritis

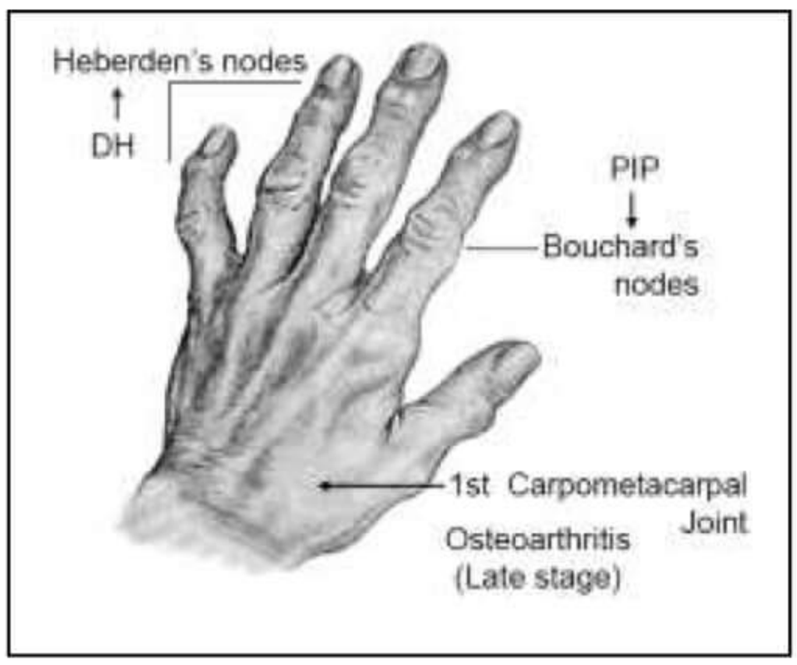
→ MCP Spared

→ Base of thumb (1st metacarpal joint) – characteristic feature

→ DIP > Knee

→ DIP involved in Osteoarthritis- **HEBERDEN'S NODES**

→ PIP involvement- **BOUCHARDS NODES**



Cardinal signs of Osteoarthritis

→ Narrowing of joint space

→ subchondral sclerosis (age related)

→ Marginal osteophytes

→ Subchondral cysts

GENU VARUM ['O' between legs]

→ Medical compartment is involved

→ Muscle involved →Quadriceps, specifically vastus medialis

→ Specific fiber → Vastus medialis obliques


Genu varum

Treatment

→ Initially - Conservative

1) Physiotherapy
2) Glucosamine

→ If daily activities are affected- Surgery

Young Pts surgery→ High tibial osteotomy (upto 20° deformity)

Less than 60 years → correct deformity

60 or more than 60 years → Total knee replacement

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→ High Tibial Osteotomy: removal of wedge of a bone where the lateral border is bigger than the medial border which is called as lateral based wedge osteotomy.

→ Total Knee replacement: replaces the joint surface and It gives good movements, proprioception good and mild insignificant sensory loss.

Patellar Clunk Syndrome

→ After Total Knee replacement – patella makes noise when the knee is flexed

→ Fibrotic nodule at the upper end of patella

→ Patella is important to climb stairs

1. Rheumatoid Arthritis	2. Osteoarthritis
→ Synovitis → Osteopenia → Genu Valgus	→ arthritis → Sclerosis (below the joint) → Genu Varus

Classification Criteria for Rheumatoid Arthritis – 2010		Score
Joint involvement	1 large (shoulder, elbow, hip, knee, ankle)	0
	2-10 large joints	1
	1-3 small joints (MCP, PIP, Thumb IP, MTP wrists)	2
	4-10 small joints	3
	>10 joints (al least 1 small joint)	5
Serology	Negative RF and negative ACPA	0
	Low-positive RF or low-positive anti-CCP antibodies (>3 times ULN)	2
	High-positives RF or high positive anti-CCP antibodies (>3 times ULN)	3
Acute phase reactants	Normal CRP and normal ESR	0
	Abnormal CRP or abnormal ESR	1
Duration of symptoms	< 6 weeks	0
	> 6 weeks	1
Total score 10 Score ≥ indicates	R.A	

→ Anti CCP – Present In 98% of RA: Most specific antibody

→ RF present in 80% cases of RA

The 1987 Revised Criteria for Diagnosis of RA

1. Guidelines for classification 4 of 7 criterion are required to classify a patient as having RA Patients with 2 or more criteria are not excluded.

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2. Criteria (a-d must be present for at least 6 weeks and b-e must observed by physician.)
   a) Morning stiffness, in and around joint lasting 1 hour before maximal improvement.
   b) Arthritis of 3 or more joint areas, observed by a physician simultaneously, have soft tissue swelling or joint effusion, not just bony over growth. The 14 possible joint areas involved are right or left proximal interphalangeal joints (MTP).
   c) Arthritis of hand joints eg., Wrist, MP or PIP joints
   d) Symmetrical arthritis i.e. simultaneous involvement of same joint area on both side of body.
   e) Rheumatoid nodules: Subcutaneous nodules over bony prominences, extensor surfaces or juxta articular region. (PATHOGNOMIC)
   f) Serum rheumatoid factor
   g) Radiological changes: bony erosion or unequivocal bony decalcification, periarticular osteoporosis and narrowing of articular (joint) space.

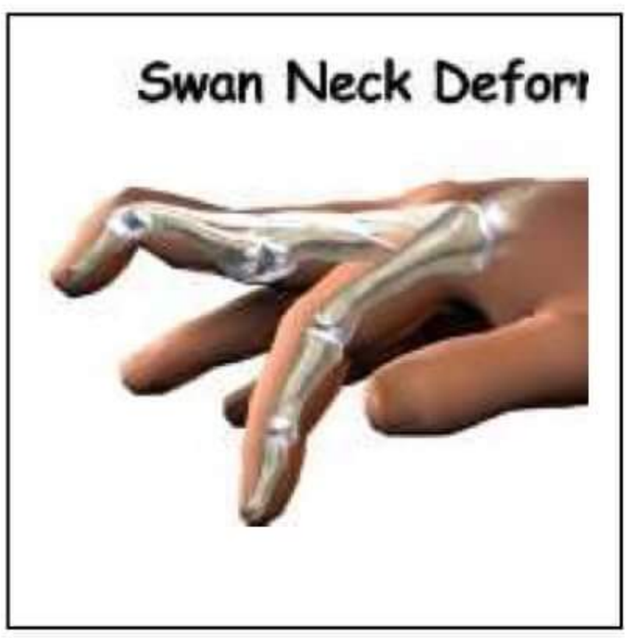
Deformities of RA

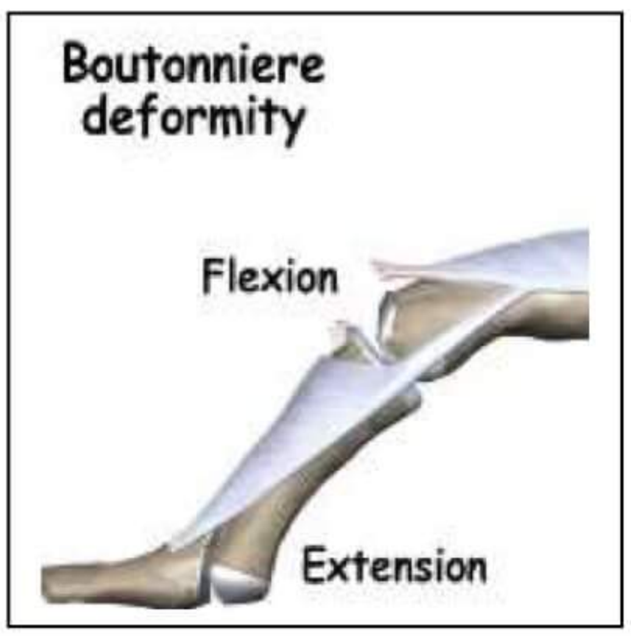
→ **Swan Neck Deformity**
- Flexion at DIP and hypertension at PIP
- Flexor insufficiency of PIP

→ **Boutonniere deformity** / Button hole deformity
- Extensor deficiency at PIP joint
- Hypertension of DIP & Flexion of PIP

→ **Z deformity of thumb**

→ **Ulnar deviation of fingers**

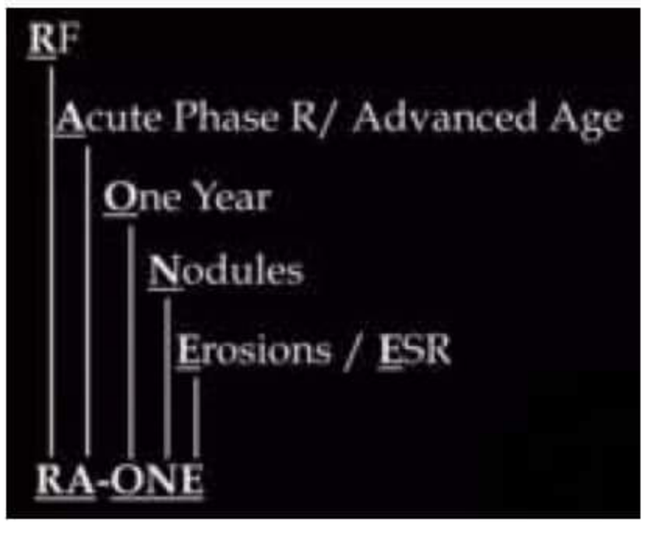




Z deformity of thumb

Ulnar deviation of fingers

Poor prognostic factors of RA



Pencil in cup seen in Psoriatic arthritis	Acro-osteolysis (terminal phalanges) seen in scleroderma	Arthritis mutilans – seen in RA and psoriasis
		

Ankylosing Spondylitis

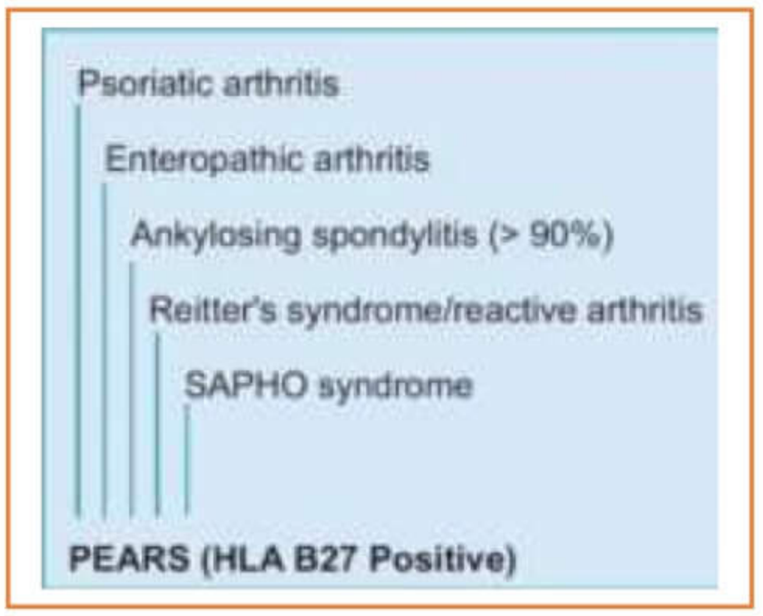
HLA B27 positive in more than 90% cases of AS

Diagnostic criteria:

→ Essential criteria- Definite radiographic sacroiliitis

→ Supporting criteria

- Inflammatory back pain
- Limited chest expansion
- Limited lumbar spine motion in both sagittal and frontal plane (Schober test/Modified Schober test)



Sacroiliitis

Characteristic features

1) Enthesitis- Inflammation of insertion of tendons and ligaments
2) Axial skeleton disease

-30% only Appendicular (peripheral joints)

→ Disease of root joints

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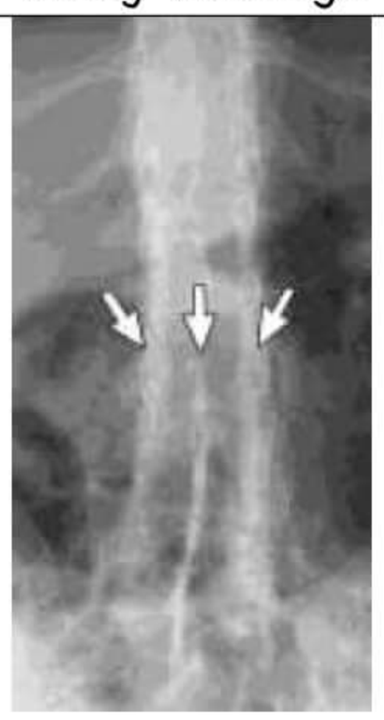
3) 30% causes ANTERIOR UVEITIS
   → MC extra-articular manifestation
4) Cardiac conduction defects

Radiographic findings

→ Bamboo spine (Bony ankylosis)
→ Squaring of vertebrae
→ Inter-spinous ligament calcification: **DAGGER SIGN**
→ Facet calcification of joints + inter spinous ligament: **TROLLEY TRACK SIGN**
→ Sclerosed vertebral edges: **ROMANUS SIGN**

Bamboo spine	Dagger Sign	Trolley Track sign	Romanus Sign
			

Test for AS

SI joint:

→ Gaenslen test
→ Patrick/FABER test
→ Figure of 4
→ Pump handle test
→ Side to side compression test
→ Cervical spine: Fleche test

	Ankylosing hyperostosis	Ankylosing spondylitis
Age	Elderly	Young
Sacroiliitis	Absent	Always present
Chest expansion	Mild restriction	Marked but not reliable in elderly
Tenderness	Dorsolumbar	Sacroiliac
ESR	Normal to mild rise	High
Syndesmophytes	Present	Present

PrepLadder

Eye involvement in joint disorders

KESRA

→ Kerato-conjunctivitis sicca (KCS)> Episcleritis>scleritis – **RA**

→ Anterior uveitis – AS

Disc space calcification seen in **Alkaptonuria** (Hx of urine tuns black on standing-Ochronosis)

Gout

→ Inflammed great toe

→ Middle aged business man(usual history)

→ Great Toe- **Martels sign** (overhanging bone)

→ Punched out Erosions with history of great toe pain

Characteristic	GOUT	PSEUDOGOUT
Joint	Great Toe	Knee
Crystal Deposited	Uric-Acid-negatively birefringent-Needle shaped	Calcium pyrophosphate-positively birefringent Rhomboid shaped
Association	Protein + Alcohol intake	Hypothyroidism
X-ray	Bone and soft tissue erosions	Chondrocalcinosis (calcification of the cartilage)

CHARCOTS JOINTS

→ Totally destroyed joints

→ Neuropathic joints

→ Loss of proprioceptor fibers

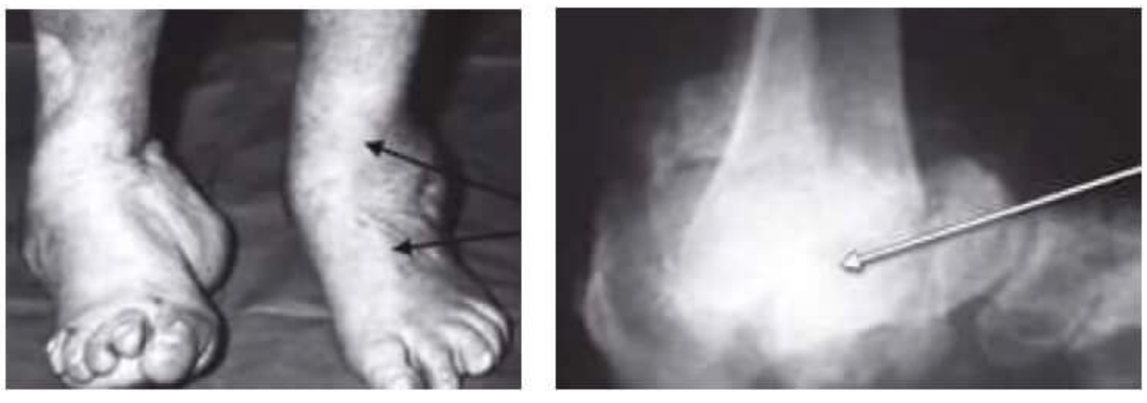
→ Anatomy deranged

- PAINLESS

(Other painless ds: mycetoma)

→ Indication for Arthrodesis

→ MC cause: Diabetes



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Disease	Joint Involvement
Diabetes	Midtarsal (Most common) > tarsometatarsal, metatarsophalangeal and ankle joint > knee and spine
Tabes dorsalis	Knee (most common), hip, ankle and lumbar spine
Leprosy	Hand and foot joints
Syringomyelia	Shoulder (Glenohumeral), elbow, wrist and cervical spine

HEMOPHILIA

→ Inflammatory condition
→ MC affects knee joints
→ In Children: ANKLE

X-ray findings: PENIA

→ Periarticular osteopenia
→ Squaring of patella
→ Epiphyseal enlargement
→ Widened notch
→ Decreased joint space(arthritis)
→ Subarticular cyst
→ Arnold Hilgartner classification

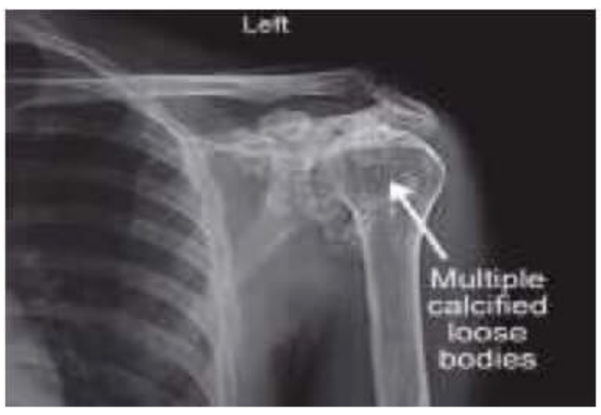
Widened inter-condylar notch:

Found in hemophilia, TB and JRA

Synovial chordotomies

→ MCC of multiple loose bodies in a joint
→ MC Joint: KNEE
→ Loose body above, but not at joint because synovium of knee travel beneath patella in suprapatellar area, synovium is continuous with knee cavity.
→ MCC of loose bodies: OSTEOARTHRITIS (Knee)

Synovial chordotomies

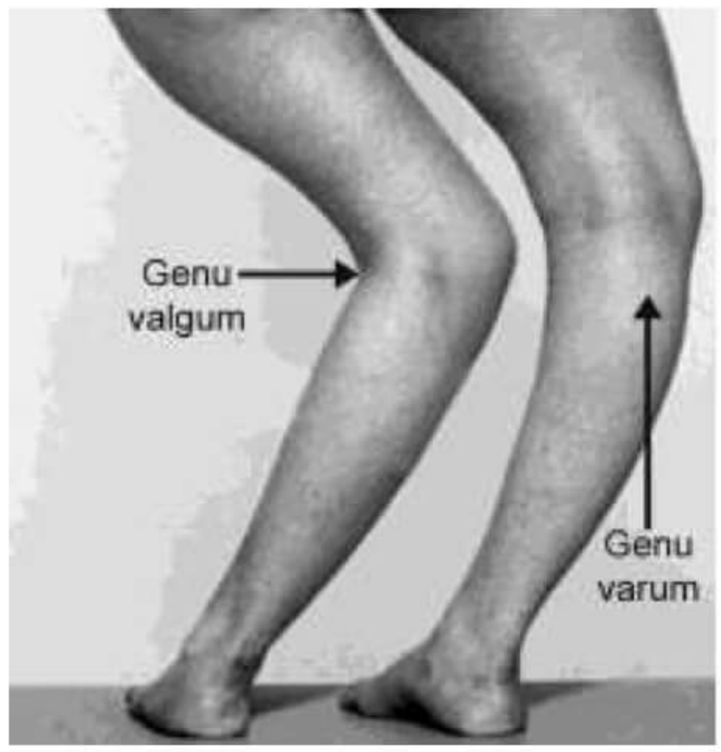


→ Osteoarthritis →VARUS

→ RA → Valgus

→ Valgus in one and Varus in other knee - **Windswept deformity / Tackle deformity**

→ **causes:** Rickets > RA



Synovial fluid finding

Viscosity: due to hyaluronic acid

→ Normal synovial fluid is clear, WBC count less than or equal to 200/uL

→ Inflammatory fluid WBC count 2,000 to 50,000/uL and a polymorphonuclear leukocytic predominance.

→ Inflammatory fluid has reduced viscosity & diminished hyaluronic acid.

→ Infections (pyogenic) is purulent, WBC count > 50,000/uL

→ Infections(tuberculosis/granulomatous) WBC count 10,000-20,000/ uL , PMN 60% and presence of lymphocytes, plasma cells and histiocytes

TRIGGER FINGER

→ Constriction around MCP joint called: Stenosing tenosynovitis / Trigger finger

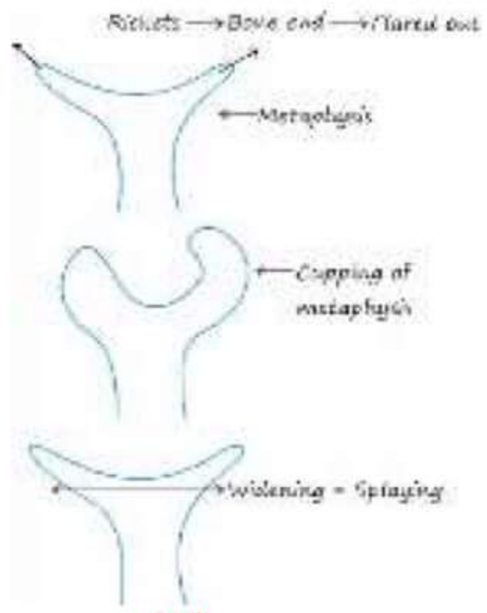
PrepLadder

METABOLLIC DISORDERS-1

- Wrist- Rickets
- Knees → Scurvy
  → Rickets

Rickets

→ Mineralization defect
→ Zone of calcification near metaphysis is defective
→ Which results in (i) Cupping(**A**)
(ii) Splaying
(iii) Flaring



(A)

→ Generalized muscle weakness
→ Widening knees / wrist
→ Rachitic Rosary(**B**) - Prominent Non- tender and Round costochondral junction
→ Harrison's groove→Sub costal sulcus d/t pull of diaphragm
→ Genu valgum / varum(**C**)
→ Coxa vara→Reduced neck shaft angle of femur.
→ Enamel defect (tooth)
→ Cupping, splaying, flaring(**D**)
→ Osteotomy correction done only once healing takes place
→ White line of frankel (**E**)-Healing rickets(**F**)


(B)


(C)


(D)


(E)


(F)

PrepLadder

Bio-chemical changes in Rickets

- → Normal/↓Ca^{+2}
- → ↓ PO_4^3 →usuallly low by(↑ PO_4^3 is seen in CRF Rickets)
- → ↑ ALP
- → ↑ PTH

Note: These changes are also seen in Osteopetrosis.
Changes are reversed in healing Rickets

Hypophosphatemic Rickets

- → X-Linked dominant
- → PHEX gene mutation
- → Normal Ca, PTH, Vit D
- → ↑ ALP
- → ↑Incidence of skeletal deformities.

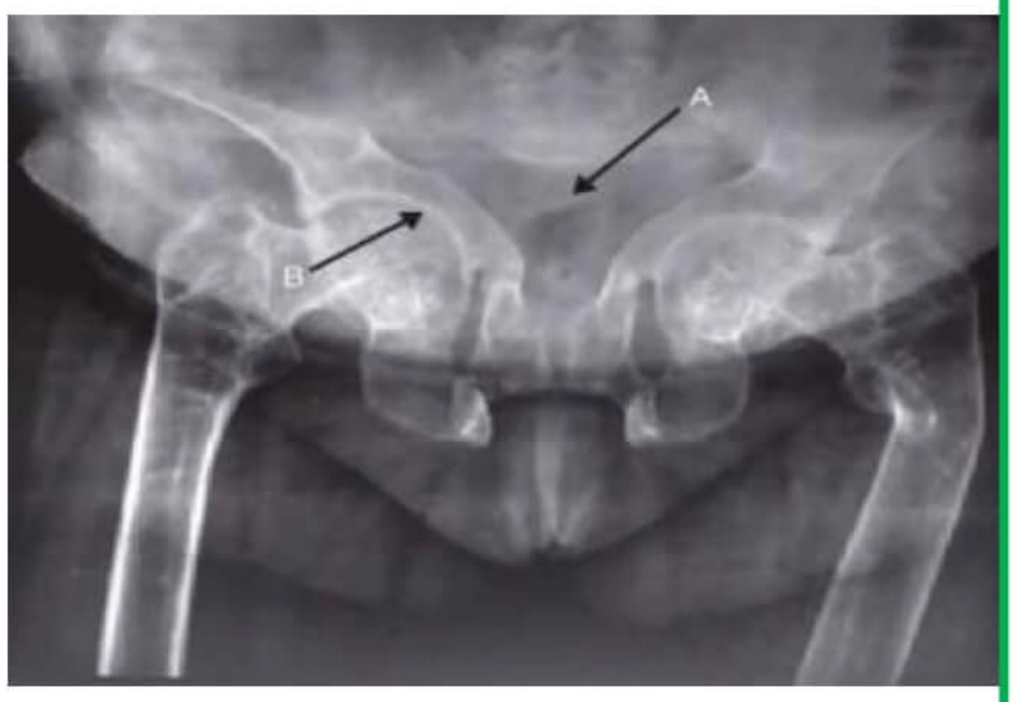
Osteomalacia

Osteon= bone; malacia: Softening

- → Adult counterpart of Rickets
- → Tetracycline labelling is used to calculate turnover
- → Osteoid/Osteon>1
- → **Note:**
  - -Osteoid = immature bone
  - -Osteon = mineralized bone

Gold standard Investigation- Biopsy

- → Otto pelvis due to protrusio acetabuli
- → Triradiate pelvis



Scurvy

- → Occur in knees of children
- → Sharp and tender rosary
- → Disease due to lack of vit c (Ascorbic acid)

PrepLadder

Findings

→ Wimberger ring sing –Sclerotic margin of epiphysis (↑)

→ White line of Frankel (→)

	SCURVY	RICKETS
X-Ray Epiphysis	Sclerosed	Normal
White line of frankel	Always	If +nt→healing rickets
Sclerotic margins	White	Wide(A)

(A)

Note

- **Wimberger ring sing** → Scurvy→ Sclerotic margin of epiphysis
- **Wimberger corner sign** → Congenital syphilis→ Metaphyseal defect
- **White line of frankel** →Scurvy, Healing Rickets,
  Lead poisoning,
  Methotrexate therapy.

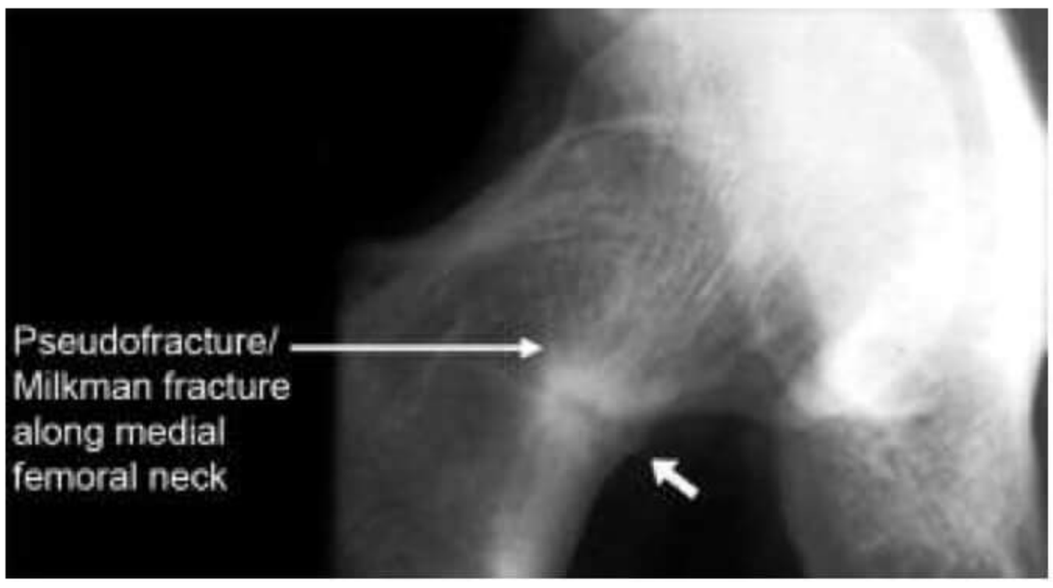
Umbauzanon

→ Found in bone softening disorders such as: – (i) Osteomalacia > Rickets
(ii) Hyper PTH
(iii) Neurofibromatosis

→ Lesions found in N.O.F and Pubic Rami

→ Indentation of cortex due to arterial pulsation
Known as Pseudo-fracture. / Milkman fracture. / Loosers Zone

Treatment: Treat the primary cause, Rest



PrepLadder

METABOLIC DISORDERS-2

HYPERPARATHYROIDISM

CASE

30 yr. ♀, Abdominal groans or Psychic moans, Renal stones.

→ PTH $\overset{POSITIVE}{-}$ Osteoblast leading → Rotting fence post appearance(**A**)

↓

Rank ligand

↓

Rank-Receptor on Osteoclast

↓

*Causes 1) Bone Resorption

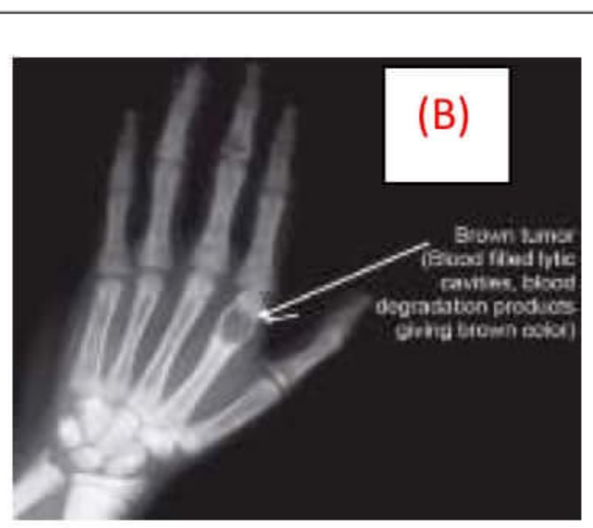
2) Fibrosa Cystica

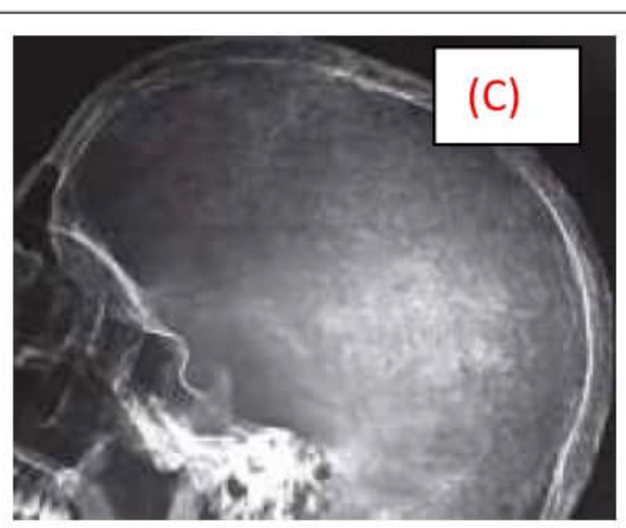
3) Brown tumor(**B**)

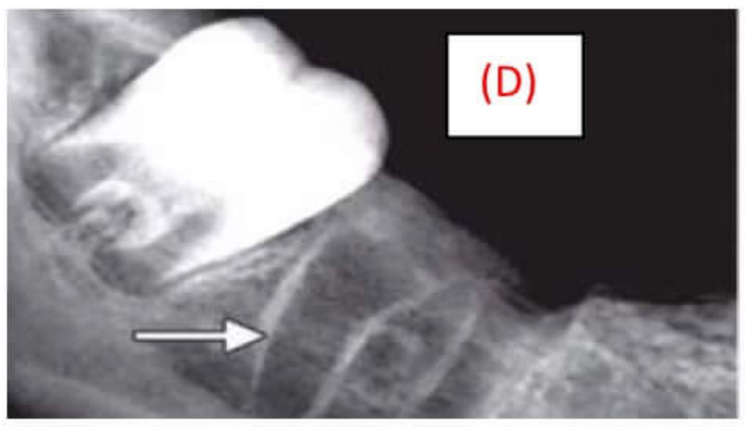
→ Salt pepper skull(**C**)

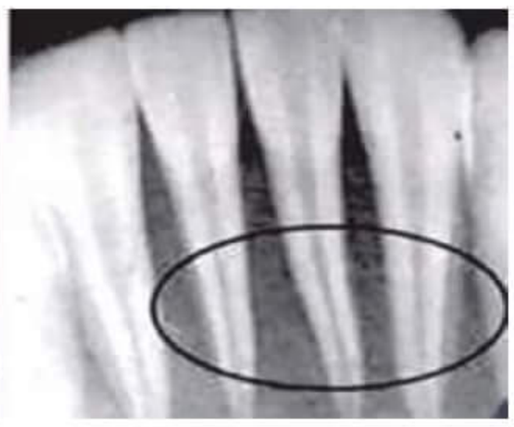
→ Loss of lamina dura(**D**)

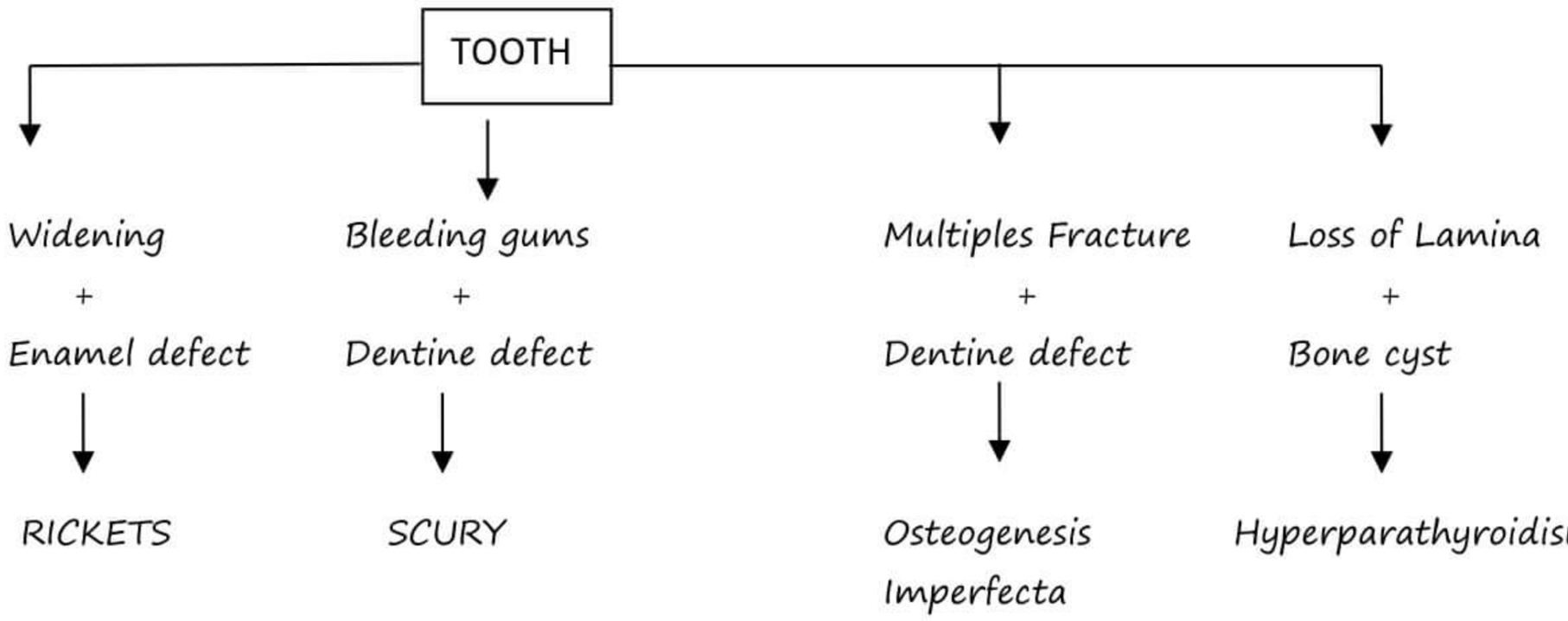
→ AVN rarely.









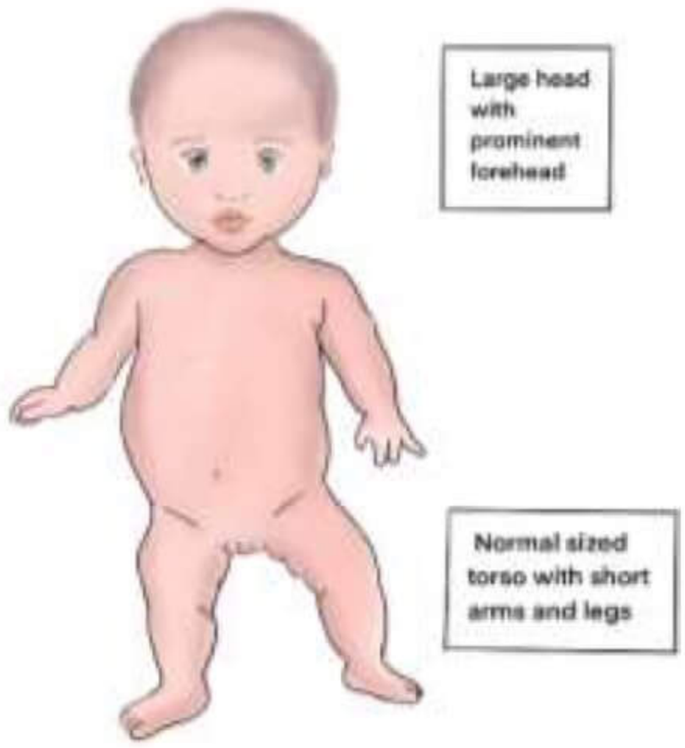


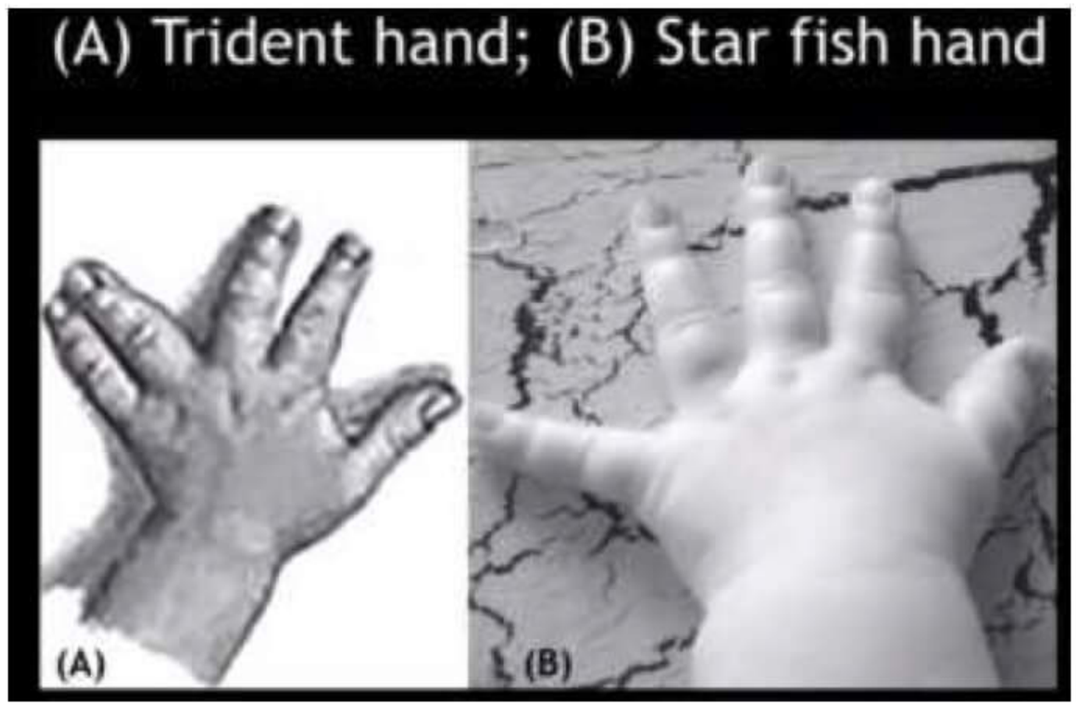
ACHONDROPLASIA

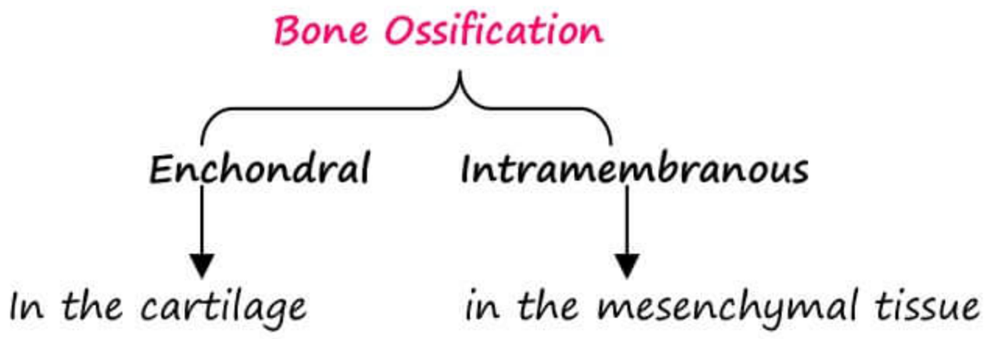
- → Normal intelligence
- → Good mood
- → Normal trunk Size
- → Trident hand or starfish hand
- → Bullet nose vertebra
- → Champagne glass pelvis [Width>depth] (a)
- → Limb dwarfism

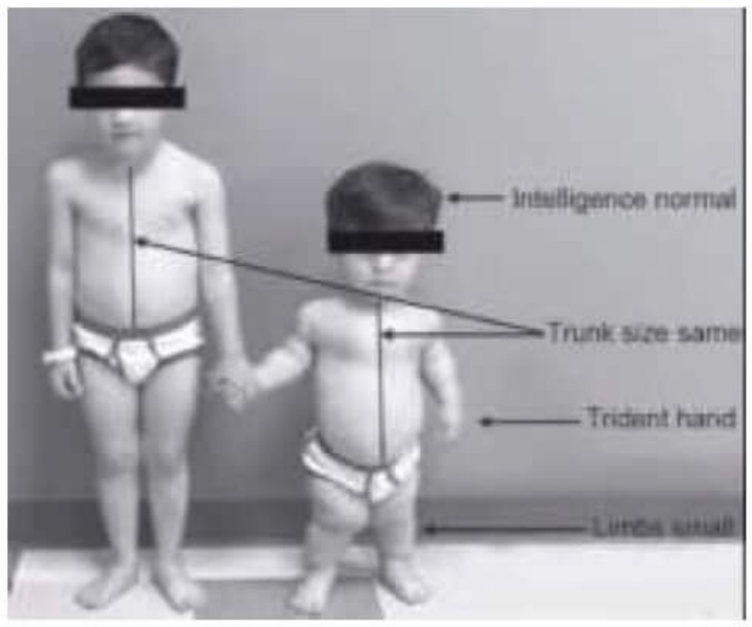
Causes

- → Due to FGFR & mutation leading enchondral ossification defect.









PrepLadder

Cleidocranial disorder

- → AD
- → Intramembranous ossification defect
- → Absent clavicle - shoulders meet in midline(a)
- → Squashed / flat face
- → Delayed dentition
- → Scoliosis and coxa vara
- → Deformities in spine or reduced neck shaft angle

Cleidocranial disorder

Osteoclast Defects

Osteopetrosis > Paget's (Multifactorial)

Osteopetrosis

- → Known as Marble bone ds.
- → Absent bone marrow
- → Shape of bone- normal
- → Bone appear white = Marble bone disease
- → CA II proton pumps defect genetically –Bone resorption.
- → Functional deficiency of Osteoclasts
- → Pancytopenia due to absent bone marrow
- → Anemia→ secondary hematopoiesis
- → Infection → Osteomyelitis of mandible.
- → Hepatosplenomegaly
- → N/v defects-Blindness→2nd CN Compression
  - -Deafness→8th CN Compression
  - -M/c compressed CN → 7th CN (Facial)

- → Delayed bone healing
- → Few studies claim normal healing.
- → **T/t** -Bone marrow Transplant (I/v)
- → Bone within a bone appearance(D) (Also in Sickle cell Anemia)
- → Rugger jersey spine (Renal Osteodystrophy)
- → Erlen Mayer flask deformity

also seen in Gaucher's > Osteopetrosis.

PrepLadder

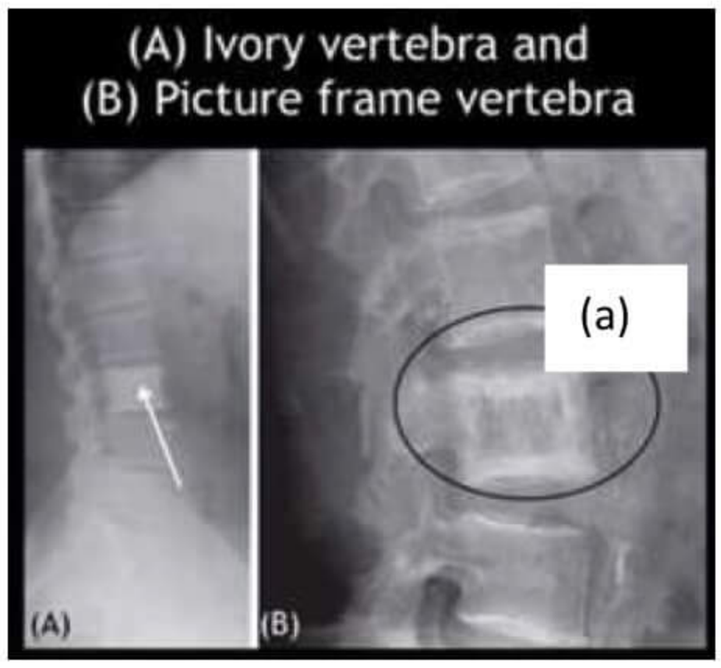
Rugger jersey spine

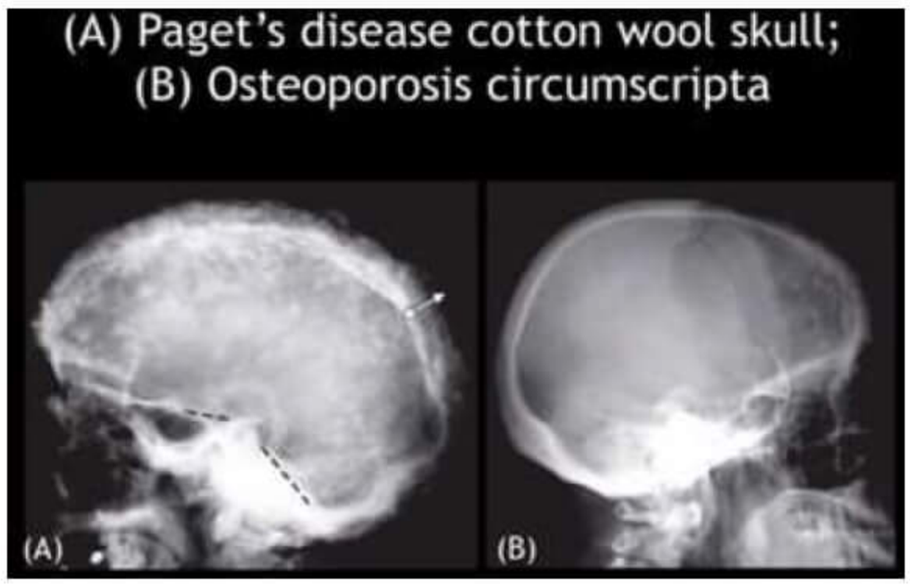
Erlen Mayer flask deformity

PAGET'S DISEASE – OSTEITIS DEFORMANS

→ ↑ Bone formation
→ ↑ Bone Resorption
→ Osteoclast defect → larger, irregular
→ Excessive Disorganized bone turnover
→ Age > 50 yr., Males (6th decade onwards)
→ Pelvis commonly affected
→ M/c symptom pain
→ Normal Ca^{+2} and P
→ ↑ALP
→ **Diagnostic histological Feature** → Cement lines→ Mosaic pattern
(or) Marble pattern(**A**)
→ Ivory vertebra; picture frame vertebra
→ Cotton wool skull (↑ head/ hat size)
→ Osteosarcoma (1%)
→ **Blade of Grass/ flame appearance – BRIM SIGN**

DOC→ Bisphosphonates
→ Calcitonin Good for pain control





Note

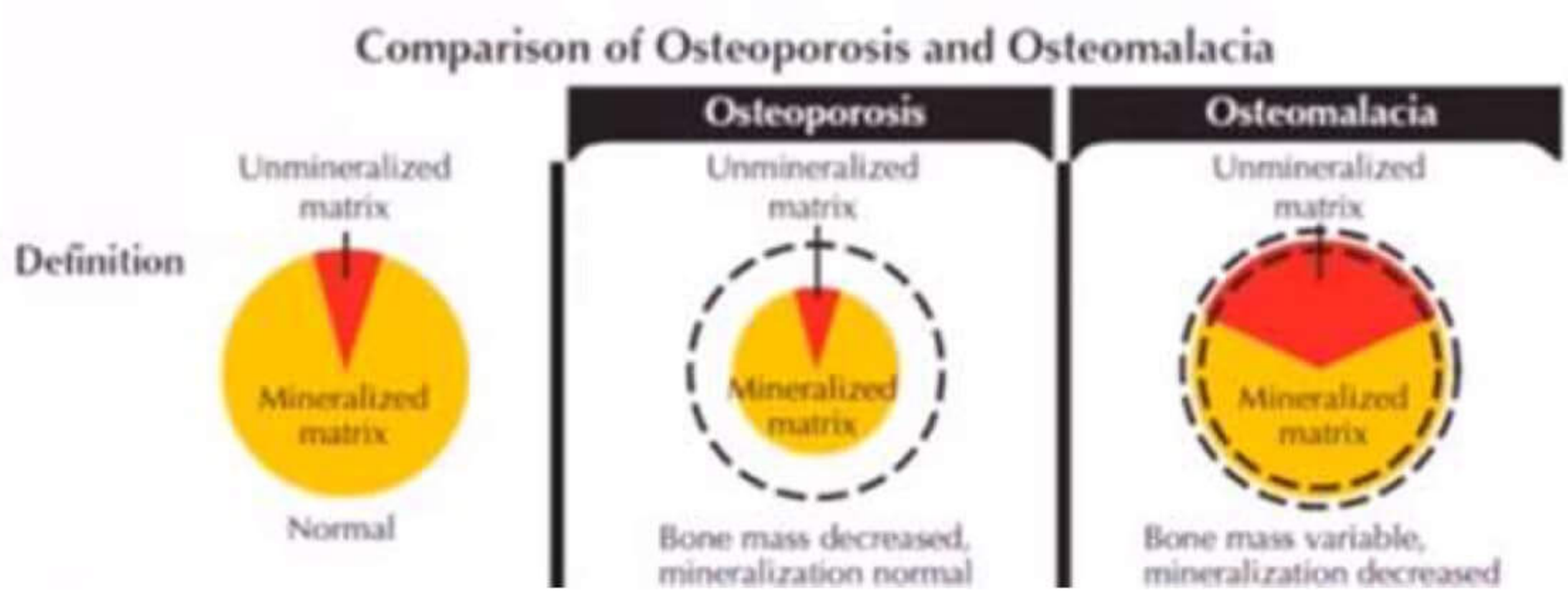
i) **Rim Sign** *Chronic Osteomyelitis.*

ii) **Brim Sign** *Paget's disease*

iii) **Ring Sign** *Scapho-Lunate dislocation*

iv) **Wimberger Ring Sign** *Scurry*

v) **O' Ring Sign** *chondroma*



Osteoporosis

→ *Normal Ca, P and ALP*

→ *↓Bone mineral density measured by DEXA scan.*

→ *T Score-0 to -1 = Normal*

1 to – 2.5 = Osteopenia

<- 2.5 = Osteoporosis

→ *Severe Osteoporosis → Osteoporosis with fracture Vertebra > fracture Hip > Colles fracture*

→ *In Hemiplegic patient → Humerus has max loss of bone mineral*

UL > LL; Proximal>distal

- **Treatment**: *Estrogen → (-) Rank L*
- *Bisphosphonates → (-) osteoblast but increase hip fracture after prolonged use.*
- *Calcitonin (-) Osteoclast*
- *Low dose PTH (20µg/dL) (Teriparatide) → (+) Osteoblasts.*

PrepLadder

Drugs

- ↑ Formation: Fluoride, PTH
- ↓ Resorption: -Bisphosphonates
  -Calcitonin
  -Denosumab → (-) Rank L
  -Estrogen → (-) Rank L
- Both: Strontium.

X-Ray findings: -

→ Codfish vertebrae (Osteoporosis > Osteomalacia)

Cod fish vertebrae

Osteogenesis imperfecta

→ MC cause of multiple fracture in childhood
→ AD
→ Bone shape not maintained
→ Deformed bones, fractures in different areas & different stages of healing.
→ Defected type I collagen but fracture healing is normal.
→ MC involved - Femur (LL)
→ Hyper laxity, DDH
→ Blue Sclera
→ Deafness
→ Dentinogenesis imperfecta
→ Sillence classification

Treatment -Gene therapy

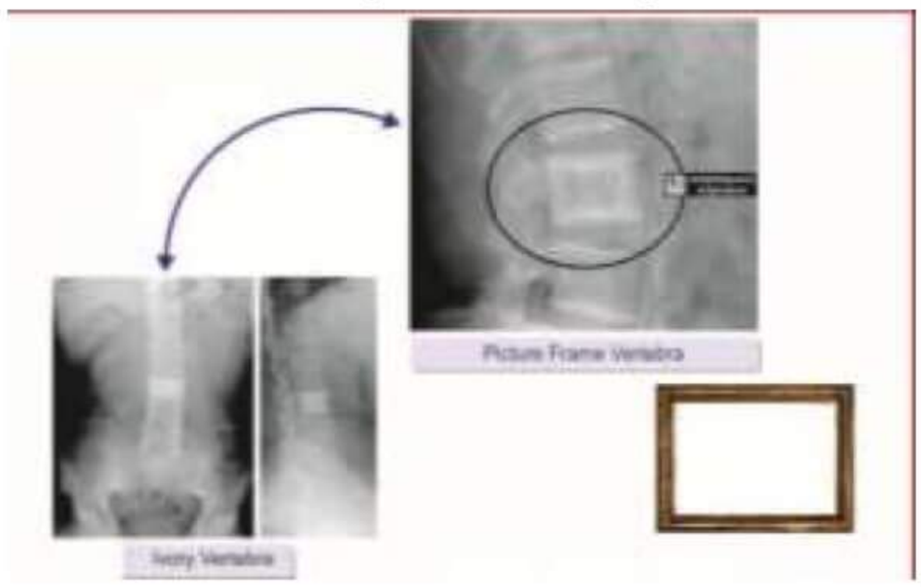
→ Pathological fracture: Bailey Dubow rods (adjust nail length with growth)
→ If presented with deformities-Sofield Miller Surgery-Seekh kabab surgery

PrepLadder

Types of Spine

Rugger Jersey Spine-Chronic Renal Failure

Picture frame/ Ivory vertebra-Paget's



Bullet shaped vertebra-Achondroplasia

Cod fish vertebra-Osteoporosis

Bamboo Spine -Ankylosing Spondylitis

Candle dripping disease/ Melorheostosis

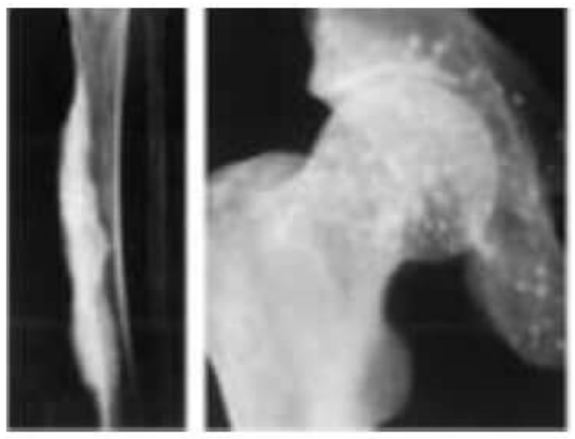
→ Sclerosis over the bone

→ Looks like dripping of the wax

PrepLadder

Osteopoikilosis

→ *periarticular, symmetrical and uniform size bony spots*



Osteopathia striata

→ *Striations over entire skeleton*

Pectus Excavatum

→ *Inward Sternum*

Associated with

→ *Prematurity*

→ *Congenital heart disease*

→ *Poland syndrome*

→ *Marfans syndrome*

→ *Noonan syndrome*

→ *Homocystinuria*

→ *Decreased pulmonary functions*

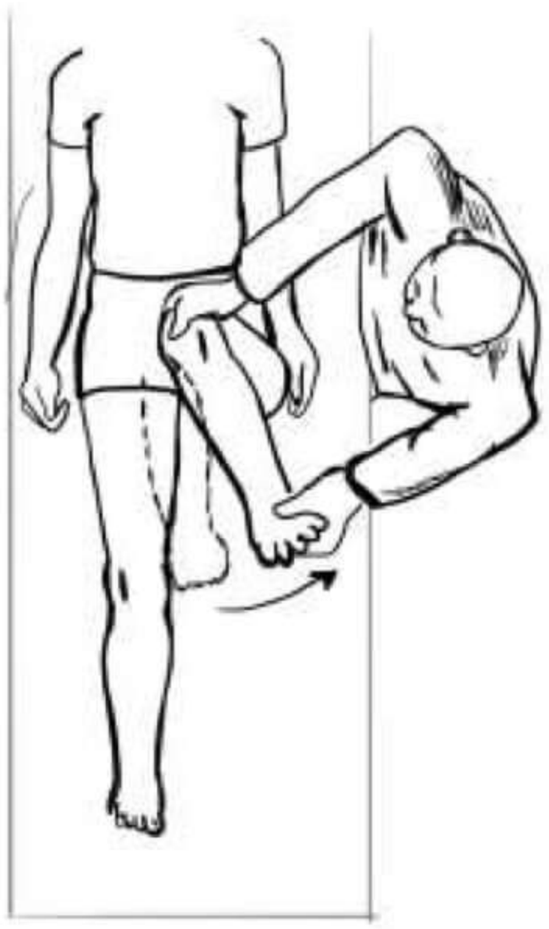
→ *Mitral valve prolapse*

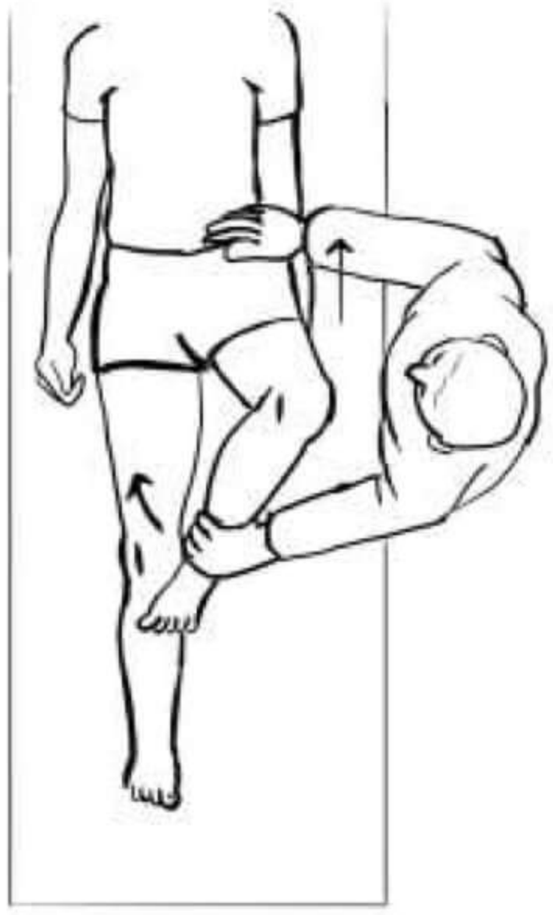
PrepLadder

PEDIATRIC ORTHOPEDICS-1

Hip

→ Altered shape of femoral head-Limitation of abduction & internal rotation





Internal rotation – leg goes out, hip goes in	External Rotation – Leg goes in, hip goes out

→ In internal rotation & abduction when you flex the knee

↓

Knee goes towards the clavicle - Normal Axis

→ If hip is destroyed, knee goes towards axilla - Axis deviation

→ Investigation of Choice - MRI

→ Treatment of Choice - Maintain the hip reduced (do Abduction of hip)

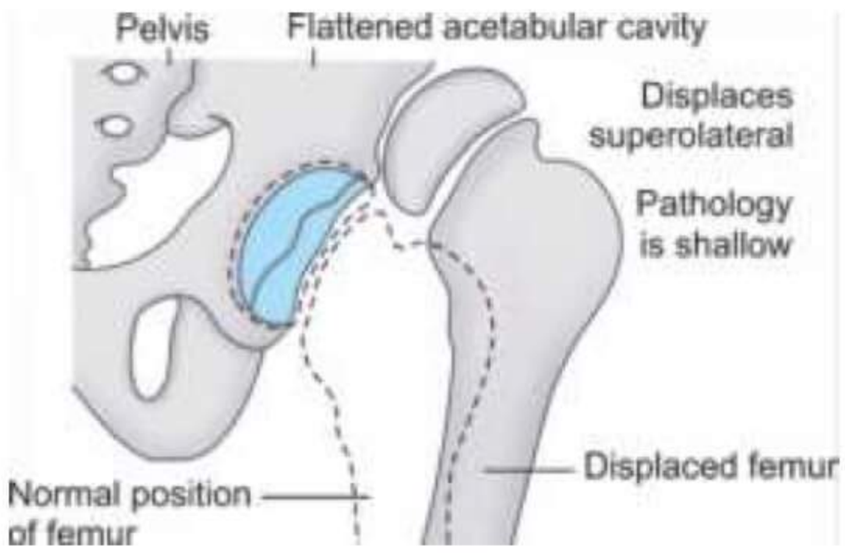
Disease	M: F	Bilateral
1. Development dysplasia of Hip / CDH	1:6	20%
2. Perthes Disease	3:1	20%
3. Slipped capital femoral epiphysis	3:1	40%

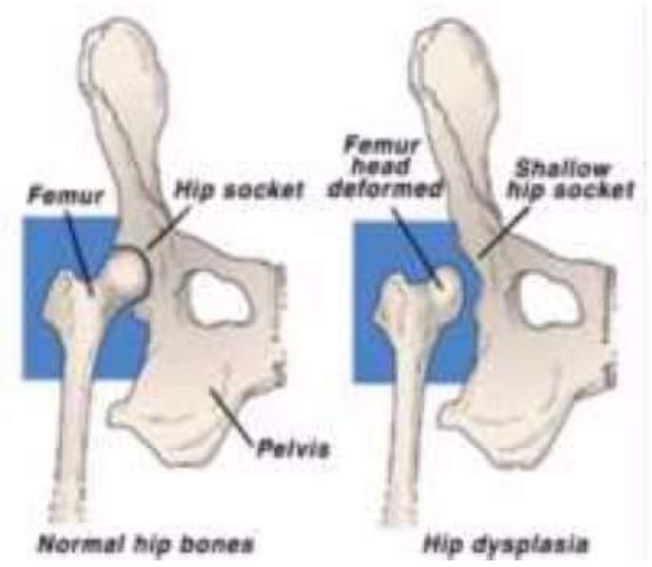
PrepLadder

Development Dysplasia of Hip

→ Epiphysis of femur small

→ Acetabulum flat / shallow





X-ray Findings

Developmental Dysplasia of Hip

→ Shallow / flat acetabulum

→ Epiphysis small

→ Epiphysis / Head dislocated superolaterally

Test

1. **Ortolani maneuver "Rab"**
   → Reduction of hip by abduction

2. **Barlow maneuver**
   → Dislocation of hip by adduction

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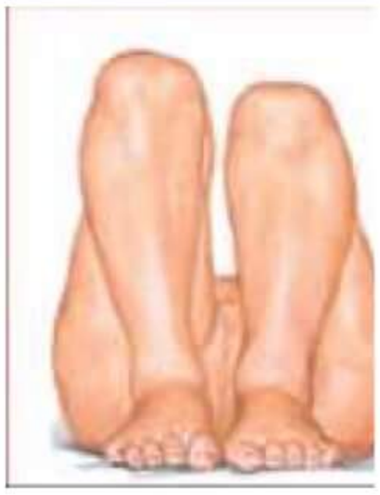
3. Allis or Galeazzi test

→ for superolateral dislocation

→ Knee of normal side is higher than the knee of affected side



Allis test

4. Klisic's Test

→ For measurement of DDH for bilateral disease

X-ray findings:

1. Shenton's arch:

→ an arch over the proximal femur & pubic rami

- In DDH, senton's arch is broken

2. Hilgenreiner's line

→ Horizontal line to triradiate cartilage

3. Perkins line

→ Vertical line at the edge of acetabulum

→ In normal hip, the epiphysis is inner to Perkin's line & lower to Hilgenreiner's line

→ In DDH, the epiphysis is upper to Hilgenereiners line & outer to Perkins line

→ **Acetabular Index** - The slope of acetabulum with the horizontal line

→ In DDH, acetabulum index keeps on increasing as the disease worsens / progresses

USG in DDH

→ Screening tool

→ Alpha angle decreases

→ Beta angle increases in DDH

In DDH:

Acetabular index → increases

Central edge angle→ decreases

Central edge angle → center of epiphysis forms on angle with Perkins line

PrepLadder

→ IOC → MRI

→ In DDH, femoral artery pulsations are not felt **Vascular sign of Narath positive**

Risk factors for DDH:

→ Oligo hydramnios

→ Metatarsus adducts (medial deviation of metatarsals)

→ Congenital muscular torticollis (Cock- robin appearance)

→ Talipes calcaneo-valgus

- (Heel prominent) > CTEV (clubfoot)

→ Family history

→ Breech presentation

→ Females

→ First born child

→ Left side is more commonly affected

→ Twin pregnancy is not a risk factor

→ A strong association exists between congenital dysplasia of the hip and other musculoskeletal abnormalities such as Congenital torticollis, Metatarsus adductus and Talipes calcaneo-valgus

→ The most common IV position places the left hip of the fetus against the maternal sacrum. This could partially explain the increased incidence of DDH in the **left hip**.

→ Ligamentous laxity as a contributing factor in congenital dysplasia of Hip.

→ Increased incidence of DDH → Swaddle infants with hip in extension;

→ Flexion & abduction prevents DDH

→ Hence DDH is uncommon in India.

Metatarsus Adductus

Talipes calcaneo – valgus

Management

→ Up to 6 months → closed reduction (maintain abduction)

→ Maintain abduction by using

1. Pavlik harness

PrepLadder

2. Von Rosen splint
3. Bachelors cast

→ 6 months- 18 months → Open reduction

OR is due to changes in hip joint such as:

→ Inverted limbus
→ Hypertrophy ligamentum teres
→ Interposed iliopsoas tendon
→ Pulvinar (thickened fibrocartilage tissue)
→ Capsular constriction
→ Transverse acetabular ligaments
→ 18 months – 3 years → Femoral correction

↓

- Use osteotomy
- Cut femur place the epiphysis at position
- As child grows, bone remodeling occurs by the pressure of femoral head in acetabulum

→ 3 years → Femoral and Pelvic correction

↓

Using osteotomy --**Salter's osteotomy**→ Cut & Create acetabulum

Perthes Disease

→ Avascular necrosis of femoral epiphysis
→ 4-8 years of age
→ Painless > Painful
→ Self – resolving
→ More common in male
→ 20% bilateral

Gage's sign→ Lysis in epiphysis & proximal part of metaphysis

Sagging Rope sign→ Lateral subluxation – epiphysis can come out of acetabulum

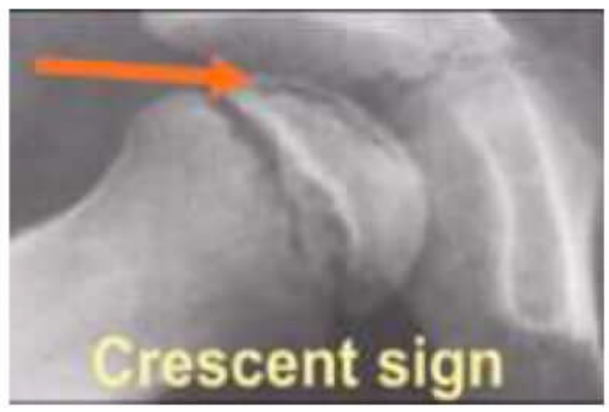
PrepLadder

→ Initial x-ray in normal in Perthes

→ IOC - MRI

→ Management - **Broom stick cast**

- Aim- Maintain abduction



X-ray: Crescent sign seen on Perthe's disease

Slipped Capital Femoral Epiphysis (SCFE)

→ Age: 11-20 Years

→ Misnomer - **"metaphysis slip", not slipped epiphysis**

→ Cause – Endocrinopathies (Hypothyroidism) and Growth spurt

→ IOC - **MRI**

→ Along with IR + abduction, flexion is restricted

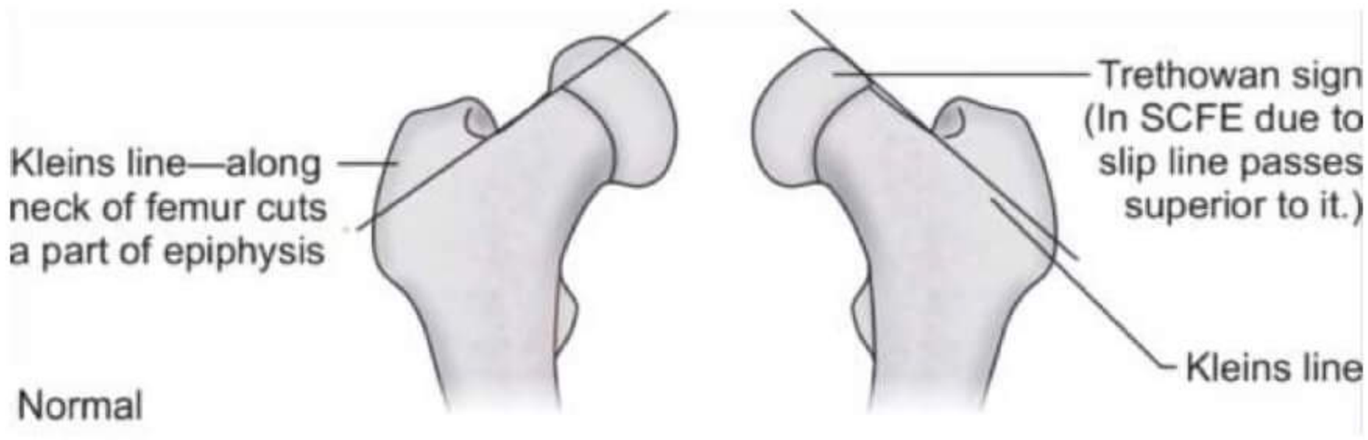
→ AP x- ray of pelvis

→ **Klein's line** → line over the neck, it must have a part of epiphysis above it

→ **Trethowan's sign** → When epiphysis goes down, then there is nothing above the line

→ Management - Fixation

→ In neglected cases osteotomy is done



PrepLadder

PEDIATRICS ORTHOPEDICS 2

Duchene Muscular Dystrophy

→ Defect in ***Dystrophin*** gene (Largest gene in human)

→ Swollen calf → Pseudohypertrophy of calf (Fibrous fatty deposit)

→ *Gower's sign:* Patient uses his own body to climb up as there is proximal muscle weakness.

→ X-linked recessive (Xp 21)

→ Boys- more common

→ Average age of presentation is 4 years (occurs in < 5 years of age)

→ Patient is unable to walk by 12 years of age

→ Average life span is 26 years

→ Proximal muscle weakness is seen

→ Pseudohypertrophy of calf & tongue is seen

→ Cardiomyopathy and congestive heart failure are seen

→ Definitive diagnosis is by muscle biopsy and genetic studies.

Swollen calf in DMD

Gower's sign- climbing on himself

Congenital muscular torticollis

→ Sternocleidomastoid muscle is affected

→ AKA *wry neck*(or) *twisted neck*

→ Associated with breech delivery, shoulder dystocia, birth injury and SCM ischemia / tumor (like compartment syndrome)

→ Associated with metatarsus adductus, DDH, CTEV (cock-robin appearance)

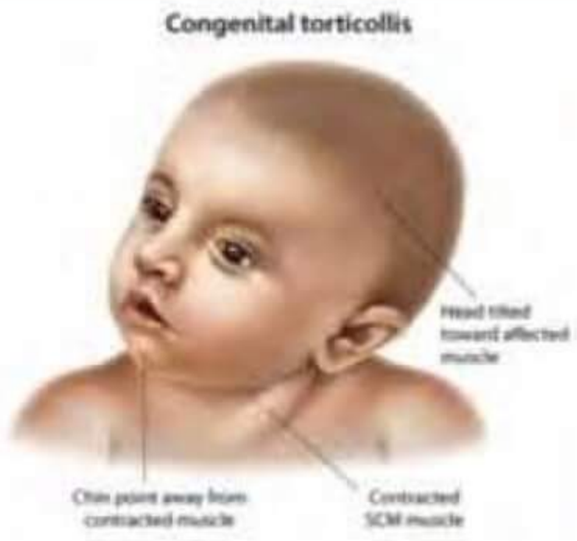
→ Knot can be detected in the body of SCM in first 3 months of life

→ It can disappear spontaneously (90% by 1 year)

→ There may be asymmetrical development of face (Plagiocephaly)

→ Treatment = SCM release – optimum age→ 1-4 years

- < 1 year→ disappears
- 4 years→ Plagiocephaly



cock-robin appearance

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Klippel-Feil syndrome

→ Posterior hair line very low

→ Short neck

→ Decreased movements

→ It is associated with congenital osseous fusion of the cervical spine, involving one or more vertebra.

→ Classical triad:

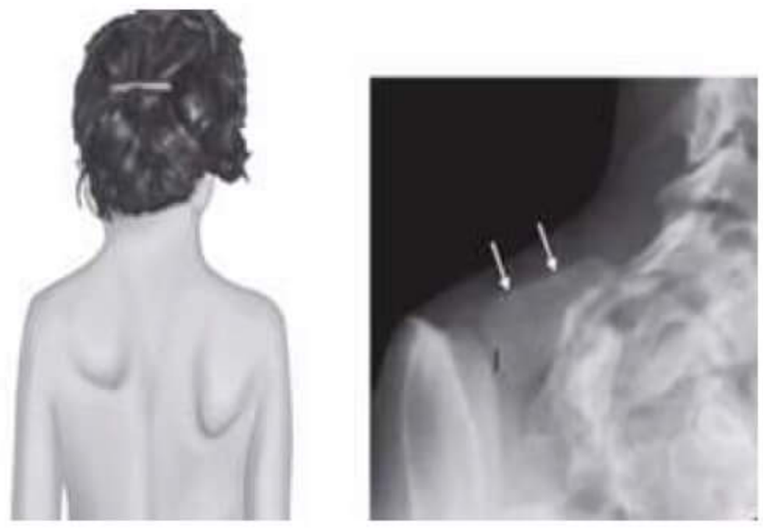
Short web neck (prominence of Trapezius)

Low hair line — Restricted neck movements

→ Most common associated disease → scoliosis (60%)

→ Associated disease → **Sprengel's deformity** (50%)

Sprengel's deformity



→ It is Congenital elevated or undescended scapula

→ (omo-vertebral bone bridges the cervical spine to the scapula and limits the neck& shoulder motion)

→ Omo-vertebral bar: between vertebra and scapula leading to Short & high scapula

Blount's Disease

→ characterized by Varus (Tibia> genu)

→ Tibia vara occurs due to posteromedial defect of Upper tibia.

→ Genu recurvatum (Hyperextension of knee)

→ Internal torsion of tibia

Lower end of femur and tibia goes medially →**Genu varum**

Only the tibia goes medially →**Tibia varum**

PrepLadder

→ Sudden deviation of tibia due to posteromedial defect occurring metaphysis – diaphysis junction. Also, posteromedial instability of knee→ **"Siffert Kartz sign"**

Siffert Kartz sign in Blount's Disease

	Blount's	Physiological bowing
Side	60% bilateral	100% bilateral
Progress	Progresses	Resolves
Treatment	Tx required	Observation

→ Tx of Blount's Disease →High tibial osteotomy (cut at upper end of tibia)

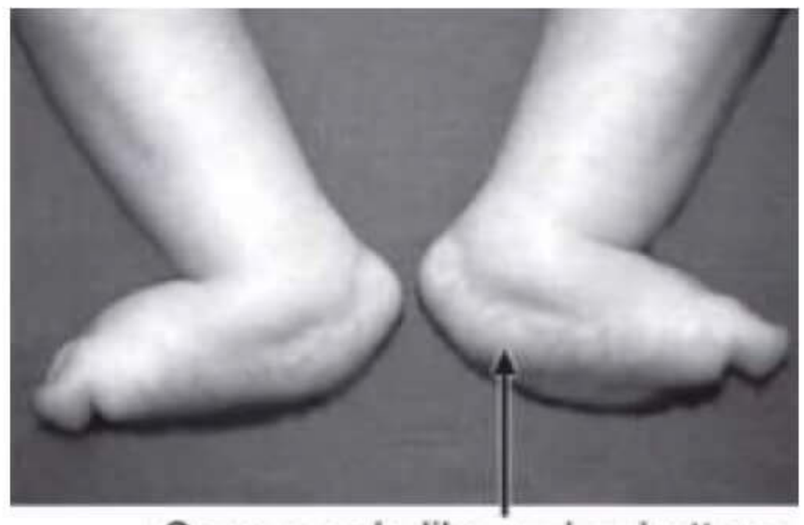
Rocker bottom foot

→ Convexity of sole

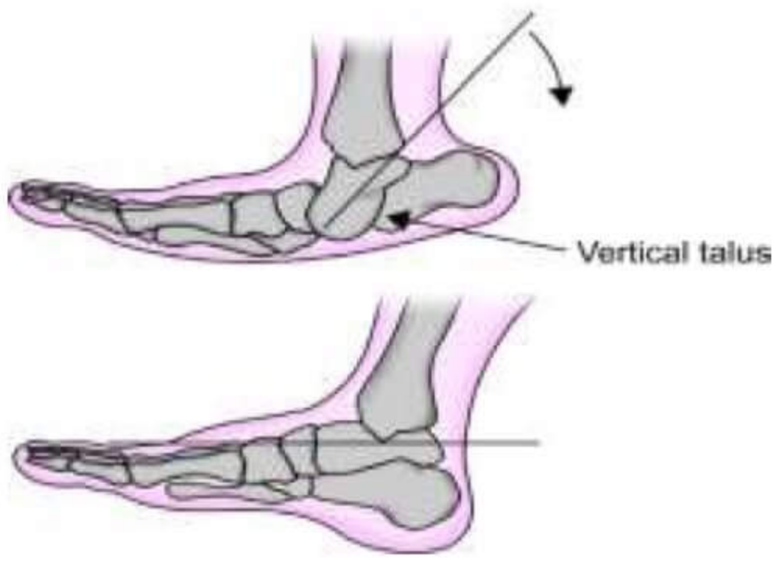
→ Cause:

1. Due to incorrect correction of CTEV
2. Vertical talus

Normal talus- horizontal



Convex sole like rocker bottom



Pes planus (Flatfoot)

→ In normal foot, the arch is formed with heel as the center. The arch is due to medial longitudinal arch.

- Obliterated / lost medial longitudinal arch → **Flat foot**
- Heel goes to lateral deviation (valgus) → **Plano valgus**

PrepLadder

Types (Jacks test)

1) **Flexible** = arch disappears on non-weight bearing (arch disappears when placed on ground & comes back when foot is lifted off)

   Mgt → conservative

2) **Rigid** = Flat on both ground & when lifted

   →Due to congenital vertical talus (or) RA (or) infection or tarsal coalition (AD – talocalcaneal and calcaneo navicular) or tibialis posterior dysfunction

   →They often require surgical intervention,

Tibialis posterior→ important muscle to maintain the arch;

it is the soft tissue cause for flat foot.

Club foot / Congenital Talipes Equino Varus(CTEV)

Combination of 4 deformities:

Mn: CAVE

1. Cavus (↑arch)
2. Adduction (medial deviation of fore foot &mid-point)
3. Varus (inversion at sub-talar joint)
4. Equinus (Plantar flexion at ankle)

Order of correction

Cavus → Adduction → varus → Equinus

If not corrected correctly, leads to rocker – bottom foot

Management:

→ < 1 year → manipulation + cost

→ 1-3 year → soft tissue release

→ >3 years → Soft tissue release + Bony wedge taken out

→ In CTEV, most important joint is **Talonavicular abnormalities**.

PrepLadder

Management:

→ **Kite's method:**

1. At birth → Manipulation by mother for 1st 2 weeks
2. At 2 weeks old → cast application

   Change of cast every 2 weeks
3. Order of correction → **C-A-V-E**(**calcaneo-cuboid area**)

   One at a time

   The deformity is corrected in 6-9 months

→ **Ignacio V ponsetti's method:**

1. At birth: apply cast (includes manipulation also)
2. Change cast every 7 days

   → As collagen fibers recontract on day 8 as change cast before that.
3. Order of correction → **C-AV-E**

   → Adduction& Varus can be corrected together

   →Push **Head of talus** laterally

   (***kite's error → calcaneo-cuboid***)

The deformity is corrected in 6-8 weeks

Ponseti method is followed now

→ 1-3 years old → ***Soft Tissue Release***

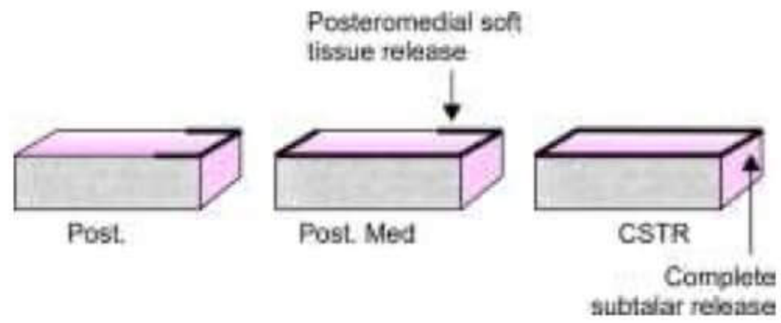
→ Soft tissue tied only posteriorly (around heel) →release them

→ Soft tissues are tied postero-medially, release them →**TURCOS** (Most common surgery done)

→ If soft tissues are tied all around,

then→ **Complete sub-talar release** is done.

→ 3 years → soft tissue release + lateral column shortening



Treatment

1. **Birth up to 1 yr.**

   -manipulation (Head of talus) + cast

   -Tendo Achilles tenotomy (at end to correct Equinus)
2. 1-3 years = STR (PMSTR – Turcos)
3. > 3 years = STR + Bony wedge

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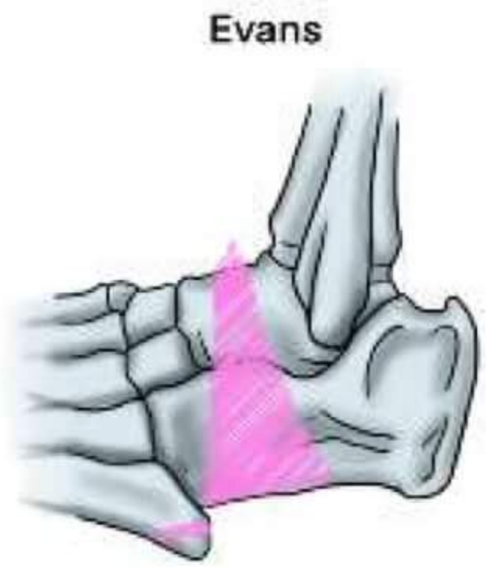
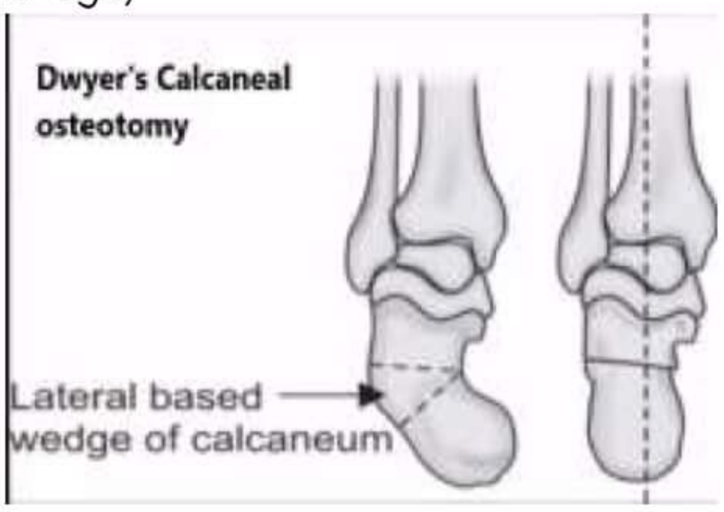
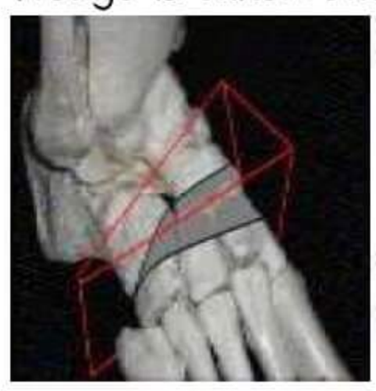
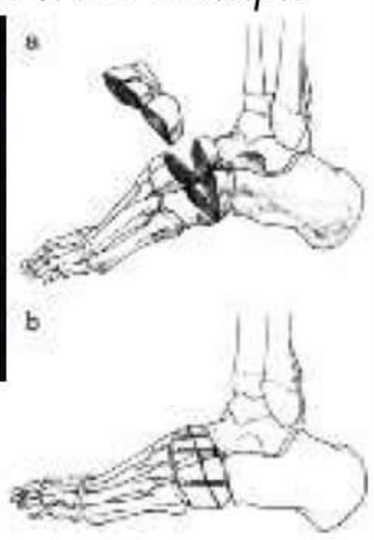
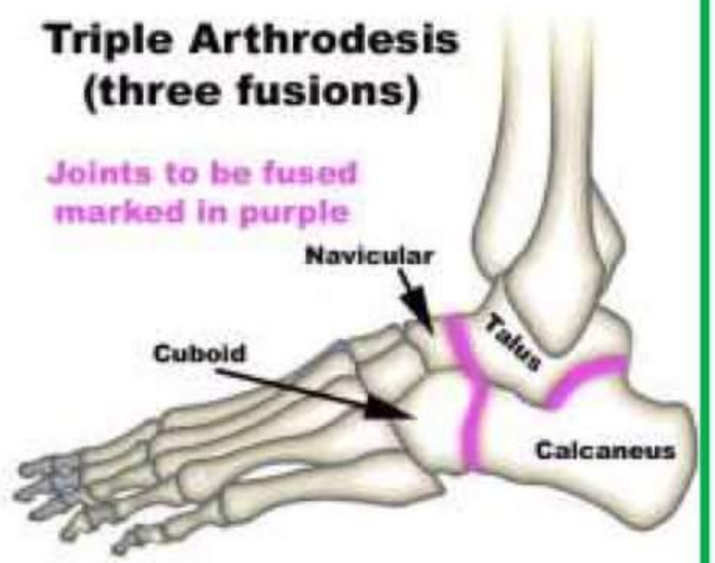
4. 3-5 years of age	5. 5-8 years of age	6. 8-10 years of age
Evan's procedure + STR Evan's: Calcaneo-cuboid wedge 	Evan's Procedure + STR + Dwyer's calcaneal osteotomy (to correct heel Varus in > 5 years of age) 	Wedge tarsectomy Wedge is taken out from multiple  

7. Beyond 10 years of age →**Triple arthrodesis** (fusion of three joints)

a) Talonavicular - most difficult to fuse

b) Talocalcaneal

c) Calcaneocuboid



Talonavicular joint is difficult to fuse, hence may form Pseudo-arthrosis.

→ Children with skeletal maturity management (> 10 years of age)

- Ilizarov
- Joshi's external stabilization system (JESS)

Treatment for CTEV:

At birth → cast

1-3 years → PMSTR (Turcos)

3-5 years → STR + Evan's procedure

5-8 years → STR + Evan's + Dwyer's

8-10 years → Wedge tarsectomy

>10 years → Triple arthrodesis

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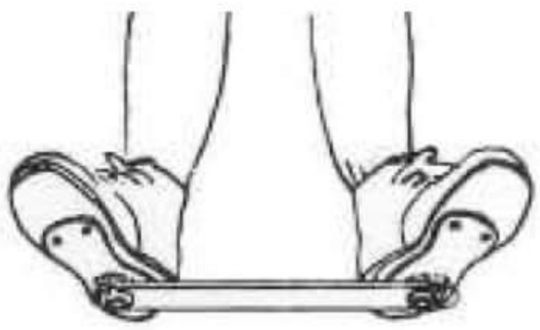
CTEV Shoes: by Thomas

→ Straight medial border → for Cavus& adduction

- Outer raise → for Varus
- No heel → for Equinus
- Given up to 7 years of age

→ Dennis Brown splint: Applied 23 & half – 24 hours a day& Bilateral side



< 1 year old → only splint

>1-year-old → splint at night and CTEV shoes at day

Atypical CTEV: Poor prognosis

AMC → Arthrogryposis multiplex congenita

NF → Neurofibromatosis

Pirani scoring for CTEV

6 parameters

1. Equinus
2. Lateral part of head of talus
3. Heel
4. Curvature of lateral border
5. Medial crease
6. Posterior crease

Pirani scoring → **THE LMP**

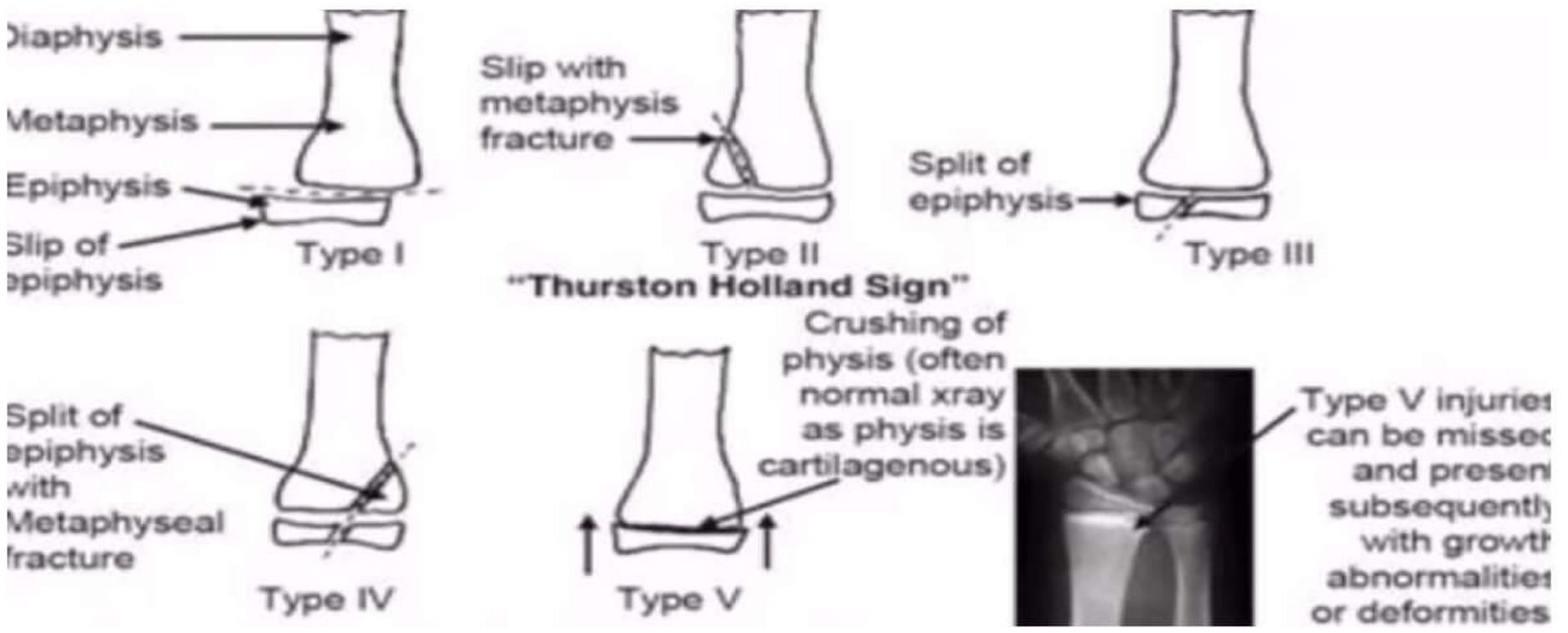
Talar head	**L**ateral curvature
Heel	**M**edial crease
Equinus	**P**osterior crease

→ In CTEV, there occurs parallelism of talus and calcaneus in AP and lateral view.

PrepLadder

PEDIATRICS ORTHOPEDICS – 3

Salter Harris classification for Physeal injuries



→ Type I → Slip of epiphysis

→ Type II→ **MC type**; "Thurston Holland sign"; slip of epiphysis along with metaphyseal part fracture

→ Type III → Epiphysis splits into two parts

→ TYPE IV →Epiphysis splits along with metaphyseal fracture

→ TYPE V → Vertical crushing plate of Physis with normal x-rays

Battered baby syndrome

→ AKA Infantile whiplash syndrome

→ Child is manipulated by guardian / parents

→ Injury in metaphysis

1. At corner→ chip fracture
2. Metaphyseal bucket handle fracture

→ In femur: Fractures are spiral

→ Sub-epiphyseal micro-fractures are seen on MRI

→ Nobbing fractures are seen in the ribs

→ X-ray of specific parts required → skeletal survey; Babygram are not done

Battered baby syndrome – Chip fracture

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Types of pediatric Injuries

1. Torus fracture → Buckling of cortex at metaphyseo-diaphyseal junction → Torus- bend seem at the bottom of a pillar	
2. Plastic deformation → Bend without a break	
3. Green stick fracture → Single cortical breech	

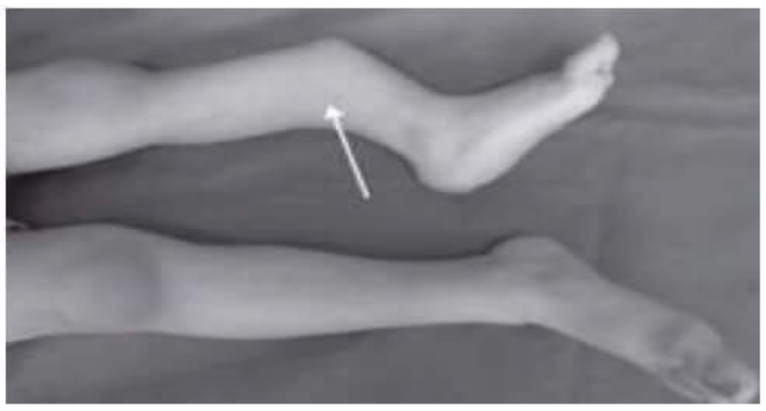
Congenital pseudo arthrosis tibia

→ Arthrosis is between 2 bones and has hyaline cartilage and synovial fluid.

→ If these are not present, then its Pseudo arthrosis

→ Occurs due to non-union, failed surgery or congenital deformities

- Cause: Idiopathic
- Associated with neurofibromatosis
- Leads to anterolateral defect of tibia



Crawford classification

→ Type I: Anterolateral bowing of tibia

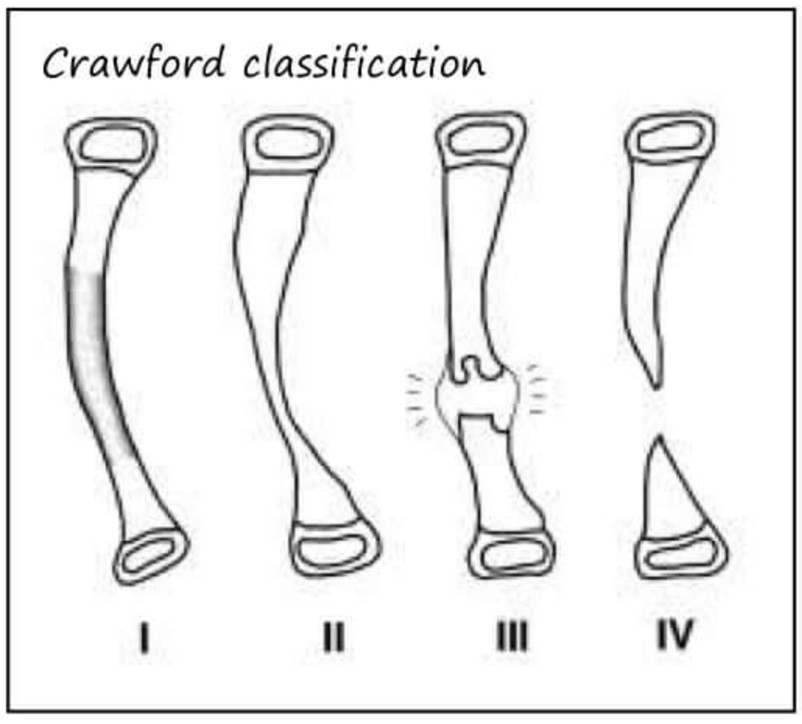
→ Type II: Antero lateral bowing

- Increased cortical thickness
  - Narrow medullary canal
  - Tubular defect

→ Type III: Cystic lesion

→ Type IV: Presence of cyst, fracture or frank pseudo arthrosis

→ Treatment- Bone graft + stabilization by Ilizarov



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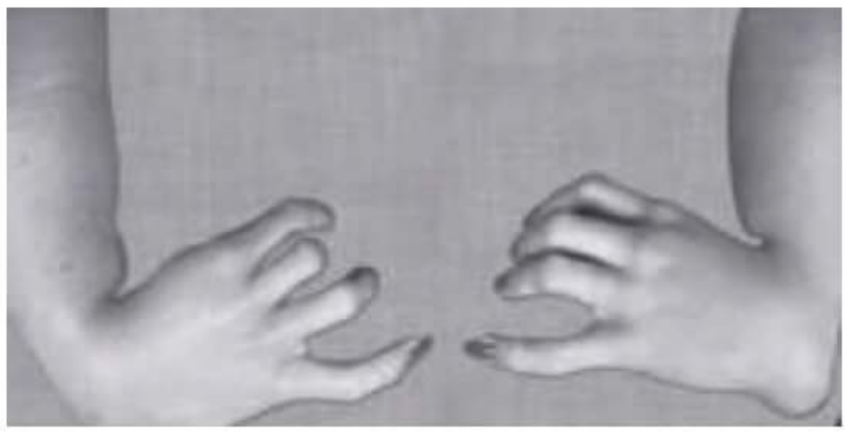
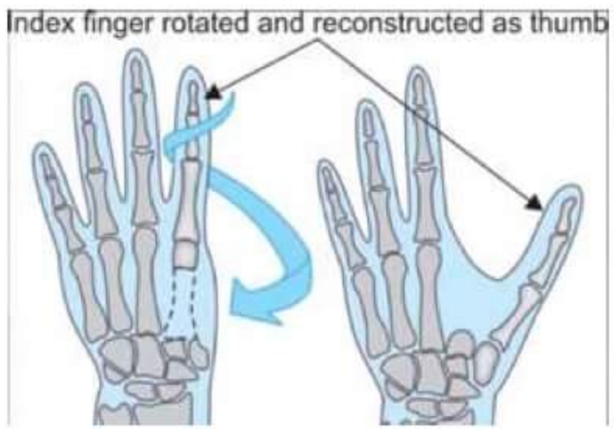
Radial hemimelia

→ Radial club hand
→ Deficiency of radial bone and thumb (40% of hand)
→ Hand deviated to radial side
→ Associated conditions:
    1. Hold Oram syndrome
    2. VACTERL





Management

→ Pollicization (create thumb)
→ Centralization of ulna

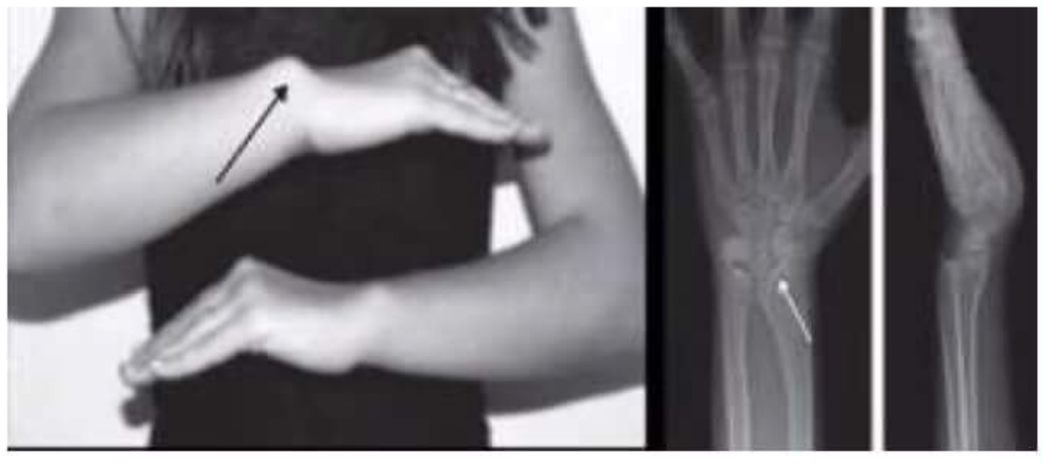
Posteromedial bowing of Tibia → self-resolving

Tibial Hemimelia – absence of tibia

Fibular Hemimelia – absence of fibula → Valgus

Madelung deformity

→ Defect in the palmar and ulnar aspect of lower radius
→ Prominent ulnar head
→ 50% are bilateral
→ More common in females
→ Associated with turner syndrome
→ Has excellent functions



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Polio

→ Involves lower limb > upper limb

→ Most common muscle to be affected → **Quadriceps femoris** (Partial)
"Hand-knee gait"

→ Most common completely paralyzed muscle →**Tibialis anterior**

→ In upper limb → Deltoid

→ Hand muscles (very rare) – Opponens pollicis

→ Acute fatality is due to involvement of respiratory muscles

Toddler's fracture

Toddler's fracture

→ Spiral fracture in tibia

→ Occurs in toddlers

External Tibial Torsion

→ **Charlie Chaplin Gait**

Pyle's disease

→ Metaphyseal dysplasia

→ Autosomal recessive

→ Presence of mental retardation

→ Presence of Genu valgum

→ Dental caries, mandibular prognathism

Trevor's disease is epiphyseal dysplasia

OSTEOCHONDRITIS

Osteochondritis- Damage to cartilage with underlying bone

- → Disease of young
- → Keinbock – Lunate
- → Kohler – Navicular
- → Freiberg – 2nd metatarsal head
- → Iselin – 5th metatarsal base
- → Severs – Calcaneum
- → Panners – capitulum
- → Perthes – femur epiphysis
- → Osgood schatter's – Tibial tuberosity
- → Sinding Larson's – Lower pole of patella

Keinbock disease

Keinbock

- → Lunate
- → Ds of young
- → Pain -base of 3rd MC
- → Very painful on wrist dorsiflexion

Treatment: Arthrodesis / arthroplasty

Kohler disease-osteochondritis of navicular

Osteochondritis Dissecans(a)

- → seen in lateral surface of medial epicondyle in adolescents
  - – Wilson Test
  - – Treatment: drill holes in damage, then new bones will form – Microfracture technique(b)

(A)

(b)

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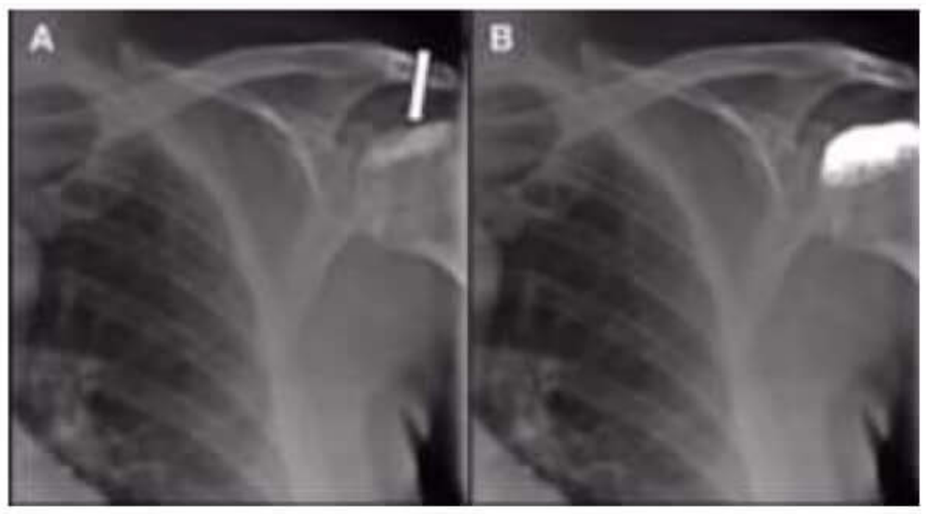
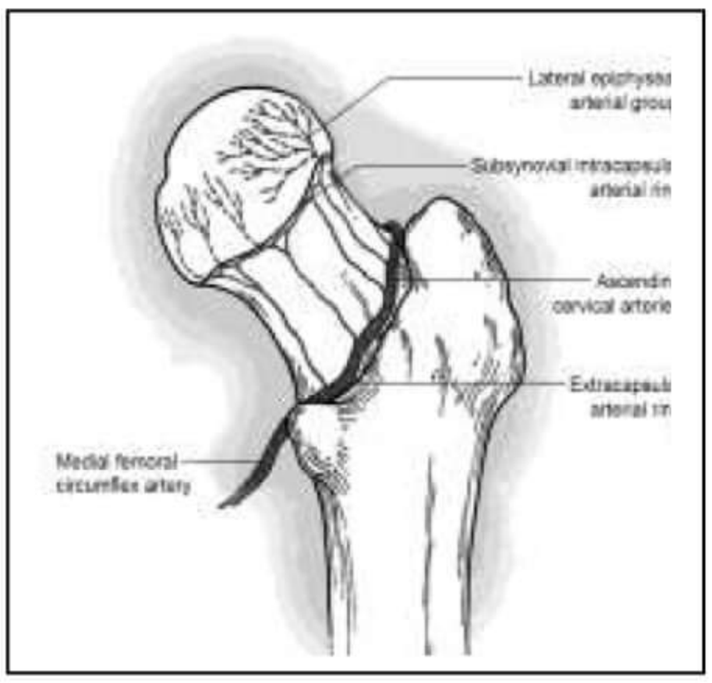
Avascular Necrosis: death of bone due to poor blood Supply

MOST COMMON SITE	CAUSE
1. Head of femur	Neck of femur & Posterior dislocation of hip
2. Proximal pole of scaphoid	Fracture through waist of scaphoid
3. Body of talus	Fracture of Neck of talus
4. Proximal pole of lunate	Dislocation
5. Capitulum	
6. Distal femoral condyles	
7. Humeral head	



Snow cap sign – AVN of humeral head

Head of femur



→ Blood supply - profunda femoris which is from middle circumflex femoral Artery, a branch of lateral epiphyseal artery. The arteries are easily compressed causing AVN.

→ MC cause of AVN → idiopathic **"Chandelier's disease"**

Compartment Syndrome → Cast
Myositis → massage
Sympathetic overactivity→ Sudeck's
Femur fracture(48hrs) → Fat embolism
AVN → Steroids

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Sequalae of AVN_→ Dead bone (appears white on X-ray)

Scaphoid

→ Scaphoid has retrograded blood supply which is from distal to proximal pole.

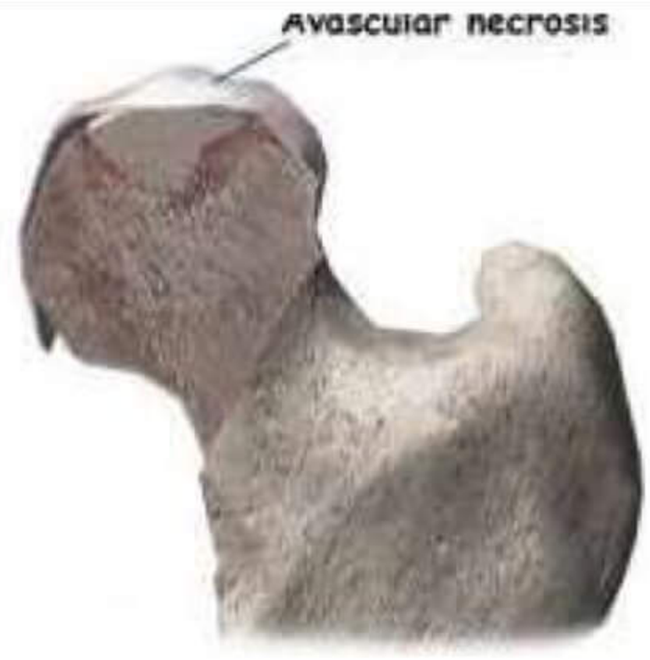
→ During fracture, there is poor blood supply to the proximal pole as the fracture is usually at the waist of the scaphoid leading to AVN of proximal pole.

AVN in proximal pole of Scaphoid

Femur AVN

→ Afects anterolateral aspect of femoral head

- IOC - MRI



Sectoral Sign – reduction in IR and Abduction

Crescent sign on X-ray -on femoral joint surface

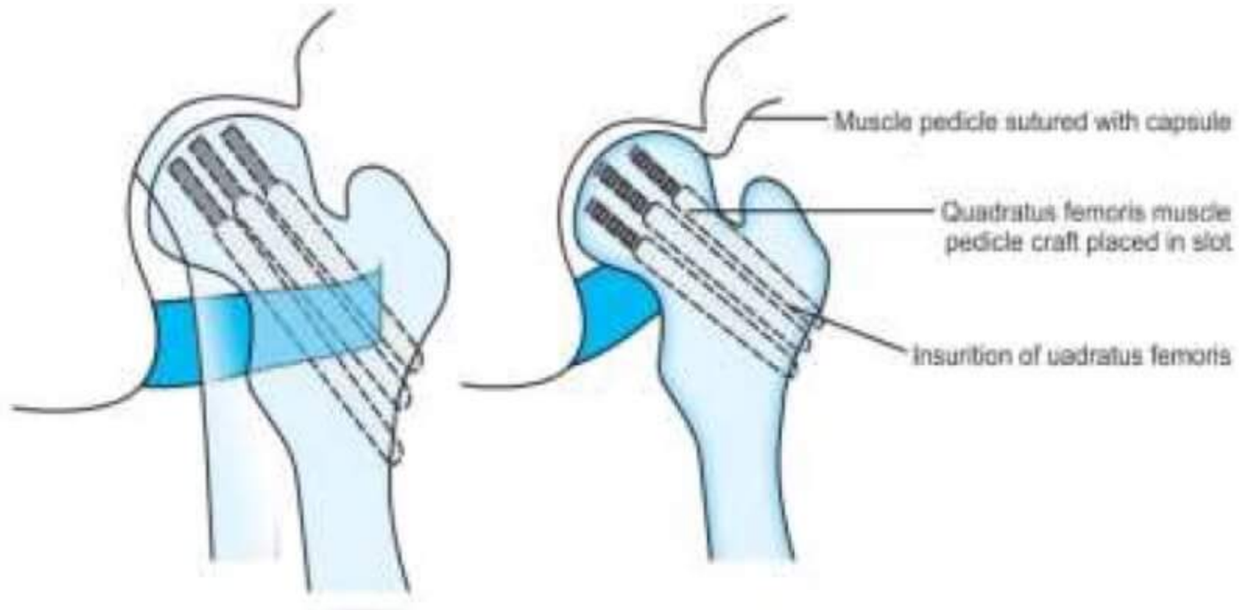
Double line sign on MRI

Treatment of AVN

1. Core decompression (↓ pressure) + Fibular graft (↑ vascularity)

   Muscle pedicle graft

   i. "Meyer's graft" – In AVN of femur; Quadratus femoris muscle is used



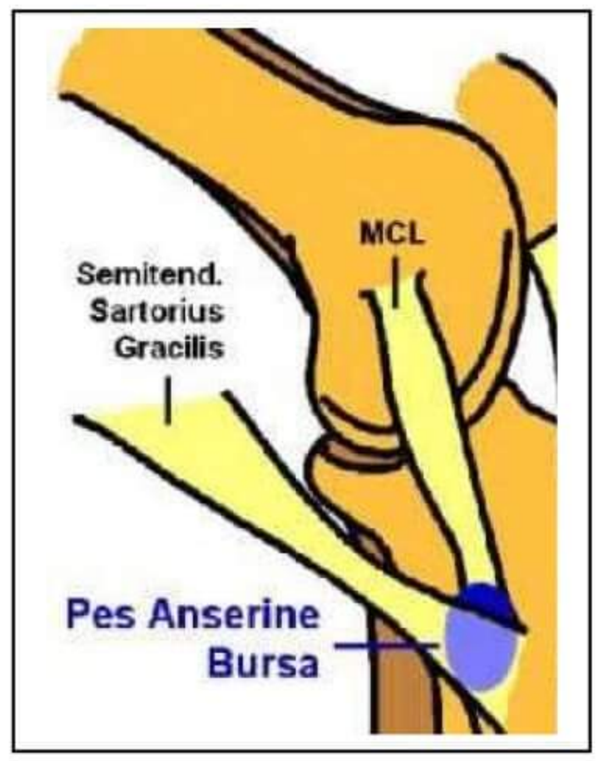
   ii. Joshi's graft - Tensor fascia Lata muscle used.

2. Total hip replacement- currently used

Snapping knee syndrome

→ Pes anserinus tendon snaps of posteromedial corner during movement

1. Semi-tendinosis
2. Sartorius
3. Gracillis



Ganglion

→ MC swelling of hand & wrist
→ Cystic structure
→ No synovial living
→ Found in dorsal wrist – scapholunate

Baker's cyst

→ Semi-membranous
→ At medial head of gastrocnemius-compress popliteal artery
→ Pressure diverticulum may arise
→ Prominent on extension
→ Causes associated with it: OA / RA / Pigmented villo nodular synovitis / medial
   - meniscus injury

Treatment: Excision if symptomatic

PrepLadder