

ORTHOPEDICS 429 TEAM

"2nd Edition"



SOURCES

429 LECTURE NOTES

427 TEAM

TORONTO'S NOTES

DOCTORS SLIDES

Index Orthopedics Lectures

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Examinations:

Shoulder Examination
 Knee Examination
 Back Examination
 Foot/ ankle Examination
 Peripheral nerves / upper extremities Examination
 Hip Examination

Two Additional Lectures were given to Group A2
 is ***also attached*** just Incase

19. Ortho history taking
 20. X ray interpretation skills

Clinics:

- ◆ OR principles of surgical treatment in orthopedics.
- ◆ Two Clinics
- ◆ ER visit
- ◆ Two Plaster Room visit
- ◆ OR visit

Skills:

Splinting and casting SKILLS
 Reduction SKILLS
 knee Aspiration

CBL: 6 cases

You can find here only the theory Lectures

The Team is in the same order of the Lectures time.

The Team is simple work to make it easy as much as it can be.

This is not a Full Source to study from: The Team covered the notes, Slides and most of the objectives.

Thank you and best of luck!

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Principle of Fractures

- **A Fracture is a Break in the continuity of bone**
- It could be complete or incomplete (green-stick fracture)
 - Complete usually in old people.
 - Incomplete usually in pediatric due to high water content in the bone.



Fig. 1 Complete fracture

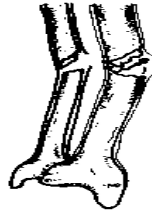


Fig. 2 Incomplete fracture

◆ Classification of fracture:

- It may classify in different ways:
- Depending on communication with external environment :
 - 1- Simple (closed): Does NOT communicate with external environment
 - 2- Compound (open): Communicate with external environment, Infection!!→orthopedic emergency.
"Note: In-out open fracture (the bone get out of the skin) OR out-in open fracture (anything broke the bone and get inside)".
- Depending on the presence or absence of soft tissue (viscera, nerve, blood vessel) damage:
 - 1- Complicated : Associated with damage to nerves, vessels or internal organs
 - 2- Non-complicated.

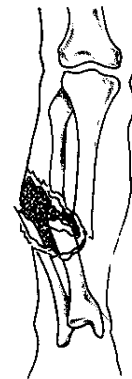


Fig. 4 Open fracture tibia

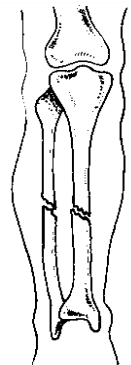


Fig 3. closed fracture tibia

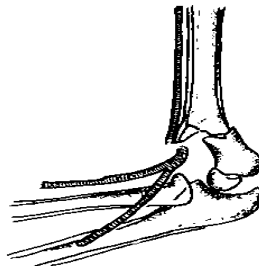


Fig. 5 A supracondylar fracture of the humerus with damage to the brachial artery

- Depend on amount of force ; it is classified into :

| | |
|--|---|
| 1- Traumatic fracture. | |
| 2- Pathological : Fracture abnormal bone Cyst, Tumor, Infection | <p style="text-align: center; font-size: small;">Fig 6 Pathological fracture - simple bone cyst</p> |

Other special classification e.g.: fracture around the hip, ankle, etc.

Group A1

- **Dislocation** : Complete separation of the articular surface . Distal to proximal fragment Anterior, Posterior, Inferior, Superior .can't move.

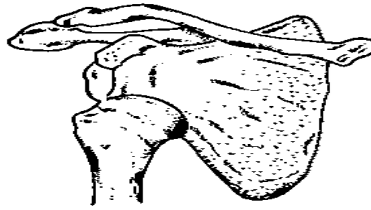


Fig. 7 Dislocation of the shoulder

- **Subluxation**:-Incomplete separation (partial separation). Joint Function in Anatomical position Only, can be moved!!

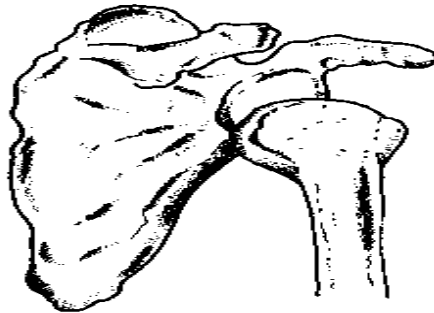


Fig- 8. Subluxation of the shoulder

Note: The **Dislocation** & **Subluxation** can be associated with Fracture.

◆ Mechanism of injury:

The line and extent of the fracture are determined by:

- 1- Amount of physical force.

Trivial force = Pathological
Magnitude = Non-pathological

- 2- Direction of physical force (direct or indirect)((we don't have to know the details just the fracture can be direct & indirect force))

Details: غير مطلوب



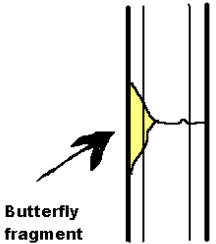


A-direct force:

- The bone fractured at the point of impact.
- Usually associated with complicated fracture.👈
- 3types:
 - 1- Trapping force: lead to transverse fracture.
 - 2- Crushing force; lead to comminuted fracture.
 - 3- Penetrating force; lead to comminuted fracture.

N.B. comminuted fracture: one in which the bone is splintered or crushed.

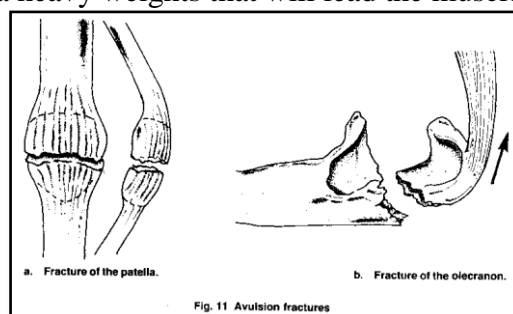
Group A1B- Indirect force:

- It is a force which is exerted at a distance from the site of the fracture.
- Less chance to association with complicated fracture.👉
- 5 types:

| | | | |
|--|---|--|--|
| 1- Twisting force; lead to spiral fracture. |  | 2- Angulation force; lead to transverse fracture .(may need ORIF or 3weeks casting) |  |
| 3- Angulation +axial compression force; lead to partial transverse fracture +butterfly (a separate triangular fragment).👉 N.B. The axial fracture in spine occurs at: <i>thoracolumbar</i> . |  <p>Butterfly fragment</p> | 4- Twisting + angulation + axial compression; lead to short oblique fracture. 90% need surgery. maybe it takes time if conservative |  |
| | 5- Vertical compression force ;lead to comminuted fracture Direction of Force On Cancellous Bones:- Direct OR Indirect Comminuted Pattern Burst |  | |

Indirect force due to Resisted Muscle Action: - “Avulsion” Transverse pattern

Note: i.e. Bodybuilders lift a heavy weights that will lead the muscle to break the bone.



◆ Diagnosis:

A. History :(Note: always it's acute history of trauma.)

- ❖ Ask about history of trauma; to exclude pathological fractures.
 - * Pathological (trivial)
 - * Non-pathological (magnitude)
- ❖ Mechanism of trauma to suspect :(asks about: Fall from height, RTA, pedestrian, Driver....?)
 - 1- The possible injury
 - 2- The association with soft tissue injury
 - 3- Help in management (by reverse the force during reduction).
- ❖ Complaints :
 - Pain: sharp, sudden in onset, aggravated by movement, relived by rest, usually not referred. (Localized).
 - Lose of function.
 - Deformity.
 - Symptom related to complications.
- ❖ Ask about other systems especially in head, chest and abdominal injuries.
- ❖ Past medical, surgical history.
- ❖ Past drug history (important in pathological fracture).♫

Commonest Presentation

B. Examination :

- ❖ General examination :
 - ✓ Sign due to fracture or trauma :
 - Vital signs, Shock A,B,C
 - Any associated injury to head, chest, or abdomen.
 - ✓ Sign related to the cause fracture (especially to the pathological fracture) for example; cancers of lung or prostate. (Full examination if we suspect pathological fracture.)
- ❖ Local examination :(always compare)

| Look | Feel | Move | Do |
|------------------------------|----------------------|-----------------------------|--|
| Simple Vs. compound fracture | Localized Tenderness | Active Vs. passive movement | Special test: a) Circulation b) Nerves |
| Any deformity | | Abnormal movement | Measurement: shortening |
| Hematoma | | Crepitus | |
| Skin lesion | | | |
| Swelling | | | |

C. X-rays:

Essential requirements: 2 views 2 Joints

- ❖ Two views:
 - Antero-posterior (AP view) and lateral view.
 - It is need for 2 reasons:
 - Some fracture may show in one view only, e.g.: undisplaced fracture of the neck of the femur.
 - To determine the degree of displacement at the fracture site.



Group A1

- ❖ Two joints:
 - Joints above and below the site of fracture.
 - It is needed for two reasons:
 - ◆ To detect any associated injury.
 - ◆ To determine the angulation at the fracture site.
 - Pre and post reduction.

Occasional requirements:

- Two limbs for comparison ,especially in children.
- Repeat the X-ray after 1-2 weeks(Two Occasions):
- Indication if the X-ray doesn't show a fracture .
- (**Note:** common in bones with less blood spilled e.g: scaphoid, femoral neck,..)
- Applied most commonly in suspected fracture to the scaphoid .
- Special X-ray ,e.g. stress films to ligamentous injuries (decrease its use nowadays since the MRI has taken the job) .

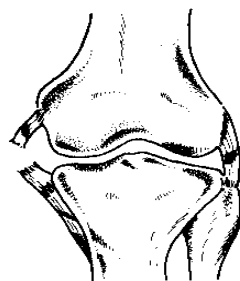


Fig. 13 The knee looks normal although the medial ligament is ruptured

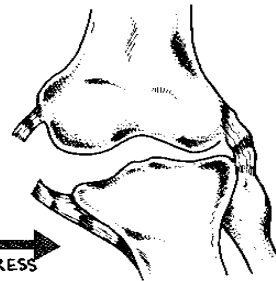


Fig. 14 Same knee under valgus stress shows widening due to the ruptured medial ligament.

◆ Description of the fracture on X-ray:

- Situation :
 - Side (right or left)
 - Site (upper, middle, or lower).
- Pattern :Line of the fracture (transverse ,spiral ,or comminuted)
- Displacement which could be :
 - ◆ Shift (lateral ,medial, anterior, or posterior)
 - ◆ Tilt (angulation)
 - ◆ Twist (rotation).(internal or external)
 - ◆ Shortening (over riding or impaction)

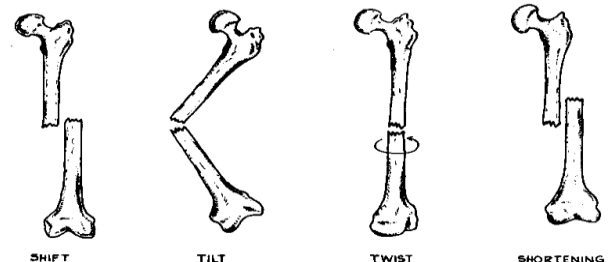


Fig. 15 Displacement

◆ Management:

Repair of the fracture:

- a- **Primary repair:**
 - With Rigid Internal Fixation
 - No Callus formation
 - Active Haversian remodeling
 - Long time to heal
- b- **Secondary Repair:**
 - **Without rigid fixation**
 - **Commonest type even with I.F.**
 - Fast healing
 - Callus formation

◆ Healing of fracture:

- ◆ Factor that affect the rate and effectiveness of healing process:
 - Age
 - Line of fracture
 - Systemic or local disease.

A. fracture healing without rigid fixation :

- ❖ **Stage I:** hematoma formation: Clot formation (**Note:** hematoma formation has all the supplement of bone healing).
- ❖ **Stage II :** traumatic inflammation :
 - More fibrin will accumulate to already present clot.
 - Increase blood flow and infiltration of leukocyte.
- ❖ **Stage III :** Demolition:
 - Macrophage will take place through removal of inflammatory exudates, fibrin, RBC's and debris.
 - Remove any bone fragment undergoes necrosis by macrophage and osteoclasts.
- ❖ **Stage IV:** formation of granulation tissue.
- ❖ **Stage V :** woven bone and cartilage formation :
 - By the activity of osteoblasts.
 - Formation of external intermediate and internal callus (callus: unorganized network of woven bone, which is absorbed as healing, is completed, and ultimately replaced by true bone).
- ❖ **Stage VI:** Formation of lamellar bone: Form over the woven bone and cartilage.
- ❖ **Stage VII.** Remodeling: (Note: The remodeling can't be happened if the bone twisted.)
 - Continuation of osteoclastic removal and osteoblastic laying down of bone.
 - External callus will removed slowly, intermediate callus converted to compact bone while the internal callus will hollow into narrow cavity which contain cancellous bone.

B. Fracture healing with rigid internal fixation :

- The bone heals by primary vascular bone formation.
- No formation of external or internal callus.☞

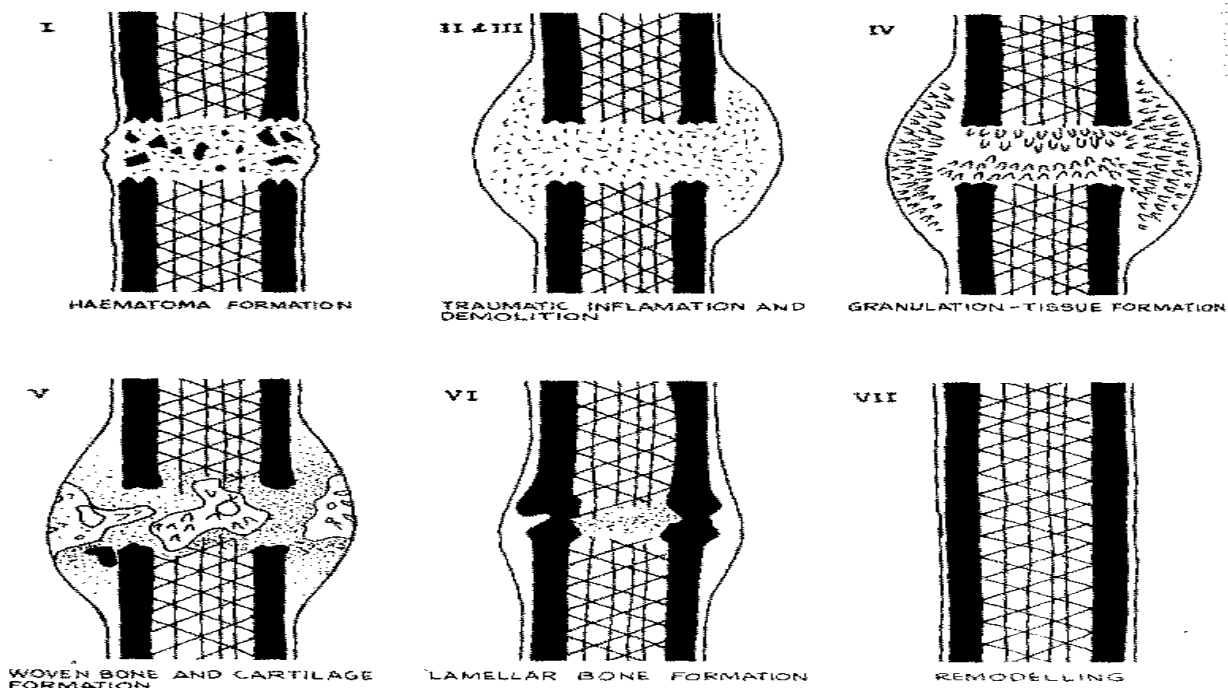


Fig. 37 Stages in fracture repair without rigid fixation

Group A1

| Time Factor- Perkin's formula | | |
|-------------------------------|---|--|
| | Union | Consolidation (remodeling) |
| Upper limb | Spiral: 3 weeks Transverse : 6 weeks | Spiral=6 weeks Transverse =12 weeks |
| Lower Limb | Spiral:6 weeks Transverse:12 weeks | Spiral =12 weeks Transverse =24 weeks |

N.B. Remodeling takes double the time of union .AND the children take the half of the period.

◆ Fractures in children:

- Fracture in children has a special consideration for the following reasons:
 - 1) Healing is more rapid.
 - 2) Open reduction is rarely indicated, except in cases of fracture into joints. (Note: We always start the management with closed reduction until we need to do open reduction.)
 - 3) High remodeling rate. Especially in angular deformities not in rotation deformities.
 - 4) Growth distribution in epiphyseal injuries.
 - 5) Often missed due to poor communication with the child .b/c the child often tends to cry.
 - 6) X-rays of both limbs for comparison are required .especially if it is near joints.
- Children differ than adult in:
 - 1) Children bones are more malleable, allowing a plastic type of bowing injury.
 - 2) The periosteum is thicker than adult & usually remain intact on one side of fracture.
 - 3) Usually incomplete so, green stick fracture is common.
- Fracture caused by child abuse :
 - Multiple areas of large ecchymosis in different stages of resolution (from black & blue to brown & green) also are pathognomic of child abuse.
 - Mostly occurs between birth and 2 years of age.
 - Most commonly occurs in long bones (humerus , tibia , femur)
 - bone scan or a skeletal survey generally is indicated
 - It may be diagnose d by excludition :
 - 1-Heamophilia
 - 2- metabolic bone disease
- ☒ N.B. multiple fractures in different stage of healing are almost indicative of abuse.
- ☒ N.B. growth plate b/w metaphyseal& epiphyseal.

Note:


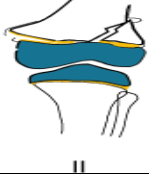



- The growth plate is the weakest point more than bone & soft tissue also it's the most common place in injury.
- Injury in the growth plate (in the side or middle of growth plate) can cause deformity (e.g. angular deformity, leg length discrepancy...).
- We have to compare to the other limb in case of fracture.
- We have to apply a cast if we suspect fracture with no x-ray sign of fracture.

A. Physeal injuries :

- Represent 30% of fractures.
- Occurred twice as often in the upper extremities as in the lower extremities .
- Commonly used classification is that of salter and harris , which is based on the roentgenographic appearance of the fracture .

N.B. before applying the Salter & Harris classification you should note the open growth plate.

Salter & Harris classification for physeal injury

| Type | Features | Treatment | Prognosis |
|--|--|--|--|
|  I | Epiphysis is completely separated. No fracture through bone. | By closed reduction | Excellent No growth – disturbance |
|  II | Commonest type (70%) Small fracture through metaphysis. | By closed reduction | Excellent No growth – disturbance |
|  III | It is intra –articular fracture .(only in epiphysis) | Accurate reduction is essential. Open reduction may be necessary. | Good |
|  IV | It is intra –articular fracture (in epiphysis +metaphysis) | Open reduction is almost always necessary. | Can be favorable if anatomically reduced. |
|  V | Due to severe crushing force. No epiphyseal displacement. | No reduction Just immobilization by plaster of paris cast. | Poor. Cessation of growth Angular deformities often occur. |

B. Birth fracture:

- Generally it is iatrogenic.
- These fractures occur most commonly in the clavicle "most common" ,humerus ,hip ,and femur .(long bones)
- They rarely require surgery.
- It is frequently diagnosed as pseudopalsy, infection, or dislocation.
- It may be present as a mass or deformities (length deformity is a common)
- Treatment: conservative.

◆ Pathological fracture:

- ◆ It is a break of the continuity of bone within an abnormal bone structure.
- ◆ Abnormal bone structure could be due to :
 - 1) Congenital disease (osteogenesis imperfect).(defect in type II collagen)
 - 2) Infection (osteomyelitis).
 - 3) Fracture through a cyst.
 - 4) Metabolic disease (osteoporosis, osteomalacia, Paget's disease).
 - 5) Primary bone tumors.(rare)
 - 6) Metastatic bone tumors. (more common) especially from:
(Kidney –thyroid- lung – prostate – breast...cancer's)

❖ **Diagnosis :**

✓ **History :**

- ◆ Insignificant amount of trauma[♠].
- ◆ Constitutional symptoms.
- ◆ History of malignancy.
- ◆ Family History.

✓ **Examination :**

☒ **General :**

- a) Sign of malignancy ,e.g.: weight loss
- b) Sign of infection.

☒ **Local:**

- a) Tenderness, pain and swelling.
- b) Muscle spasm and deformity is minimal

✓ **Investigation :**

➤ **Radiology :**

- 1) X-rays, MRI, CT scan of the lesion site (are essential).
- 2) CRX and CT-chest to detect pulmonary metastasis .b/c the sarcomas of the bone metastasis to the lung.
- 3) Bone scan, PET scan.

➤ **Laboratory :**

- 1) Specific tests e.g. raised acid phosphatase in prostatic cancer, and positive bence jones protein (BJP) IN multiple myeloma.
- 2) Non-specific tests e.g. CBC, ESR, CRP, and LDH.

❖ **Management :**

- Aim: to make patient more functional and pain free for the remaining life span. (Saving life, limb, and its function).
- Early operative stability (e.g. by internal fixation) should be carried out.
- Other methods in advanced cancer such as chemotherapy, radiation, hormonal.
- Indication for prophylactic internal fixation (metastasis)[♠]:
 - 1) Involvement of the cortex
 - 2) Increased pain
 - 3) Pure lysis
 - 4) Weight bearing area.

◆ **Aim of management:**

General aim: To Save the Life of Patient

Local aim: *Rapid Recovery* of Injured Part and Its Function.

⊙ General aim (save the life) by :

- Full general examination.
- Treat life threatening injury :
 - 1- Head, chest or abdominal injury.
 - 2- Shock

⊙ Local aim :

- Save the limb:
- By early detection and treatment of:
 - Ischemia
 - Infection
- Save the function :
 - 1) Reduction
 - 2) Immobilization
 - 3) Soft tissue treatment
 - 4) functional activity & rehabilitation

1) Reduction :

- Should be Under Anesthesia
- Closed or Open
- Study X-Ray and direction of force
- The basic Maneuvers :
 - Traction
 - Reverse mechanism of Injury
 - Direct pressure

❖ Standards of reduction :

- Anatomical Reduction is Ideal for all type of fracture.
- Anatomical Reduction is *a MUST* be achieved in☺☺ :

**absolute
reduction**

{

- Dislocation
 - Intra-articular fractures (displaced fracture involves the joints especially in young patient.
 - Fractures both bones Forearm, to avoid loss of pronation and supination.
- X-Ray Image Intensifier help control reduction
- Remember to Assess Reduction after 10 Days☺☺ !
- Reduction can be “Acceptable” if :-
- Alignment will NOT affect Function, so some loss of opposition and slight degree of angulation (less than 10 degree) are acceptable.
- Remolding CAN correct deformity
- Remolding can correct :-
 - Angular deformities NOT Rotational deformities ☺
 - Children MORE than Adults

❖ Time of reduction:

- **Immediate Reduction** is a MUST in:
 - * Vascular Injury (risk of ischemia)
 - * Spinal Cord or Nerve Injury (risk of Para or quadric plegia)
- **Urgent R. in: (Note:** Within 6 - 24 hours but we are afraid from infection so we have to reduce it)
 - OPEN fractures ; “Save Limb”
 - Dislocations Need Urgent reduction for Pain and pressure on surrounding pressure.
- CLOSED fractures **CAN wait** if Facilities do not permit Urgent management.

❖ Immobilization

“Life is Movement, and Movement is Life”

- Do NOT Immobilize Any Joint Unnecessarily👉
- Applied after fracture reduction until union.
- Can be achieved by:
 - Plaster of Paris
 - Traction
 - Internal Fixation
 - External Fixator

❖ Open fractures (compound fracture):

- ◆ Fracture site communicate with the external environment👉
- ◆ Emergency management
- ◆ Infection will occur with delayed or inadequate treatment👉

N.B. periosteum is rich in blood supply, thick in children → faster healing.

⊙ Management :**A. general care:**

- Aim: (save life, save limb, then save function).
- Antibiotics directed against staphylococci (most common), and as needed👉.
- Tetanus prophylaxis.
- In ER:
 - 1) Splint to prevent further damage.
 - 2) Check for tetanus.
 - 3) Start with antibiotic.
 - 4) If there is gross contaminated remove.
 - 5) Put wet sponge & send to OR.
- N.B. do not irrigate, debride or clean in ER.

B. local care:

- Aim: save the limb and function.
- Steps of operative procedure:
 1. Clean:
 - Fracture site is covered; Sterile Gauze
 - Skin shaved, Limb Cleaned “ Betadine”
 2. Irrigation: Plenty of Saline or Water Dilution is the Solution For pollution
 3. Debridement(Excise Wound):
 - Debride = Unleash tight structures
 - Skin: Excise edges, incise to explore!
 - Deep Fascia: open widely, Don't Suture!
 - Dead Muscles: Excise Liberally
 4. Decontamination of the bone:
 - Curette ends, remove dirt
 - Remove small detached fragments
 - Keep large pieces
 - Reduce Fracture, Avoid Internal Fixation

Group A1

5. Closure

- Primary Closure Ideal! Skin Best Dressing
- Avoid Wound Tension
- Avoid primary suture of Nerves & tendons Except *Clean wounds * < 6 hours + *Expert
- Be aware of exception of closure in↓:
 - 1) Wound over 6 hrs.
 - 2) High velocity missile injuries (e.g. gunshot wound)
 - 3) Highly contaminated wounds.
 - 4) If closure cause tension of skin edges.

6. (Note: Reductions)

7. Immobilize.

2nd: look a patient after 48 hrs.

◆ **Complication:**☒ **Delayed Union:-**

- Healing Slow but still Active, Remove the cause!
- Fracture Site Tender
- X- Ray: little Callus, Medulla Open
- Smoking is one of the causes of delayed union

☒ **Non- Union:-**

- Reparative process Stopped, Need Intervention
- Painless, with Abnormal Movement, formation of Pseudoarthrosis (false joint)!
- X- Ray: Sclerosis, Blocked Medulla.

❖ **Delayed Union & Nonunion Causes:-**• **Local :-**

1. Poor Blood Supply
2. Soft Tissue Interposition
3. Infection
4. Inadequate Immobilization
5. Over-Distract
6. Pathology, Tumors

• **General:-**

- 1- Nutrition
- 2- Bone Disease
- 3- Old Age
- 4- Smoking
- 5- Hypothyroidism

☒ **Malunion:-**

- 1- Primary, i.e: Neglected fracture.
- 2- **After Reduction!** Watch X-Ray after 10 Days↓↓.
- 3- Secondary, i.e. unavoidable deformity e.g. crushing injury to Epiphyseal Growth plates causes deformities...fracture with extensive bone loss.

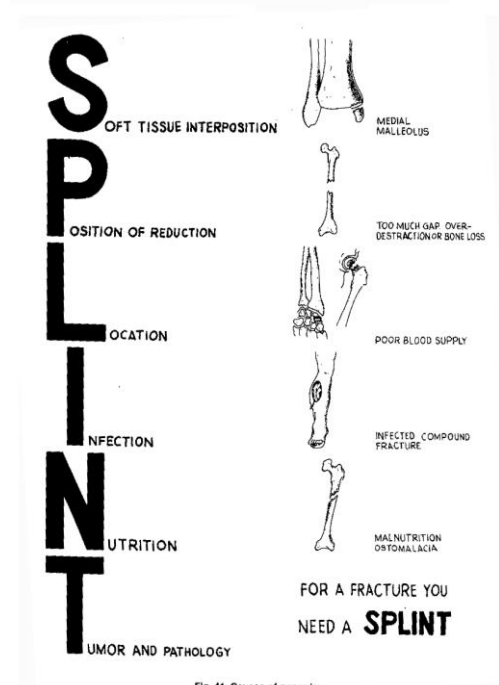


Fig. 41 Causes of nonunion

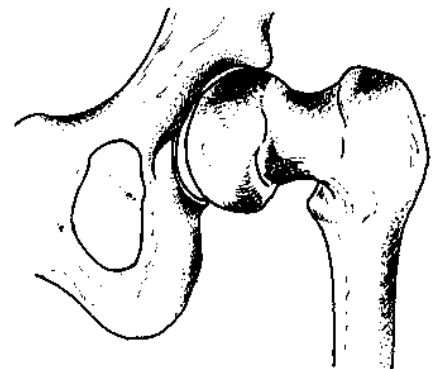


Fig. 43 Malunited fracture

Group A1**☒ Avascular Necrosis:-**

- Death of Bone from; Impairment or Loss of blood Supply.
- In X-ray , it appears as sclerosing area ((bad sign ,mean dead bone))
- The most common sites are:
 - ✓ Scaphoid bone
 - ✓ Neck of the femur
 - ✓ Talus
 - ✓ Anatomical snuff box.

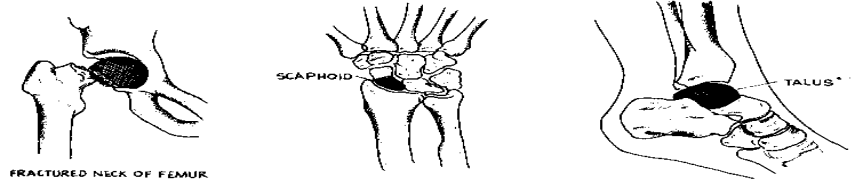


Fig. 44 Common sites of avascular necrosis

☒ Reflex Sympathetic Dystrophy

(**Note:** when there is sympathetic nerve damage due to prolonged immobilization (e.g. cast). Most common in elderly patient. It's look like patches of osteopenia in x-ray)

- “Sudeck’s Acute Bone Atrophy”
- Commonest Hand and foot # Arm or Leg!!
- Cause iatrogenic.

✓ **Diagnosis:**

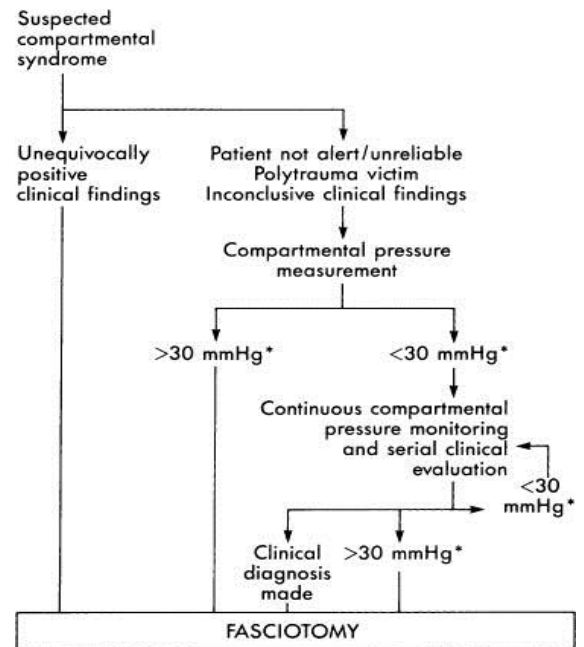
- History : Pain, Swelling, Restriction Movement
- Examination : Skin :Glossy, Smooth, Stretched with increase in local temperature (due to increase blood flow in the limb)
- X-rays: show osteoporosis.

✓ **Treatment :**

- Physiotherapy
- Sympathetic Block
 - ✓ Medical : Drugs,
 - ✓ Surgical: Regional Block Sympathectomy

☒ Compartment Syndrome :

- Elevation of the interstitial pressure in a closed osseofascial compartment that results in microvascular compromise.
- Normally the interstitial pressure = 0mm/Hg until 20-25 mm/Hg is acceptable.



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✓ **The most common causes of acute compartment syndrome are:**

1. fractures,(even open fracture)
2. soft tissue trauma,
3. arterial injury,
4. limb compression during altered consciousness,
5. Burns.
6. Other causes include intravenous fluid extravasation and anticoagulants

✓ **Diagnosis:**

- ◆ Symptom: 5 P's→ pain, pulseless, parathysia, paralysis, pallor.
- ◆ Level of leg as the level of heart for 20 minutes , if the pain goes that good ,if not →measure the pressure if high →do fasciotomy

✓ **Treatment:**

- Fasciotomy. N.B. Do not give narcotic.

Common Adult Fractures

Part 1: Upper Limb Fractures

Objectives of the Lecture

- know most of mechanisms of fracture injury
- make the diagnosis of common adult fractures
- request and interpret the appropriate x-rays
- initiate the proper management of fractures
- know which fractures can be treated by conservative or operative method
- Know the possible complications of different fractures and how to avoid them.

Upper Limb Fractures:

- Clavicle
- Humeral (Proximal , shaft)
- Both Bone forearm (Radius, ulna)
- Distal Radius

Mechanism of Injuries of the Upper Limb

Mostly Indirect

Commonly described as “a fall on outstretched hand “

Type of injury depends on: 1- Position of the upper limb at the time of impact
2- Force of injury 3- Age

A- Clavicle Fractures:

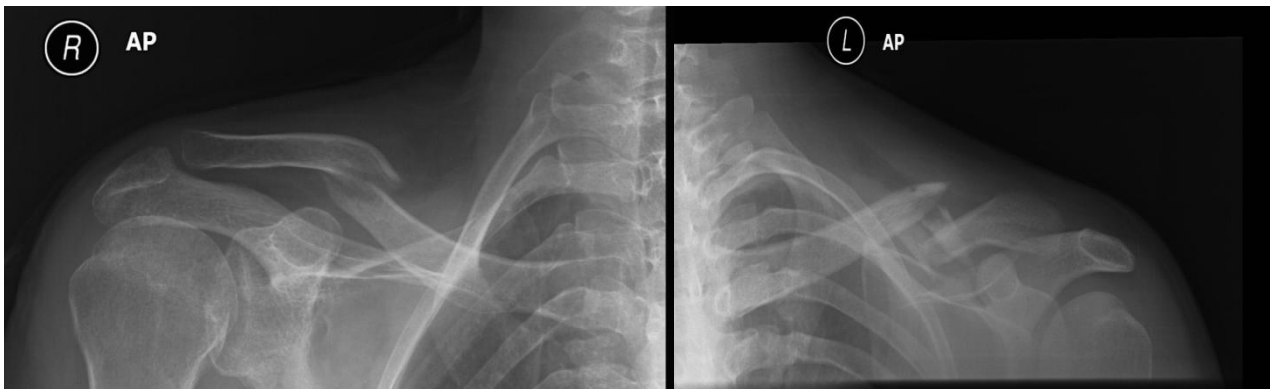
- The clavicle functions as a strut, bracing the shoulder from the trunk and allowing the shoulder to function at optimal strength
 - Incidence: 5% Proximal Third of The clavicle, 80% middle Third of The Clavicle, 15% Distal Third of the Clavicle.
 - Common In Children (Unites Rapidly without Complications in them)
- Mainly due to indirect injury
- Direct injury leads to comminuted fracture (which have Serious Complications)

Clinical Evaluation:

- Splinting of the affected extremity, with the arm adducted
- Neuro-vascular examination is necessary (due to the presence of Brachial Plexus and vessels)
- Assessment of skin integrity (open wounds)
- The chest should be auscultated

RADIOGRAPHIC EVALUATION:

- anterior-posterior radiographs
- you can see comminuted fracture

**Clinical Features:**

- ◆ Pain and Tenting of Skin.
- ◆ Arm is clasped to chest to splint the shoulder and prevent movement.

Treatment:

- Conservative:
 - Arm sling or figure of eight.
- Open Fixation:

Indication for It: **NO CAST**

N - Non Union

O - Open Fracture

C - Neurovascular Compromise Nonunion

A - Intra-articular Fracture

S - Salter- Harris 3, 4, 5

T - Poly Trauma

Complications:

Neurovascular compromise

Malunion

(0.1% to 13.0%, with 85% of all nonunion occurring in the middle third.)

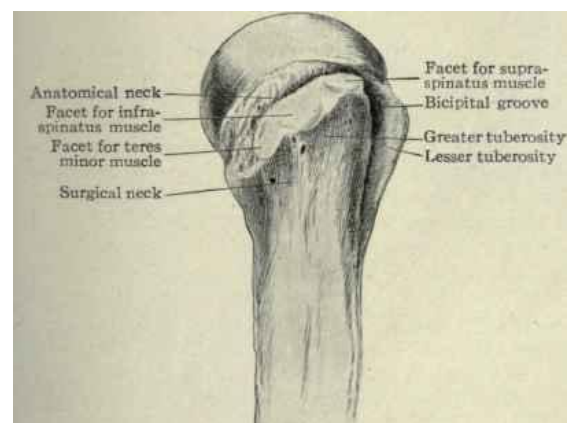
Post-traumatic arthritis at **Laterally** AC joint
, **medially** SC joint.

B- Humerus Fractures:**1- Proximal Humerus Fracture:**

- Includes surgical and anatomical neck.
- Comprise 4% to 5% of all fractures and represent the most common humerus fracture (45%).

Mechanism:

- Young: high energy Trauma
- Older: fall on an outstretched hand (FOOSH)



Clinical Evaluation:

- Pain, swelling, tenderness, painful range of motion, and variable crepitus. Ecchymosis
- A careful neuro-vascular examination is essential, axillary nerve function.

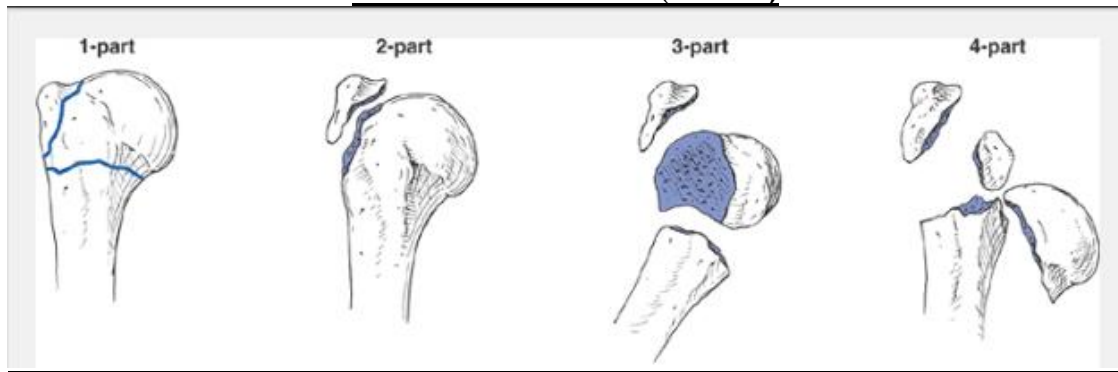
Motor: movement of the Deltoid muscle

Sensory: to deltoid Muscle

RADIOGRAPHIC EVALUATION:

- AP and lateral views
- Computed tomography: To evaluate for articular involvements and Fracture Displacement.
- Magnetic resonance imaging

CLASSIFICATION (Neer's)



- ♦ **Neer classification** is based on 4 fractures fragments: Humeral Head, Greater Tuberosity, Lesser Tuberosity, and Humeral Shaft.

1- Non-displaced: Displacement is $< 1\text{cm}$ and/or angulation < 45 degree.

2- Displaced: Displacement is $> 1\text{cm}$ and /or angulation > 45 degree.

3- Dislocate/ Subluxed: Humeral head dislocated. subluxed from glenoid.

So,

- **Two-part Fracture:** Any of the 4 parts with 1 displaced
- **Three part Fracture:** Displaced fracture of the surgical Neck + displaced greater tuberosity or lesser tuberosity.
- **Four- part Fracture:** Displaced fracture of Surgical Neck + both Tuberosities.

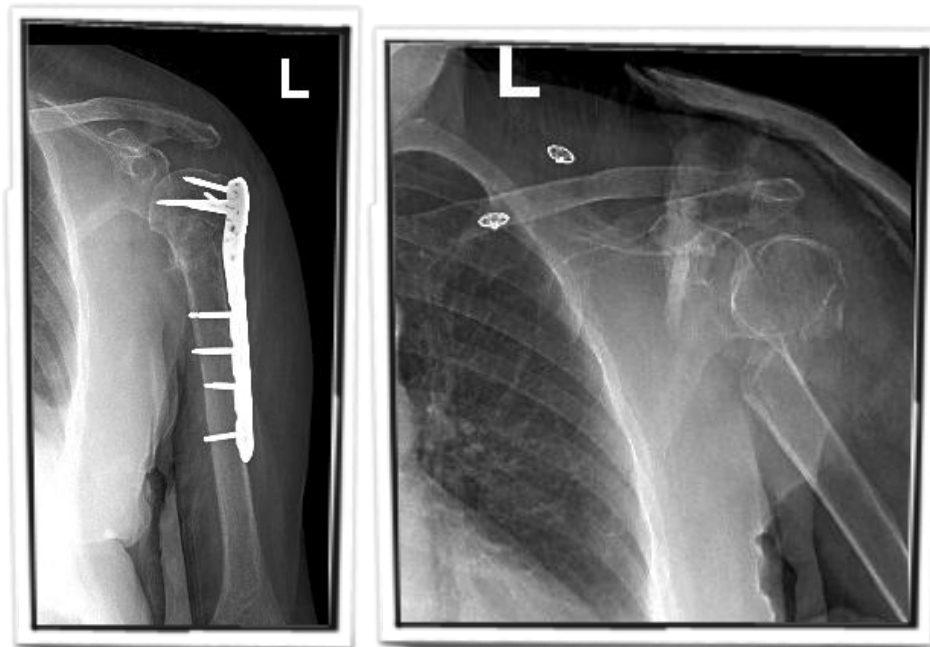
TREATMENT:

- Minimally displaced fractures:
 - 85% of proximal humerus fractures are minimally displaced or nondisplaced.
 - Sling immobilization for comfort.
 - Early shoulder motion may be instituted at 7 to 10 days.
 - Pendulum exercises and passive range-of-motion exercises.
 - At 6 weeks, active range-of-motion exercises are started.

Group A1

- Surgical indication:

- Anatomic neck fracture.
- Surgical neck fracture.
- Greater tuberosity fractures: If they are displaced more than 5 to 10 mm.
- Lesser tuberosity fractures displaced fragment blocks internal rotation or associated posterior dislocation.
- Three- part fractures
- Four- part fractures Associated almost with A-Vascular Necrosis (AVN)
 - Incidence of osteonecrosis ranges from 13% to 35%.
 - ORIF may be attempted in young patients if the humeral head is located within the glenoid fossa
 - Primary prosthetic replacement of the humeral head (hemiarthroplasty)) is the procedure of choice in the elderly
- Fracture-dislocation

ORIF- surgical neck fractureORIF surgical Neck**COMPLICATIONS**

- Vascular injury: (5% to 6%); the axillary artery is the most common site
- Neural injury
 - Brachial plexus injury: (6%).
 - Axillary nerve injury
- Chest injury: Intrathoracic dislocation; pneumothorax and hemothorax
- Myositis ossificans
- Shoulder stiffness
- Osteonecrosis: 3% to 14% of three-part proximal humeral fractures, 13% to 34% of four-part fractures, and a high rate of anatomic neck fractures.
- Nonunion
- Malunion

2- Shaft of the Humerus Fracture:

- Commonly Indirect injury
- 3% to 5% of all fractures
- Indirect injury results in Spiral or Oblique fractures
- Direct injuries results in transverse or comminuted fracture
- May be associated with Radial Nerve injury (AT THE SPIRAL GROOVE OF THE HUMERUS)

Clinical Evaluation:

- Typically present with pain, swelling, deformity, and shortening of the affected arm, crepitus.
- Soft tissue abrasions and minor lacerations must be differentiated from open fractures
- careful neurovascular examination is essential, with particular attention to radial nerve function

RADIOGRAPHIC EVALUATION:

AP and lateral radiographs of the humerus should be obtained, including the shoulder and elbow joints on each view.

CLASSIFICATION (Descriptive):

- Open vs. closed.
- Location: proximal third, middle third, distal third.
- Degree: nondisplaced, displaced.
- Direction and character: transverse, oblique, spiral, segmental, comminuted
- Articular extension.

Management of Fracture Shaft of the Humerus:

- Most of the time is Conservative
 - (>90%) will heal with nonsurgical management
 - 20 degrees anterior angulation, 30 degrees of varus angulation and up to 3 cm of bayonet apposition are acceptable and will not compromise function or appearance
- Closed Reduction in upright position followed by application of U shaped Slab of POP or Cylinder cast.
- Few weeks later or initially in stable fractures Functional Brace may be used
- Hanging cast: This utilizes dependency traction by the weight of the cast and arm to effect fracture reduction:
 - It is frequently exchanged for functional bracing 1 to 2 weeks after injury.
 - More than 95% union is reported

Indications for ORIF Fracture Shaft of Humerus

- i. Multiple trauma
- ii. Inadequate closed reduction or unacceptable malunion
- iii. Pathologic fracture
- iv. Associated vascular injury
- v. Floating elbow
- vi. Segmental fracture
- vii. Intraarticular extension
- viii. Bilateral humeral fractures
- ix. Open fracture
- x. Neurologic loss following penetrating trauma
- xi. Radial nerve palsy after fracture manipulation (controversial)
- xii. Nonunion

Surgical Techniques:

- ❖ Open reduction and internal fixation using plate and screws
- ❖ Intramedullary nail or K-wires
- ❖ External fixator: Indications include:
 - Infected nonunions.
 - Burn patients with fractures.
 - Open fractures with extensive soft tissue loss.

- Complications include pin tract infection, neurovascular injury, and nonunion.

**COMPLICATIONS**

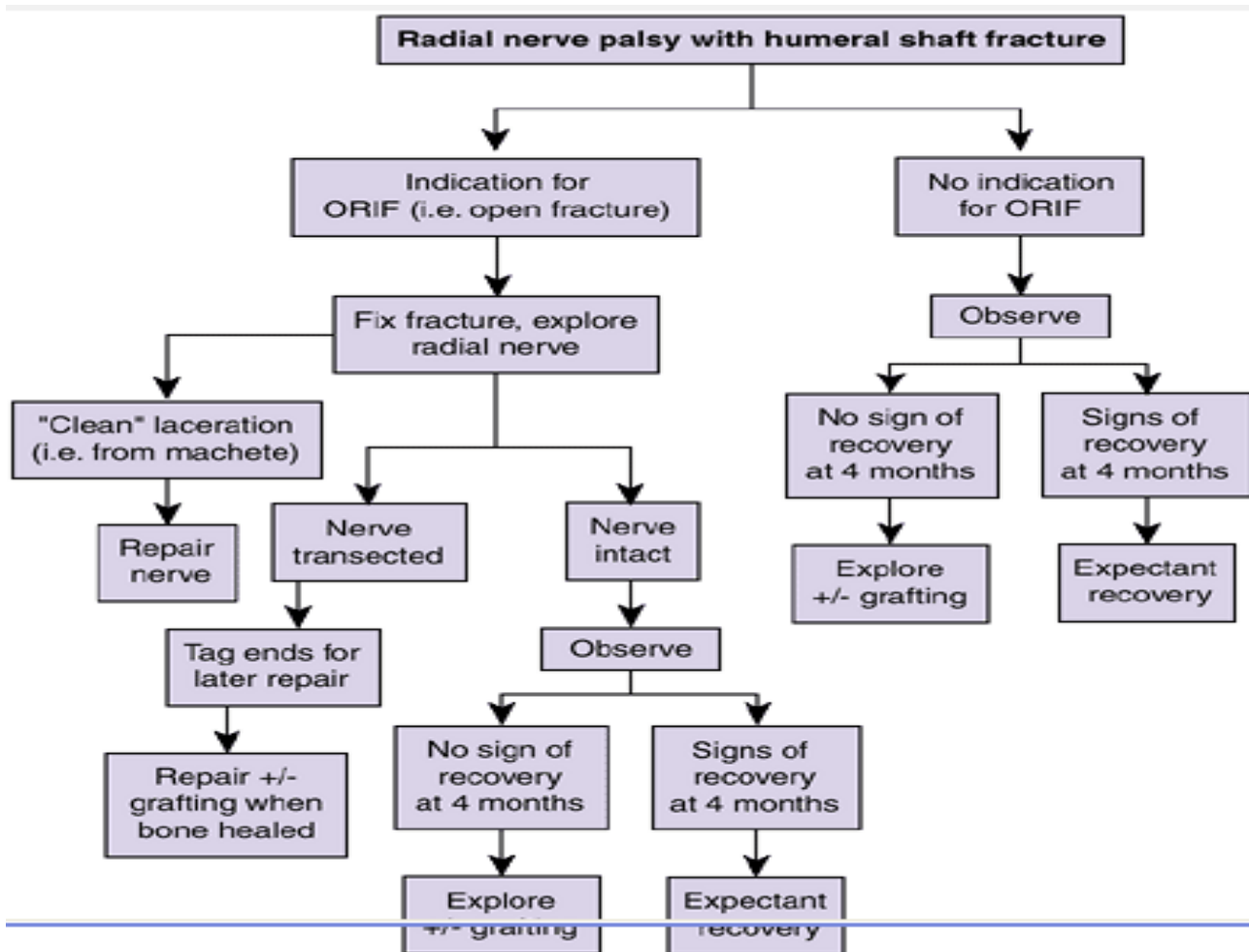
- **Radial Nerve Injury (Wrist drop):**

Fracture humerus in up to 12% of fractures

- a. 2/3 (8%) of Radial injury are Neuropraxia.
- b. 1/3 (4%) are nerve lacerations or transection.

Management of Radial Nerve injury

- Open fractures ; immediate exploration and ± repair
- In closed injuries treated conservatively; initial management is doing Nerve Conduction Studies (NCS) and Electromyography (EMG) after 6 weeks, and awaiting for spontaneous recovery
- Recovery usually starts after few days but may take up to 9 months for full recovery
- If No spontaneous recovery occurs in 12 weeks confirmed by NCS and EMG ;then exploration of the nerve should be carried out

**Vascular injury:**

It is uncommon

The brachial artery has the greatest risk for injury in the proximal and distal third of arm.

It constitutes an orthopedics emergency; arteriography is controversial because may prolong time to definitive treatment for an ischemic limb

Nonunion:

Up to 15%

Risk factors: at the proximal or distal third of the humerus, transverse fracture pattern, fracture distraction, soft tissue interposition, and inadequate immobilization

ORIF + Bone graft

c- Both Bone forearm (Radius, ulna):

- Forearm fractures are more common in men than women.
- Motor vehicle accidents, contact athletic participation, altercations, and falls from a height.

Clinical Evaluation:

- Gross deformity of the involved forearm, pain, swelling, and loss of hand and forearm function.
- A careful neurovascular
- open wound
- compartment syndrome

Radiographic Evaluation:

Anteroposterior (AP) and lateral views

Radiographic evaluation should include the two joints.



Classification (Descriptive):

- Closed versus open
- Location
- Comminuted, segmental, multifragmented
- Displacement
- Angulation
- Rotational alignment

Treatment:

- ♦ Nonoperative
 - Nondisplaced fracture need a well-molded, long arm cast in neutral rotation with the elbow flexed to 90 degrees.
 - Follow-up to evaluate for possible loss of fracture reduction.

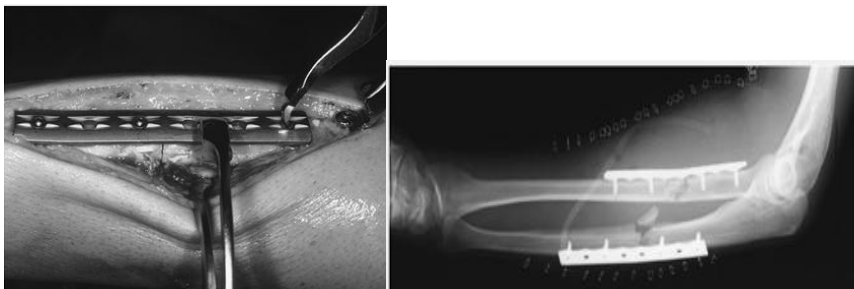
1- Operation:

A. Open reduction and internal fixation

B. External fixation

Indication

- severe bone
- soft tissue loss
- gross contamination
- infected nonunion
- Open elbow fracture-dislocations with soft tissue loss.



Complications:

- A. Nonunion and malunion
- b. Infection:
- c. Neurovascular injury
- d. Volkmann ischemia follows Compartment Syndrome.
- e. Posttraumatic radioulnarsynostosis (3% to 9%)

D- Distal Radius Fracture:

- Distal radius fractures are among the most common fractures of the upper extremity.
- one-sixth of all fractures treated in emergency departments

CLINICAL EVALUATION:

◆ Wrist deformity and displacement of the hand in relation to the wrist (dorsal in Colles or dorsal Barton fractures and volar in Smith-type fractures). The wrist is typically swollen with ecchymosis, tenderness, and painful range of motion.

◆ Neurovascular assessment:

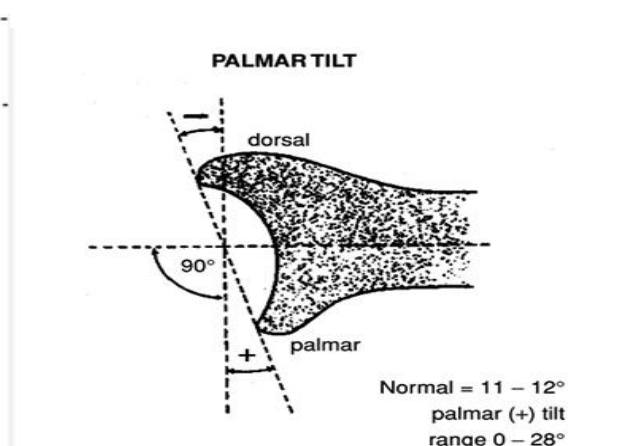
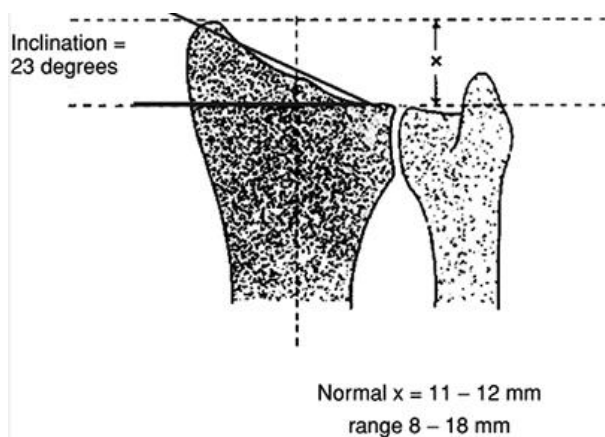
Median nerve function. Carpal tunnel compression symptoms are common (13% to 23%).

RADIOGRAPHIC EVALUATION:

Posteroanterior and lateral views

Normal radiographic relationships

- a. Radial inclination: averages 23 degrees (range, 13 to 30 degrees)
- b. Radial length: averages 11 mm (range, 8 to 18 mm).
- c. Palmar (volar) tilt: averages 11 to 12 degrees (range 0 to 28 degrees).



Radiological Evaluations



CLASSIFICATION (Descriptive):

- Open versus closed
- Displacement
- Angulation
- Comminution
- Loss of radial length

Colles' fracture:

- Extraarticular fractures.
- 90% of distal radius fractures
- Dorsal angulation (apex volar), dorsal displacement, radial shift, and radial shortening.
- Clinically .dinner forka deformity.
- Mechanism: a fall onto a hyperextended, radially deviated wrist with the forearm in pronation.
- **Usually don't Need operative Treatment**



Barton fracture:

- A fracture-dislocation or subluxation of the wrist in which the dorsal or volar rim of the distal radius is displaced with the hand and carpus. Volar involvement is more common --ORIF
- Mechanism: a fall onto a dorsiflexed wrist with the forearm fixed in pronation
- **Usually needs operative Treatment.**



Smith fracture (reverse Colles fracture):

- A volar angulation (apex dorsal) of the distal radius with an garden spades deformity or volar displacement of the hand and distal radius ----ORIF
- Mechanism: a fall onto a flexed wrist with the forearm fixed in supination

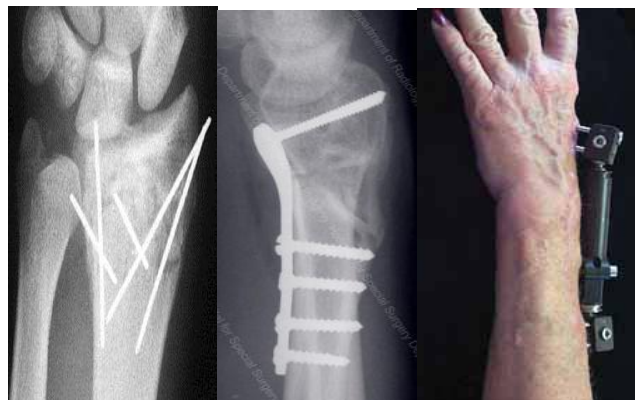
TREATMENT

- Acceptable radiographic parameters for a healed radius in an active, healthy patient include:
 - Radial length: within 2 to 3 mm of the contralateral wrist.
 - Palmar tilt: neutral tilt (0 degrees).
 - Intraarticular step-off: <2 mm.
 - Radial inclination: <5-degree loss.

Nonoperative: CR + casting, Hematoma block, Bier block, or conscious sedation

Operative: indications

- High-energy injury
- Secondary loss of reduction
- Articular comminution, step-off, or gap
- Metaphyseal comminution or bone loss
- Loss of volar buttress with displacement
- DRUJ incongruity

Operative Techniques

•Percutaneous pinning . ORIF .External fixation

COMPLICATIONS

- Median nerve dysfunction
- Malunion or nonunion
- Complications of external fixation include reflex sympathetic dystrophy, pin tract infection, wrist and finger stiffness, fracture through a pin site, and radial sensory neuritis
- Tendon rupture, most commonly extensor pollicis longus
- Midcarpal instability
- Posttraumatic osteoarthritis
- Finger, wrist, and elbow stiffness

Done 1/2!

Part 2: Lower Limb Fractures

In General:

Mechanism of fractures

- Lower limb fracture is a result of a high energy trauma like MVA, fall, except in elderly people or diseased bones.
- Types of fracture are depend on position of limb during impaction and magnitude of forces applied.

Management

- The proper way to treat a patient with high energy trauma is to look at the patient as whole, not to injured limb alone!
- So the aim to treat such patient is to save life first, then save limb, finally to save function.
- A.B.C.D

1- Pelvic fractures:

- Classifications. (Tile)

Type A. Stable

Type B. Rotationally Unstable, Vertically Stable.

Type C. Rotationally and Vertically Unstable.

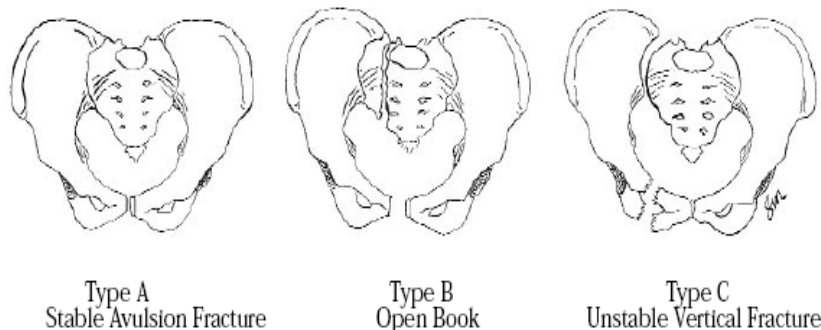


Figure 20. Illustration of the Tile Classification of Pelvis Fractures

So, Type A

Type A stable Fracture of superior & inferior pubic remi & no diasthesis of SP (Symphysis Pubis)



Type B

Type B open book fracture Diasthesis of SP more than 2cm



Group A1**Type C**

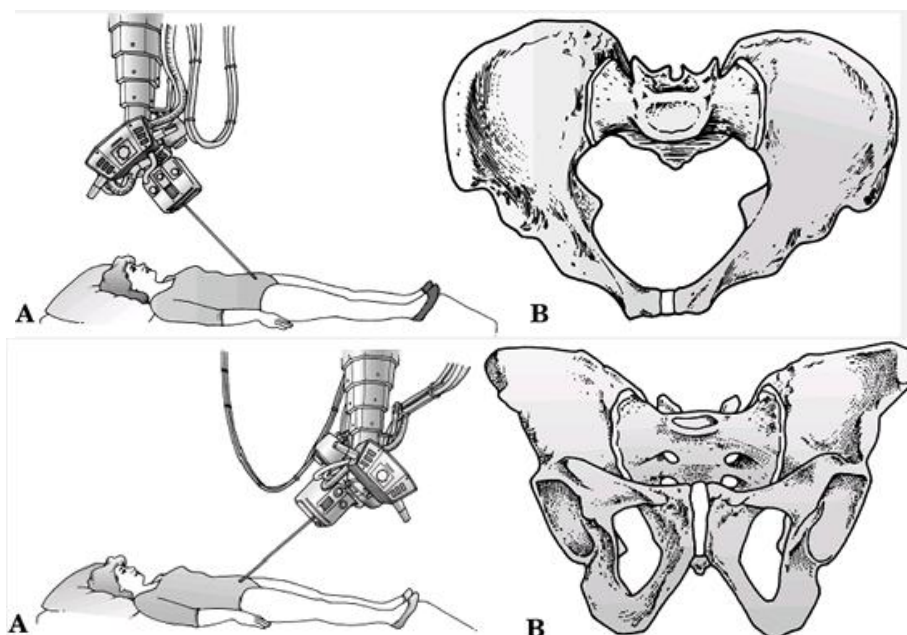
Type c fracture there is diasthesis of SP & vertical shear & SIJ (Sacro iliac joint) involvement

**Radiological examination:**

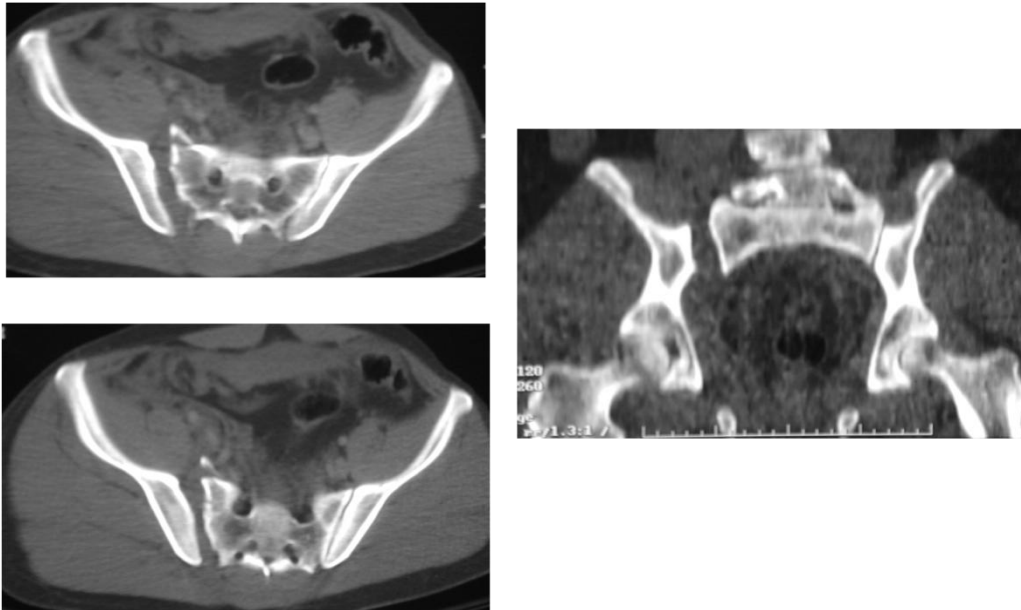
Q: which one is the normal AP?

RADIOGRAPHIC EVALUATION:

- AP of the pelvis
- Inlet radiograph
- Outlet radiograph
- Computed tomography
- Magnetic resonance imaging for any Soft tissue Injury.



CT give you clear idea about bony & soft tissues you can assess the degree of distrubtion
 Coronal CT here showing distrubtion in anterior & posterior of LT SIJ



MANAGEMENT

- Aggressive treatment. By A.B.C. D
- Think in systemic approach. (it is not always bone think about the structure inside: Urinary badder, nerves, vessels, etc)
- Specific treatment:

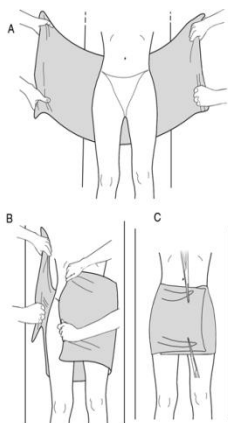
Type A. Bed rest& symptomatic treatment

Type B. ORIF with plates & screws, External Fix.

Type C. ORIF with plates & screws. Both AP.

Type A have the best Prognosis, and the worst is Type C because type C requires a very high energy to cause it!

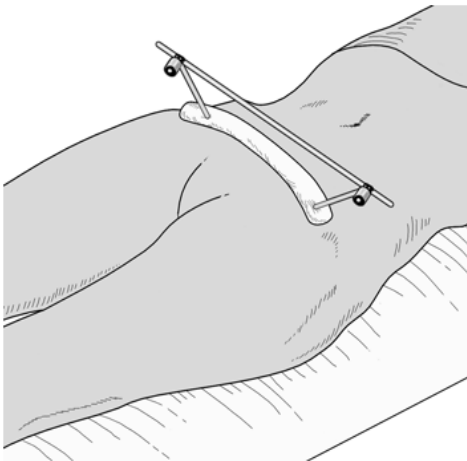
- **Pelvic banding** (to prevent expansion especially in open book fracture. usually the patient present with hypovolemic Shock) it can be applied at the site of accident also.



Source: Simon RR, Sherman SC, Koenigskecht SJ. *Emergency Orthopedics, The Extremities*, 5th Edition. <http://www.accessemergencymedicine.com>
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Circumferential pelvic anti-shock sheeting. **A**, A sheet is placed under the pelvis. **B**, The ends are brought together anteriorly. **C**, Hemostats are used to secure the sheet snugly.

○ **external fixation**



Source: Simon RR, Sherman SC, Koenigsnecht SJ: *Emergency Orthopedics, The Extremities*, 5th Edition; <http://www.accessemergencymedicine.com>

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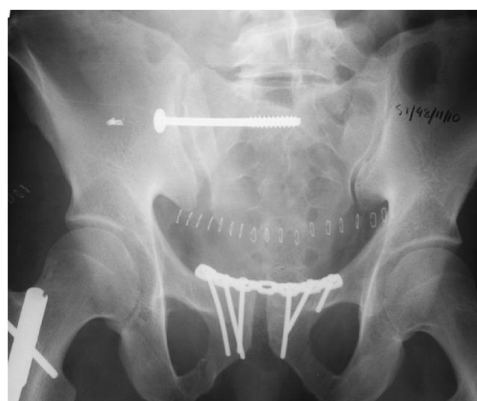
Anterior external fixator.

Operative treatment

1- Surgical correction of type B open book fracture by anterior plating [ORIF]



2-Surgical correction of type C fracture by percutaneous screw & plating of SP anterior (ORIF)



Complications

- Infection up to 25%
- Thromboembolism
- Malunion
- Nonunion
- Hemorrhage –life threatening –hypovolemic shock
- Bladder (15%)/bowel injuries
- Neurological damage (L5-S1)
- Obstetrical difficulties
- Persistent sacro-iliac joint pain

2- Hip fractures (Neck, intertrochantric):

- Fractures of the proximal femur are classified first according to their anatomical location.
- Femoral neck fractures and intertrochanteric fractures occur with about the same frequency.
- They are both more common in women than in men by a margin of three to one.
- It is a result of MVA, fall.

HIP FRACTURE

Epidemiology

- ☐ common fracture in elderly (greater incidence of osteopenia)
- ☐ female > male
- ☐ in osteopenic individual, fracture may precede simple fall (muscle stronger than bone)
- ☐ in younger individual, fracture related to high energy injury
 - markedly displaced
 - associated with other injuries

Diagnosis

- ☐ characteristic history, unable to bear weight on affected limb
- ☐ limb shortened, externally rotated, painful ROM, antalgic gait
- ☐ obtain AP of pelvis and lateral of involved hip
- ☐ if findings equivocal - bone scan and tomograms

2/ A

1. Subcapital Fractures

- ☐ fracture between femoral head and intertrochanteric line
- ☐ main vascular supply to femoral head from distal arterial ring to proximal head through femoral neck
- ☐ fracture interrupts blood supply
 - articular surface restricts blood supply to femoral head
 - AVN risk depends on degree of displacement

Table 12. Garden Classification of Subcapital Fractures

| Type | Extent | Displacement | Alignment | Trabeculae |
|------|------------|--------------|-----------|------------|
| 1 | Incomplete | Impacted | Valgus | Malaligned |
| 2 | Complete | None | Neutral | Aligned |
| 3 | Complete | Some | Varus | Malaligned |
| 4 | Complete | Marked | Varus | Aligned |

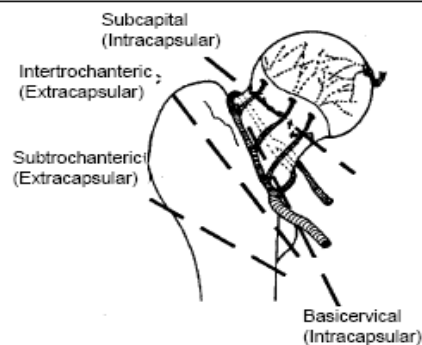
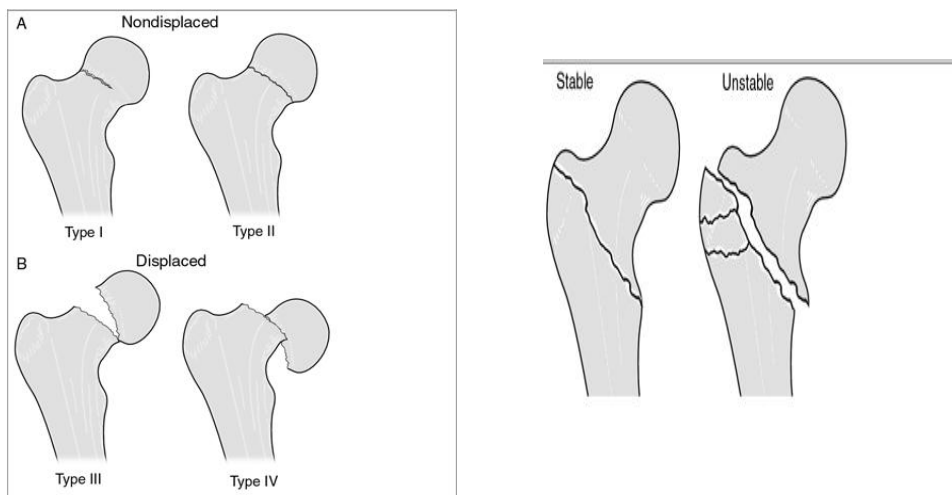
Treatment

- ☐ if needed, treat osteoporosis
- ☐ restore anatomy, attempt to save head (AVN head CAN heal)
- ☐ type of treatment depends on displacement and patient age
- ☐ undisplaced (Garden 1,2) - ORIF to prevent displacement
- ☐ displaced (Garden 3,4) - depends on patient
 - older patient, poor health → unipolar hemiarthroplasty
 - younger patient with higher demand lifestyle → bipolar hemiarthroplasty vs. total hip replacement vs. reduction and internal fixation
 - younger patient with OA of hip → total hip replacement

Complications

- ☐ AVN
- ☐ non-union

Remember the supply to the femoral Head? 3 arteries!

**Figure 21. Blood Supply to Femoral Head and Fracture Classification**

2/B**2. Intertrochanteric Fracture**

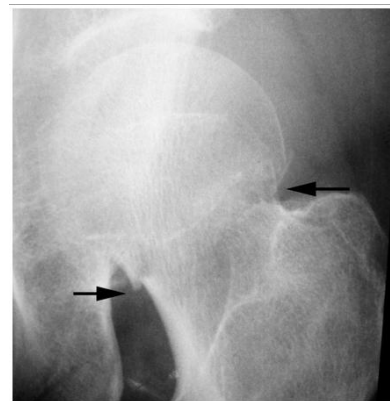
- ☐ extra-capsular fracture, therefore good femoral head viability
- ☐ fracture stability determined by amount of compromise to calcar femorale (medial cortex at neck/shaft junction)
- ☐ greater and lesser trochanters may be separate fragments
- ☐ posterior fragment may be avascular, therefore possible delayed union

Classification

- ☐ 2 part - stable, trochanter intact
- ☐ 3 part - one trochanter separated, unstable if large calcar fragment
- ☐ 4 part - unstable, both trochanters separated

Treatment

- ☐ ORIF (sliding hip screw) to preserve femoral head

Clinical picture**Type 2**

Treatment:

**NO rule for non-operative
For neck and intratrochantric
Femur fractures**

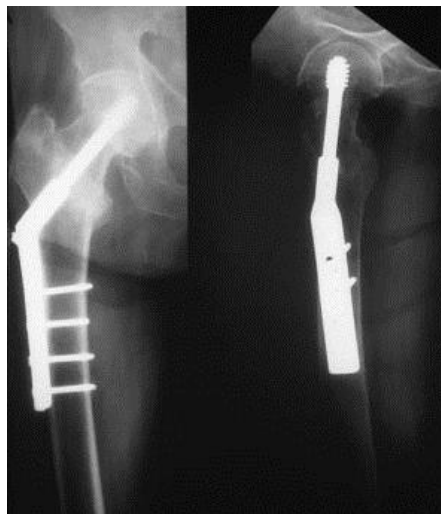
Treatment neck of femur

Nondisplaced fracture of neck of femur can be treat with canulated screws



Depends on the age!

Displaced fracture: DHS in patient less than 60 years.



Age > than 65 years look for.

. Level of activities.

. Status of the acetabulum.

Then chose THR (if acetabulum is disease!) vs. hemi arthroplasty.



COMPLICATIONS:

- Nonunion: 5% of nondisplaced fractures and up to 25% of displaced fractures
12 months as groin or buttock pain
- Osteonecrosis: 10% of nondisplaced fractures and up to 27% of displaced fractures.
- Fixation failure: osteoporotic bone or technical problems

3- Femoral shaft Fractures:**FEMORAL DIAPHYSIS FRACTURES**

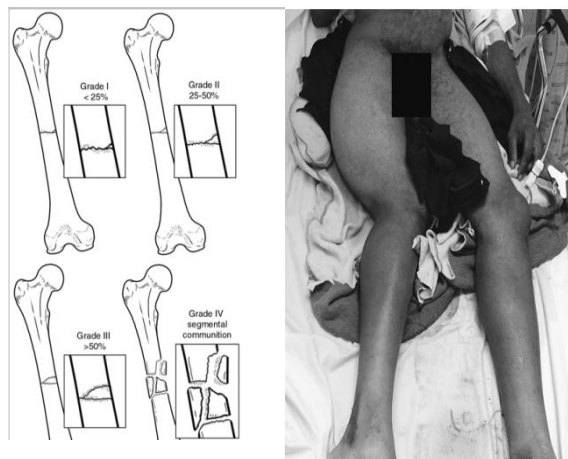
- ☐ high energy (MVA, fall from height, gunshot wounds)
- ☐ low energy (spiral fracture in children)
- ☐ high morbidity/mortality (hemorrhage, fat embolism, ARDS, MODS)
- ☐ blood replacement often required
- ☐ frequently comminuted
- ☐ soft tissue trauma

Clinical

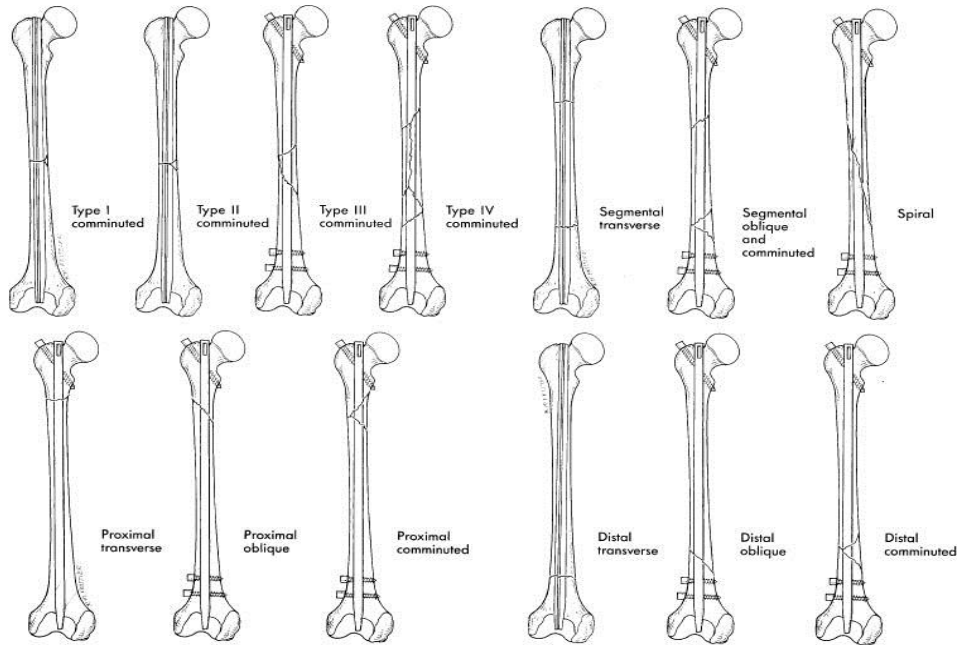
- ☐ leg is shortened, externally rotated
- ☐ unable to weight bear
- ☐ assess neurovascular status
- ☐ r/o: open fracture, soft tissue compromise
- ☐ r/o: child abuse with spiral fractures in children

Treatment

- ☐ ABCs of trauma are essential
- ☐ immobilize leg with Thomas Splint
- ☐ adequate analgesia
- ☐ surgical fixation (intramedullary nail) within 24 hours
 - high rate of surgical union after 6 to 12 weeks
- ☐ early mobilization of hip and knee



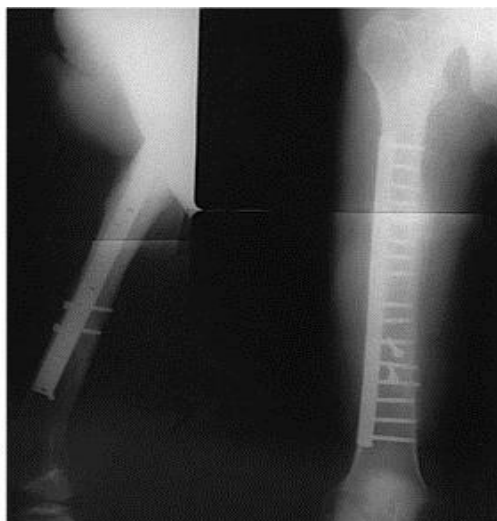
The best treatment of is I.M.N



Mid shaft femur fracture, Intramedullary femoral nail (best Treatment)



Open reduction and plate fixation for femur fracture



4- Tibia shaft fracture:**TIBIAL DIAPHYSIS FRACTURE**

- ☐ high intensity injury
 - associated with crush injuries and MVAs
- ☐ soft tissue, nerve and vessel injury common
 - assess neurovascular status
 - r/o open fracture
- ☐ displacement is difficult to control
- ☐ good reduction is required
 - shortening: < 1 cm
 - angulation in varus/valgus plane: < 5 degrees
 - angulation in antero-posterior plane: < 10 degrees
 - rotation neutral to slight external rotation
 - apposition: ≥ 50%
- ☐ healing time: 16 weeks on average

Treatment

- ☐ ABCs
- ☐ closed injuries = closed reduction
 - long leg cast x 4-6 weeks
 - followed by BK cast until healed
- ☐ open injuries
 - ORIF with external fixator
 - wounds on anterior surface heal poorly and may necrose
- ☐ unstable injuries or failed closed reduction require IM nail
- ☐ high risk of compartment syndrome
 - closed reduction and cast; admit and observe for compartment syndrome surgery; prophylactic fasciotomy if operating on tibia fracture

How Many Compartments Syndrome in the leg? (IMPORTANT)

| Table 16-1. Related Anatomy of Tissue Compartments of the Leg | | | | |
|---|--|--|--|--|
| Compartment | Muscles | Vessels | Nerves | Pain |
| Anterior | Anterior tibialis, extensor hallucis longus, extensor digitorum longus, peroneus tertius | Anterior tibial artery | Deep peroneal | Ankle plantar flexion, toe flexion |
| | | | • Weakness: Ankle dorsiflexion, toe extension | |
| | | | • Paresthesia: Web space of 1st and 2nd toes | |
| Lateral | Peroneus longus and brevis | None | Superficial peroneal | Ankle plantar flexion, foot inversion |
| | | | • Weakness: Ankle dorsiflexion, foot eversion | |
| | | | • Paresthesia: Dorsum of foot | |
| Deep Posterior | Posterior tibialis, flexor digitorum longus, flexor hallucis longus | Peroneal artery, posterior tibial artery | Posterior tibial | Ankle dorsiflexion, foot eversion, toe extension |
| | | | • Weakness: Ankle plantarflexion, foot inversion, toe flexion | |
| | | | • Paresthesia: Plantar aspect of foot | |
| Superficial Posterior | Gastrocnemius, soleus, plantaris | None | Sural | Ankle dorsiflexion |
| | | | • Weakness: Ankle plantarflexion | |
| | | | • Paresthesia: Lateral foot | |

Group A1**Classification (descriptive):**

- Open versus closed
- Anatomic location: proximal, middle, or distal third
- Fragment number and position: comminution, butterfly fragments
- Configuration: transverse, spiral, oblique
- Angulation: varus/valgus, anterior/posterior
- Shortening
- Displacement: percentage of cortical contact
- Rotation
- Associated injuries

CLINICAL EVALUATION

- Evaluate neurovascular status
- Assess soft tissue injury
- Rule out (R/o) open fracture
- Monitor for compartment syndrome
- Assess for knee ligament injuries

Clinical examination

Look to injured limb for.

- Soft tissue condition
- R/O open fracture
- Deformity

Feel for: Tenderness, pain.

Move: ROM



R/o and start treatment for open



Radiological study

1- Spiral # of distal tibia \\ twisting injury:

2-Transverse # of distal tibia caused more sever inj. To soft tissues due to direct trauma



AP view of mid shaft tibia



Lateral view showing two joints



Treatment: (best treatment is intramedullary)

- NON operative:

By casting if

- a. Shortening <1cm
 - b. Angulation in varus/valgus plane < 5 degree
 - c. Angulation in anter-posterior plane <10 degrees
 - d. Rotation neutral to slight external rotation.
 - e, bone apposition >50%
- Cast with the knee in 0 to 5 degrees of flexion
 - After 4 to 6 weeks, the long leg cast may be exchanged for a patella-bearing cast or fracture brace.
 - Union rates as high as 97% are reported, although with delayed weight bearing related to delay union or nonunion. (the problem is Prolong Casting)
 - The average union time is 16 ± 4 weeks



- Operative treatment:

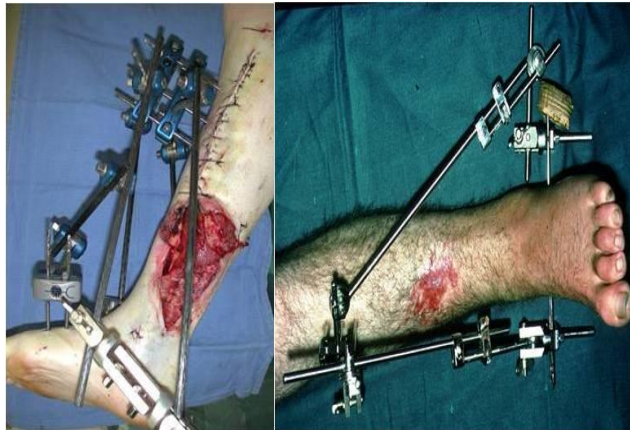
- The best treatment for mid shaft tibia fracture is Intramedullary (IM) Nailing But the most complication is anterior knee pain!!



Other Method of Fixation: External fixation:

Indication for E. F:

- Open fracture 3
- Soft tissue injury (burn, blister, infection)
- poly trauma
- Fracture with vascular injury



Union rates: Up to 90%, with an average of 3-6 months to union

The incidence of pin tract infections is 10% to 15%.

Plates and Screws: (The problem sometimes there is nothing to cover the proximal Tibia either muscles or soft tissue) Prone to Infections More!

- Fractures extending into the metaphysis or epiphysis.
- Success rates as high as 97%. Complication rates of infection, wound breakdown, and malunion or nonunion increase with higher-energy injury patterns.



Note: If the Patient Refuses the Cast (which is for a long period), he may go for a surgery directly!

5- Ankle Fractures:

EPIDEMIOLOGY

- the incidence of ankle fractures has increased
- an elderly women
- Most ankle fractures are isolated malleolar fractures
- **Open fractures are rare < 2%**

MECHANISM OF INJURY

- position of the foot at time of injury,
- The magnitude, direction, and rate of loading.

CLINICAL EVALUATION

- ranging from a limp to nonambulatory in significant pain and discomfort, with swelling, tenderness, and variable deformity
- Neurovascular status
- The extent of soft tissue injury possible open injuries and blistering
- A dislocated ankle should be reduced and splinted immediately (before radiographs if clinically evident)

RADIOGRAPHIC EVALUATION

AP view: (you are looking for the joint space)

- Tibiofibula overlap of <10 mm is abnormal and implies syndesmotic injury.
- Tibiofibula clear space of >5 mm is abnormal and implies syndesmotic injury
- Talar tilt



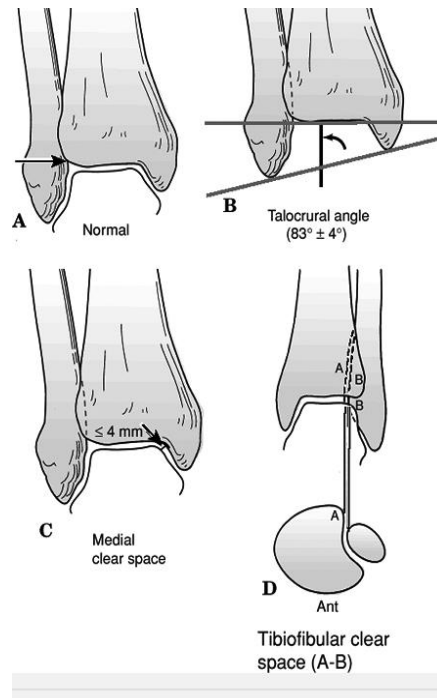
Lateral view:

- The dome of the talus should be centered under the tibia and congruous with the tibial plafond
- Posterior tibial tuberosity fractures can be identified



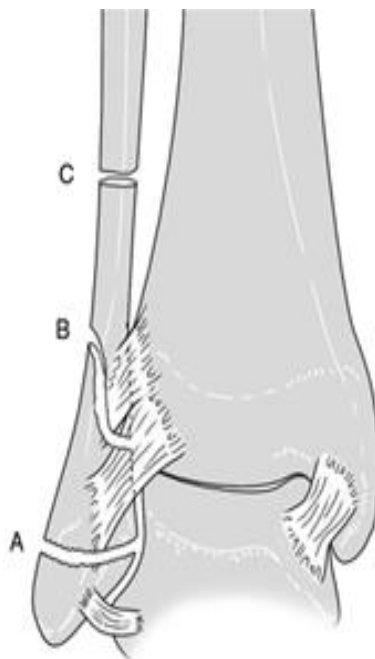
Mortise view:

- the foot in 15 to 20 degrees of internal rotation
- A medial clear space >4 to 5 mm is abnormal and indicates lateral talar shift
 - Tibiofibular overlap <1 cm indicates syndesmotic disruption
 - Talar shift >1 mm is abnormal.



Denis –weber classification: (Depends at the relation of a Muscle)

- infra-syndesmotic
- Trans-syndesmotic
- supra-syndesmotic



Danis-Weber Classification

- ☐ level of fibular fracture relative to tibial plafond
- ☐ Type A (infra-syndesmotic)
 - pure inversion injury
 - avulsion of lateral malleolus below plafond or torn calcaneofibular ligament
 - +/- shear fracture of medial malleolus
- ☐ Type B (trans-syndesmotic)
 - external rotation and eversion
 - avulsion of medial malleolus or rupture of deltoid ligament
 - spiral fracture of lateral malleolus starting at plafond
- ☐ Type C (supra-syndesmotic)
 - pure external rotation
 - avulsion of medial malleolus or torn deltoid ligament
 - fibular fracture is above plafond
 - frequently tears syndesmosis
 - Maisonneuve fracture if at proximal fibula
 - posterior malleolus avulsed with posterior tibio-fibular ligament

Treatment

- ☐ undisplaced fractures: NWB BK cast
- ☐ displaced fractures: reduction asap
- ☐ indications for ORIF
 - all fracture-dislocations
 - all type C fractures
 - trimalleolar (lateral, medial, posterior) fractures
 - talar shift or tilt
 - failure to achieve or maintain closed reduction
- ☐ prognosis dependent upon anatomic reduction
 - high incidence of post-traumatic arthritis

NWB BK= Not- wight bearing below

Treatment:

1- Stable weber B fracture (BKC)



2-Bimalleolar fracture need ORIF



Displaced MM fracture --ORIF



Tri malleolar fracture --ORIF



X-ray showed

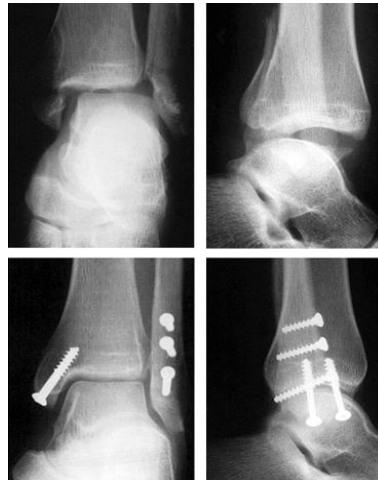
Bimalleolar ankle fracture with talarsubluxation and tilting

Treatment

ORIF



Bimalleolar fracture --- Percutaneous screw fixation



Complications:

- Post traumatic arthritis. Common
- Stiffness.
- Skin necrosis.
- Malunion or nonunion.
- Wound infection.
- Regional complex pain syndrome.

Summary:

- 1- Know the Mechanism!
- 2- Always Rule out Open Fractures. ATLS IS IMPORTANT
- 3- Treatment : Operative Treatment is Better to maintain Function status as soon as possible
- 4- COMPARTMENT SYNDROME
- 5- Hip Fracture! (When To Operate)
- 6- The Most common early Complication In open Pelvic Fracture is BLEEDING!
- 7- The Most common Is Post Traumatic Arthritis In pelvic Fractures.
- 8- The Most common Complication in the Forearm is MALUNION!

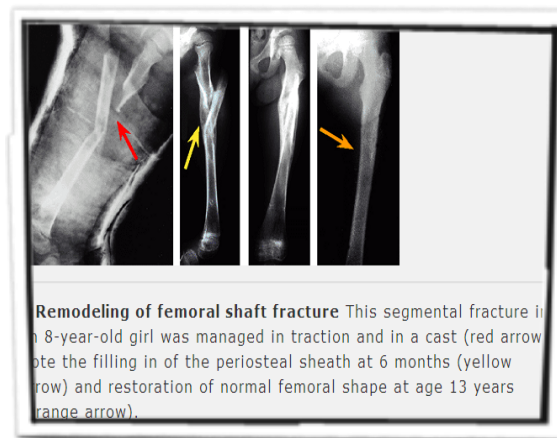
Done 2/2

Common Pediatric Fractures and Trauma**Objectives:**

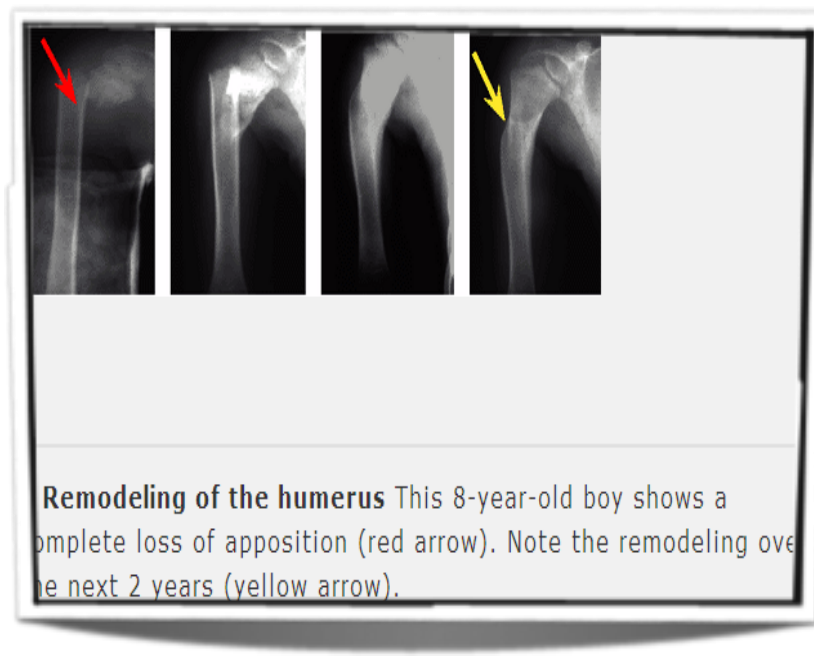
- At the end of this lecture the students should be able to:
- know most of the mechanism of injury
- make the diagnosis of common pediatric fractures
- request and interpret the appropriate x-rays
- initiate the proper management of fractures
- know which fractures can be treated by conservative or operative methods and the ways of fixation
- Know the possible complications of different fractures and how to avoid them.

The different between adult and pediatric bones

- Pediatric bone has a higher water content and lower mineral content per unit volume than adult bone so less brittle than adult bone.
- The physis (growth plate) is a unique cartilaginous structure is frequently weaker than bone in torsion, shear, and bending, predisposing the child to injury through it.
- The physis is traditionally divided into four zones that the injury through it can cause shortening, angular deformities. (In the Future).
- The periosteum in a child is a thick fibrous structure and Rich in blood supply than adult bone so there is high remodeling rate.
- Ligaments in children are functionally stronger than bone Therefore, a higher proportion of injuries that produce sprains in adults result in fractures in children.
- The Growth Plate Diffuse at the age of 16-18 years old depends mainly at the location of the growth plate.
- Twisted injury in adults will give you spiral Fracture but in Pediatric will give you injury to the growth plate.



Because of Periosteum, The Bone will remodel very well!



Common Pediatric Fractures

◆ Upper limb:

Clavicle.

Supracondylar Fracture.

Distal Radius.

◆ Lower Limbs:

Femur fractures.

- **CLAVICLE FRACTURES:**

- ♦ 8% to 15% of all pediatric fractures.
- ♦ 0.5% of normal deliveries and in 1.6% of breech deliveries. (Birth Fracture).
- ♦ 90% of obstetric fractures. (When the Deliver the babe the may press the shoulders which may lead to the fracture.
- ♦ 80% of clavicle fractures occur in the shaft. (the MIDDLE) NOT the Proximal or the Distal!
- ♦ The periosteal sleeve always remains in the anatomic position. Therefore, remodeling is ensured.

Mechanism of Injury:

Indirect: Fall onto an outstretched hand.

Direct: This is the most common mechanism; it carries the highest incidence of injury to the underlying neurovascular and pulmonary structures.

Birth injury.

Clinical Evaluation:

- In Birth fractures: an asymmetric in the Shoulder, palpable mass overlying the fractured clavicle.
- typically present with a painful (**ACUTE**) , palpable mass along the clavicle, Tenderness, **Decrease Range of Motion (ROM)**, there may be tenting of the skin, crepitus, and ecchymosis.
- **What is ecchymosis? Subcutaneous Purpura larger than 1 centimeter or a Hematoma, commonly called a bruise.**
- Neurovascular status, the brachial plexus and upper extremity vasculature may result.
- Pulmonary status must be assessed. **Why?** May Penetrate the Lung and Cause Pneumothorax!

Radiographic Evaluation:

- AP view. (the Important one that will show you where is the fracture) The COMMON!
- Cephalic tilt view (cephalic tilt of 35 to 40 degrees)
- Apical oblique view (injured side rotated 45 degrees toward tube with a cephalic tilt of 20 degrees).

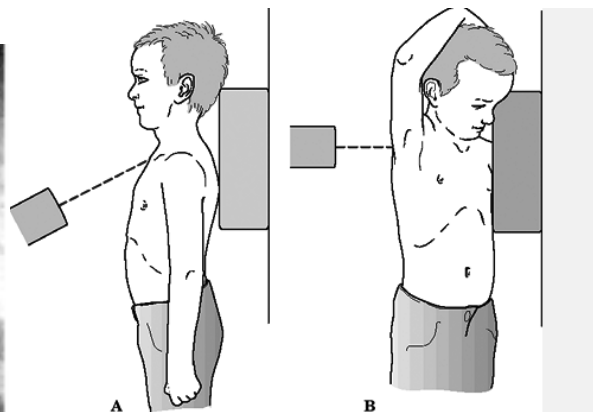


Figure 43.5. (A) Cephalic tilt views. (B) Apical lordotic view.

Classification (Descriptive):

Location

Open versus closed

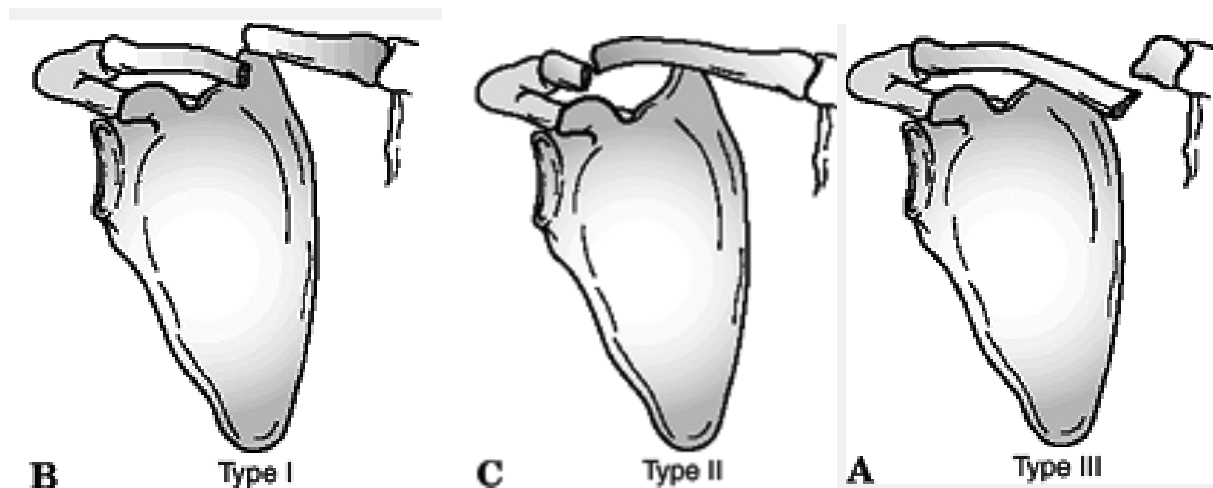
Displacement

Angulation

Fracture type: segmental, comminuted, greenstick

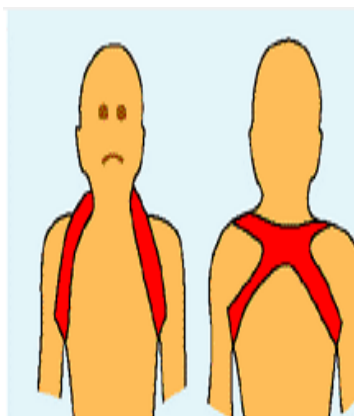
Allman classification: (Another way to Classify)

- Type I : Middle third (most common)
- Type II : Distal to the coracoclavicular ligaments (lateral third)
- Type III : Proximal (medial) third

**Treatment:**

♦ Newborn to Age 2 Years:

- ♦ Clavicle fracture in a newborn will unite in approximately 1 week.
- ♦ Infants may be treated symptomatically with a simple sling or (figure-of-eight bandage) applied for 2 to 3 weeks. **No Need For Reduction Due to presence of periosteum and the Same Teqnique May apply To Adults.**



The cullas Formation will be removed from the body After Healing ! So we don't worry about them not like adults

♦ Age 2 to 12 Years:

A figure-of-eight bandage or sling is indicated for 2 to 4 weeks

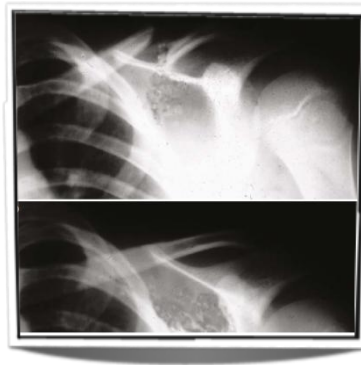
Operative Treatment: Indications

- ♦ Open fractures.
- ♦ Neurovascular compromise.

99% of The Close Fractures Treated by the closed Method Or sling!

X-ray Mid clavicle fracture: Example

- Post conservative treatment
- Healed completely
- With no complications (**No Cellus Formation or Angulation**)



Complications (Rare):

- a. Neurovascular compromise.
- b. Malunion.
- c. Nonunion.
- d. Pulmonary injury.

B) Supracondylar Fracture: (The **Commonest Fracture in Pediatric Age group)**

- Comprise 55% to 75% of all elbow fractures.
- The male-to-female ratio is 3:2.
- The peak incidence is from 5 to 8 years, after which dislocations become more frequent.
- The left, or nondominant side, is most frequently injured.

MECHANISM OF INJURY:

- **Indirect:** Most commonly a result of a fall onto an outstretched (FOOSH) upper extremity. (Extension type >95%).
- **Direct:** A fall onto a flexed elbow or from an object striking the elbow (e.g., baseball bat, automobile) (Flexion type < 3%).

Clinical Evaluation:

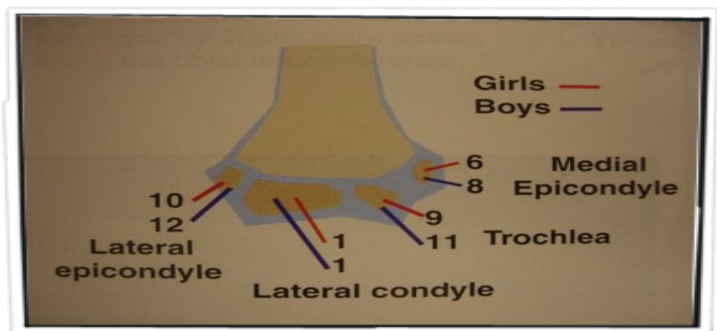
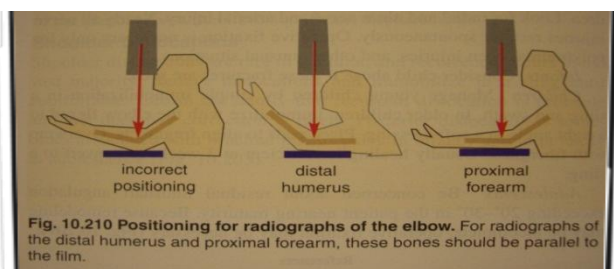
- a. A swollen, tender elbow with painful range of motion.
- b. S-shaped angulation at the elbow
- c. Pucker sign (dimpling of the skin anteriorly)
- d. **Neurovascular examination:** The median, radial, and ulnar nerves as well as their terminal branches. Capillary refill and distal pulses should be documented. and the Radial Artery. **The commonest Nerve to be injured is: Anterior Interosseous Nerve which is branch from the Median nerve and is associated more with Extension Type. The Way to assess: Ask the Patient TO Do (OK) sign!**

You are examining Flexor Pollicis Longus, Flexor digitorum longus!

So Examine Each Nerve by doing its Function!

Clinical

Complete Fracture of Supracondylar

Radiological Evaluation:**Ways of elbow x-ray**

The Growth Plate in distal humerus usually appears in different locations depending on the age:

CROTOE: Each one presents a growth plate

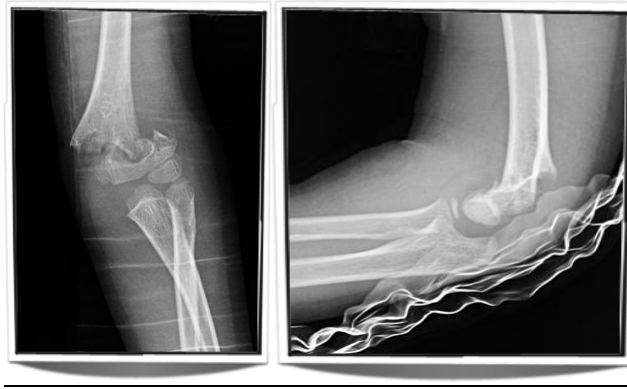
C: Cubitulum

R: Radial head

O: Olecranon

T:

O: E: (from the Figure) Not Important!

Group A1

AP view elbow

lateral x-ray view



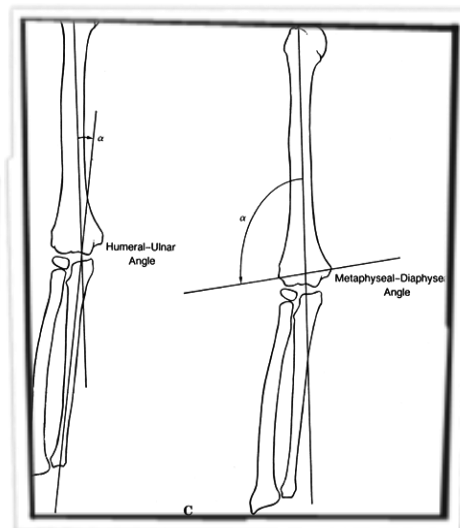
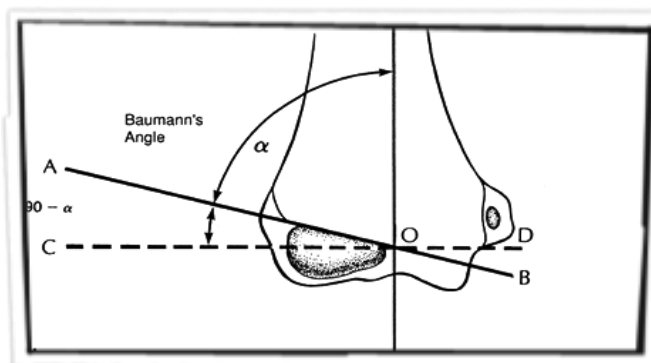
Lateral elbow x-ray

AP view

Anteroposterior (AP) and lateral views:

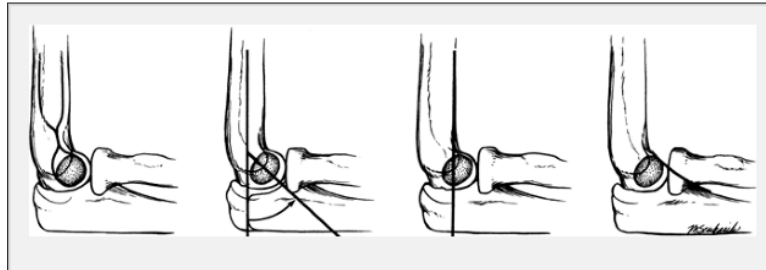
The following angular relationships may be determined:

- Baumann angle:** 15 to 20 degrees
- Humeral-ulnar angle:** reflects the true carrying angle. (M=7.f=15)
- Metaphyseal-diaphyseal angle.** Reverse of Baumann Angle!



True lateral radiograph of the elbow flexed to 90 degrees: (If any of them disrupted - Fracture!)

- Teardrop.
- Diaphyseal-condylar angle: (30 to 45 degrees anteriorly)
- Anterior humeral line.
- Coronoid line.



The contralateral elbow should be obtained for comparison as well as identification of ossification centers

Lateral X-ray:

- Fat pad signs. Black Presentation in front -- usually Fracture in X-ray!
- Anterior (coronoid) fat pad---joint effusion
- Posterior (The deep olecranon fossa) the deep olecranon fossa normally completely contains the posterior fat pad. large effusions cause posterior displacement fracture, it is present >70%

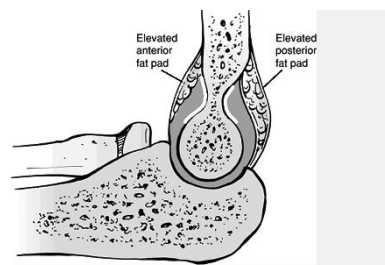
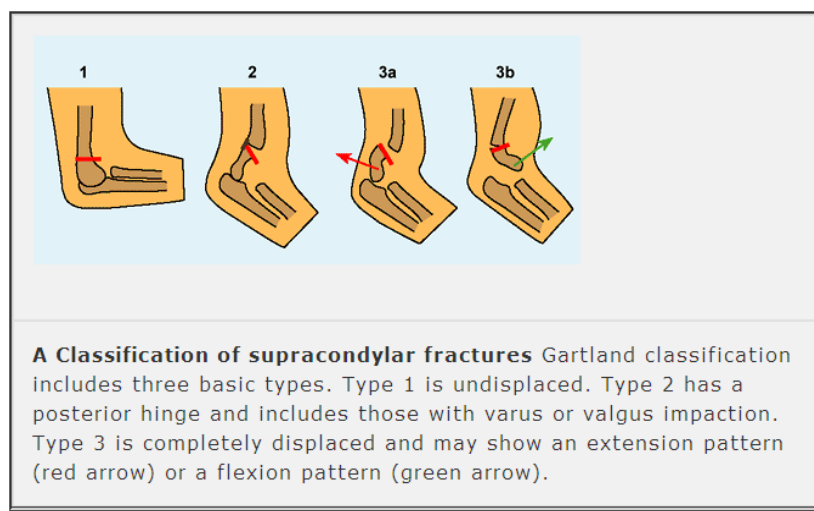


Figure 44.4. Elevated anterior and posterior fat pads.

Classification (Gartland):

Type 1: undisplaced - Anterior humeral line pass to Cubetelum

Type 2: Anterior Cortex Disrupted Posterior NO

Type 3: Both Cortex displaced.

A: posterior medial

B: posterior lateral (Flexion Type of injury which is rare)

Treatment of extension type:

Type I: Immobilization in a long arm cast or splint at 60 to 90 degrees of flexion is indicated for 2 to 3 weeks

Type II: Reduce by closed methods followed by casting; it may require pinning (K-wire) if unstable, severe swelling, tilting.

Type III:

Attempt closed reduction and pinning.

Open reduction and internal fixation(ORIF) and back slap , may be necessary for rotationally unstable fractures, open fractures, and those with neurovascular injury



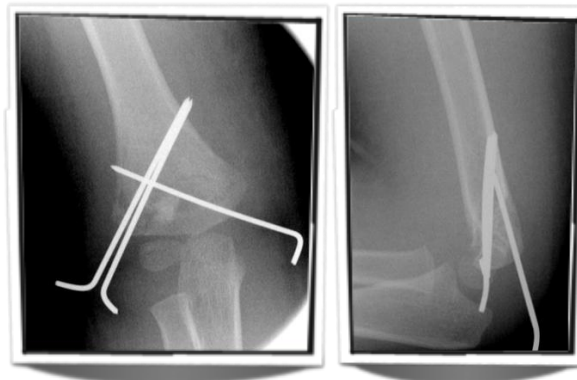
Oblique view elbow

unstable

Which type? Type 3 A



Intra op fluoroscope lateral view AP view



AP post CR+ k-wires

lateral view

Treatment of flexion type: Rare!

Type I: Immobilization in a long arm cast in near extension is indicated for 2 to 3 weeks.

Type II: Closed reduction is followed by percutaneous pinning

Type III: Reduction is often difficult; most require open reduction and internal fixation with crossed pins.

Complications:

- Neurologic injury (7% to 10%).
- ◆ Most are neurapraxias requiring no treatment
 - Median nerve/anterior interosseous nerve (most common)** in which type? Flexion
 - Radial nerve
 - Ulnar nerve:
 - This is most common in flexion-type
- Vascular injury (0.5%)
- ◆ Direct injury to the brachial artery, or secondary to swelling.
- Loss of motion
- Myositis ossificans: soft Bone Formation in the Muscle, during manipulation, which will cause decrease ROM.
- Angular deformity (Cubitusvarus more frequently than Cubitus valgus) (10% to 20)
- Compartment syndrome (<1%) **Associated with Vascular Injury leads to Volkmann's Ischemic Contracture.**

“Type of Fracture Depends on The Force and The Mechanism! But Extension here is more common than Flexion “

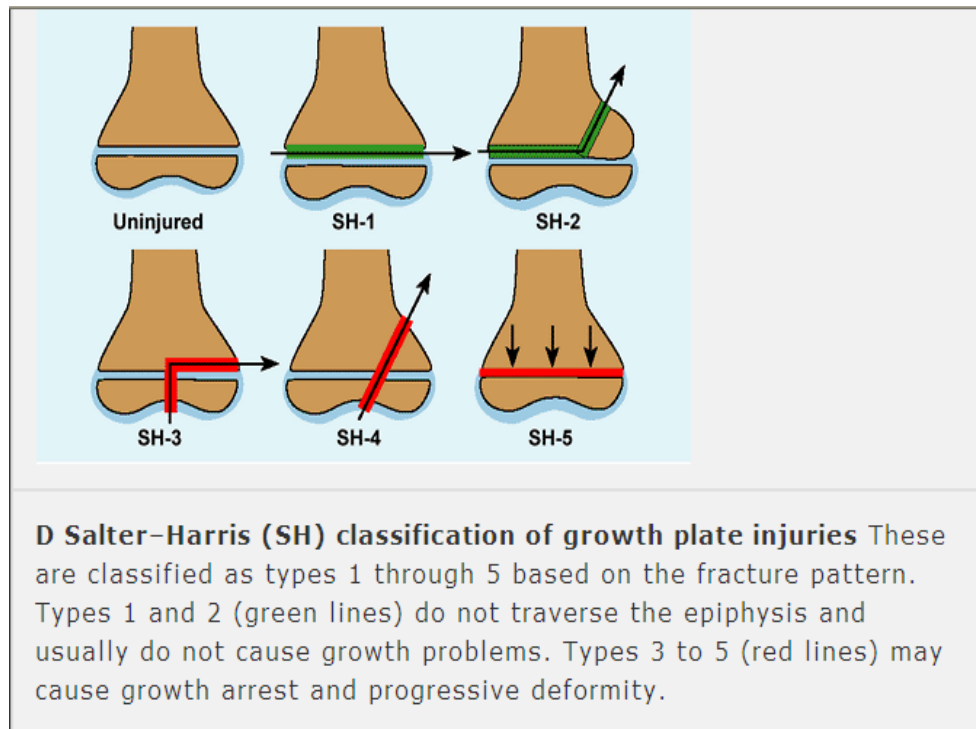
Cubitusvarus deformity:

Angular deformity (varus more frequently than valgus) (10% to 20)



C) DISTAL RADIUS FRACTURES:

- Physeal Injuries.
- Salter-Harris Types I and II.
- closed reduction is followed by application of a long arm cast or sugar tong splint with the forearm pronated
- 50% apposition with no angular or rotational deformity is acceptable. Growth arrest can occur in 25% of patients if two or more manipulations are attempted.



Common in lower limb,



Type 1



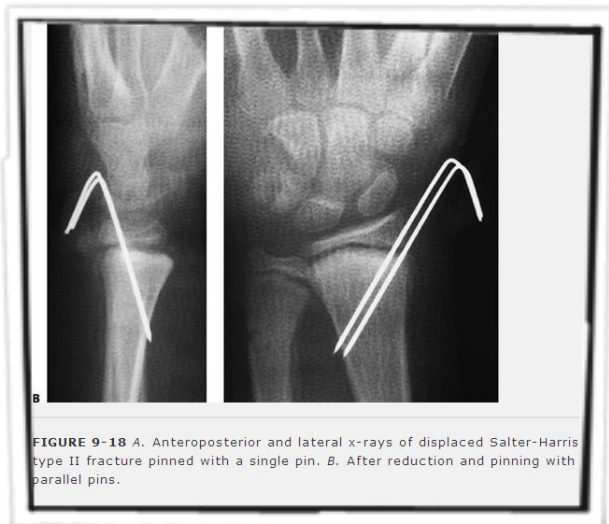
Type2



Type3

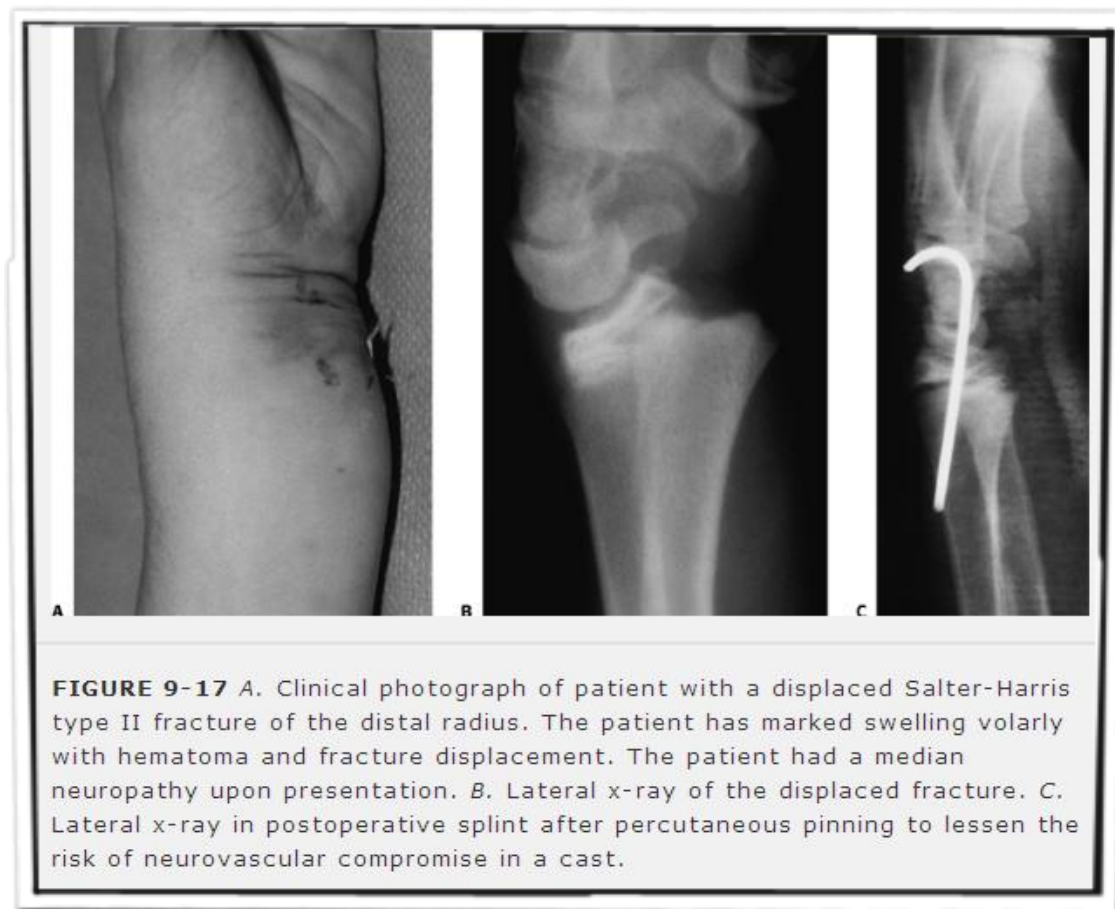


Pre op Salter Harris 2



AP and lateral X-ray post OP

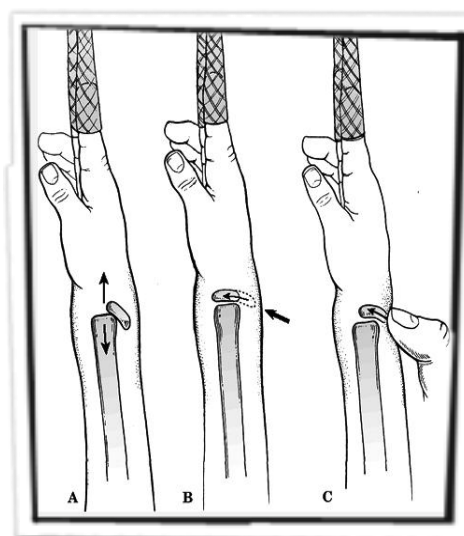
Clinical picture and X-ray pre and post op



Treatment

Salter-Harris Types I and II Treatment:

Open reduction is indicated if the fracture is irreducible (Called: Chinese Method)



Salter-Harris Type III:

Anatomic reduction is necessary

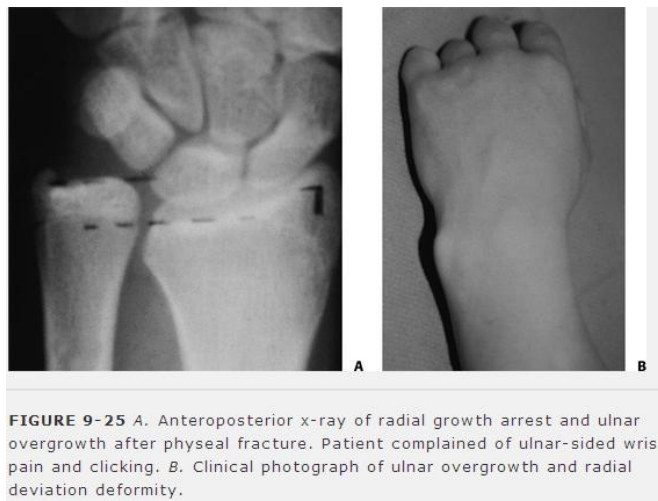
Open reduction and internal fixation (ORIF) with smooth pins (K-wire) or screws parallel to the physis is recommended if the fracture is inadequately reduced to close the Gap.

Salter-Harris Types IV and V:

Rare injuries need ORIF.

Complications:

- ♦ Physeal arrest may occur from original injury which will lead to angular Deformity.
- ♦ Ulnar styloid nonunion is often indicative of a TFCC tear.
- ♦ Carpal tunnel syndrome by pressing on the median Nerve.



Metaphyseal Injuries:

Classified by:

- The direction of displacement.
- Involvement of the ulna.
- Biomechanical pattern:
 - a. **torus** (only one cortex is involved),
 - b. **incomplete** (greenstick),
 - c. **Complete**.

1- Torus fracture:

- The injury is stable.
- Protected immobilization for pain relief.
- Bicortical injuries should be treated in a long arm cast.



2-Incomplete (greenstick):

- These have a greater ability to remodel in the sagittal plane than in the frontal plane
- Closed reduction and above elbow cast with supination forearm to relax the brachioradialis muscle.



Table 45.1. Acceptable angular corrections in degrees

| Age (yr) | Sagittal Plane | | Frontal Plane |
|----------|----------------|-------|---------------|
| | Boys | Girls | |
| 4â€“9 | 20 | 15 | 15 |
| 9â€“11 | 15 | 10 | 5 |
| 11â€“13 | 10 | 10 | 0 |
| >13 | 5 | 0 | 0 |

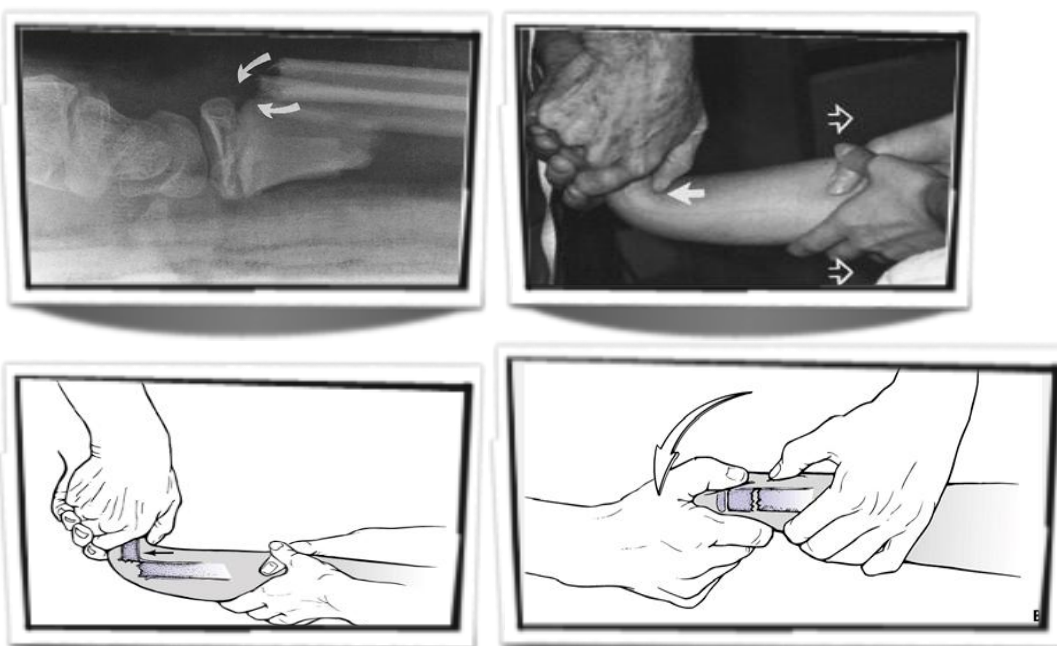
Acceptable residual angulation is that which will result in total radiographic

The younger the patient the more amount of angulation you can accept!

The Younger the Patient The more Remodeling.

3-Complete fracture:

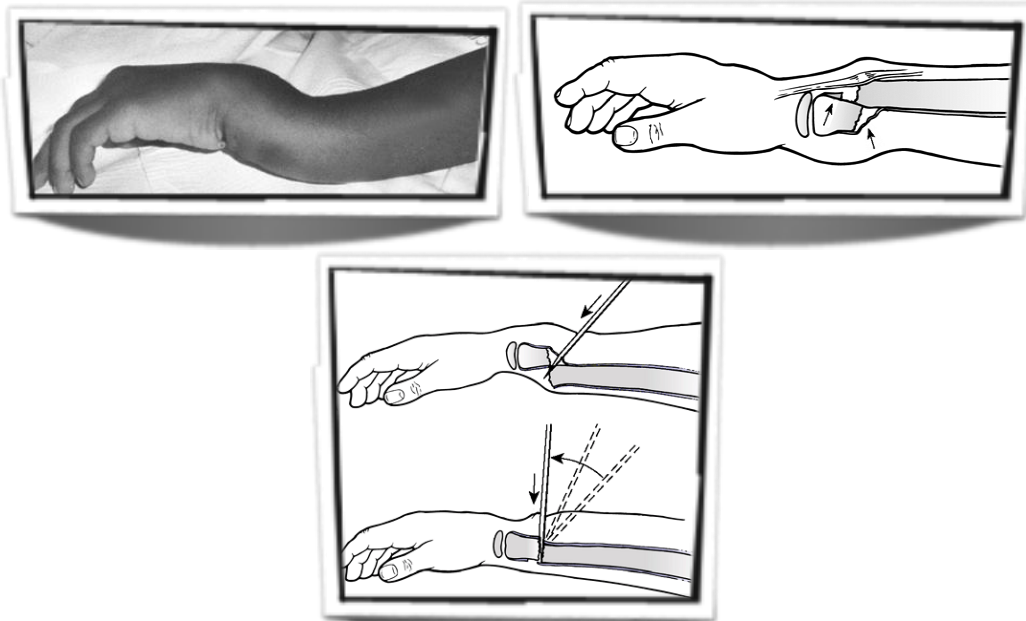
- Closed reduction. **By increase the deformity first, then after Reduction use the cast.**
- a well molded long arm cast for 3 to 4 weeks



Indications for percutaneous pinning: (K-wire)

Group A1

- Loss of reduction. excessive local swelling
- Floating elbow multiple manipulations.

**Complications:**

- Malunion: Residual malangulation of more than 20% may result in loss of forearm rotation.
- Nonunion – rare.
- Refracture: an early return to activity (before 6 weeks) removing the cast earlier.
- Growth disturbance: (overgrowth or undergrowth) 3mm/ common from 9-12Y/O
- Neurovascular injuries: Avoid extreme positions of immobilization.

Complete fracture:

Indication for open Reduction:

- Irreducible.
- Open fracture
- Fracture with compartment syndrome.



Open fracture with Deformity

D- Pediatric Femoral Shaft:

- 1.6% of all fractures in the pediatric population
- Boys are more commonly affected (because they are more active NOTHING ELSE!)
- Bimodal distribution of incidence: (Peak) 2 to 4 years of age, mid-adolescence.
- In children younger than walking age, 80% of these injuries are caused by child abuse; this decreases to 30% in toddlers.
- In adolescence, >90% due to RTA (MOST COMMON)

MECHANISM OF INJURY:

- a. **Direct trauma:** Motor vehicle accident, pedestrian injury, fall, and child abuse
- b. **Indirect trauma:** Rotational injury
- c. **Pathologic fractures:** osteogenesis imperfecta, nonossifying fibroma, bone cysts, and tumors.

CLINICAL EVALUATION:

- A history of high-energy injury should undergo full trauma evaluation as indicated.
- An inability to ambulate, with extreme pain, variable swelling, and variable gross deformity.
- A careful neurovascular examination is essential.
- A careful examination of the overlying soft tissues to rule out the possibility of an open fracture.

RADIOGRAPHIC EVALUATION:

- a. Anteroposterior and lateral views
- b. X-ray most includes hip, knee joints.



CLASSIFICATION**a. Descriptive:**

- Open versus closed
- Level of fracture: proximal, middle, distal third
- Fracture pattern: transverse, spiral, oblique, butterfly fragment
- Comminution
- Displacement
- Angulation

2. Anatomical:

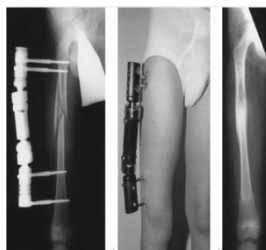
- ◆ Subtrochanteric
- ◆ Shaft
- ◆ Supracondylar

TREATMENT:Age <6 Months

- a. Pavlic harness or a posterior splint
- b. Traction and spica casting

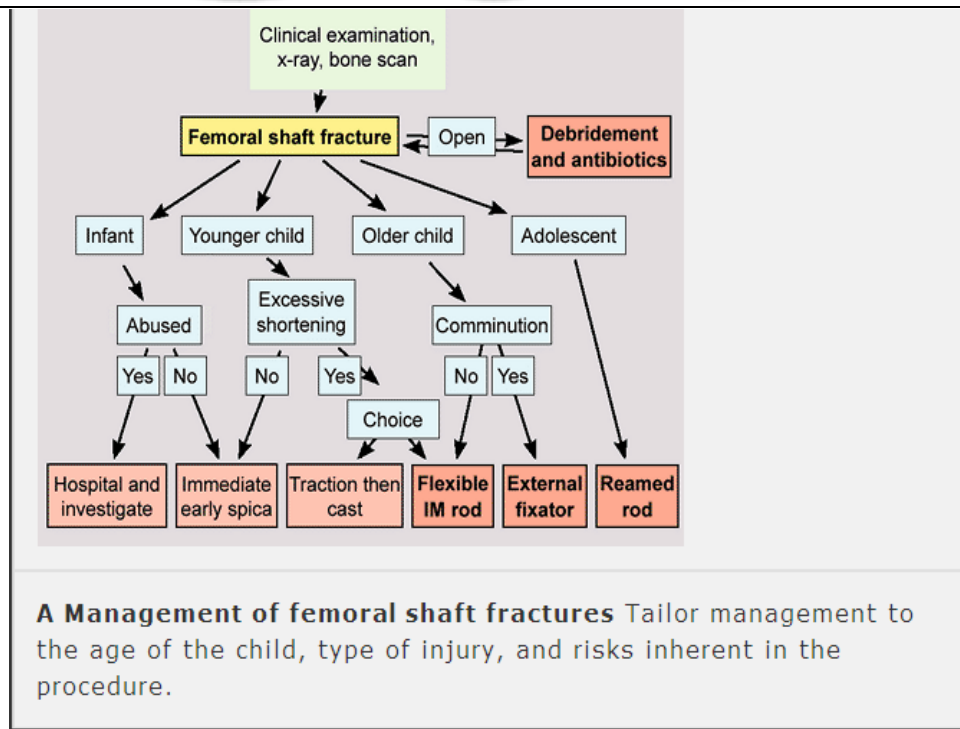
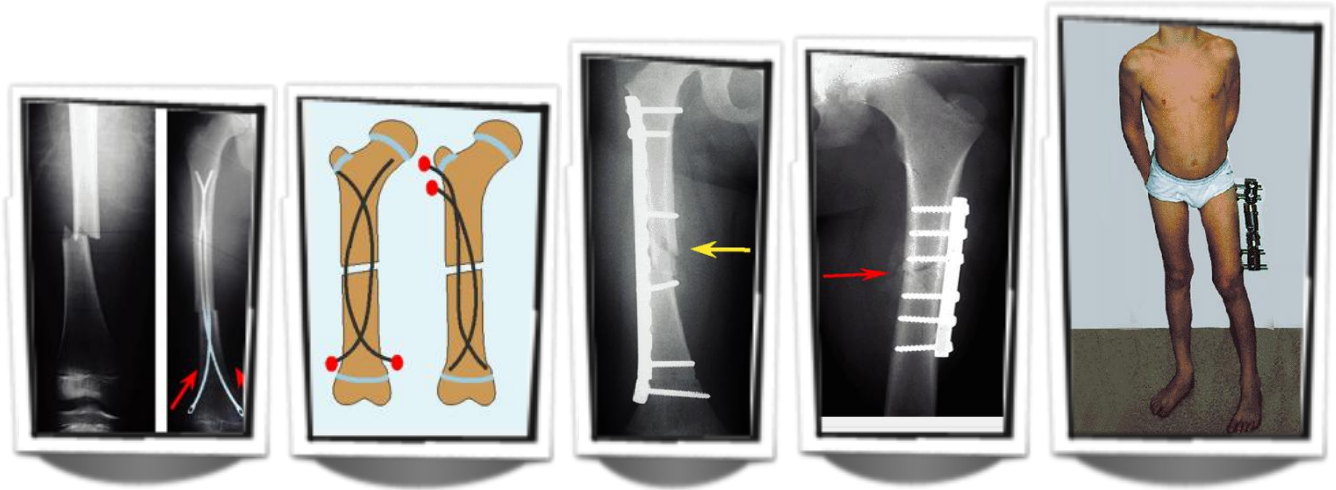
Ages 6 Months to 6 Years

- a. Immediate spica casting is the treatment of choice (>95%).
 - b. Skeletal traction followed by spica casting if there is difficulty to maintain length and acceptable alignment.
3. External fixation: When?
- ◆ multiple injuries
 - open fracture
 - comminuted
 - Unstable patient

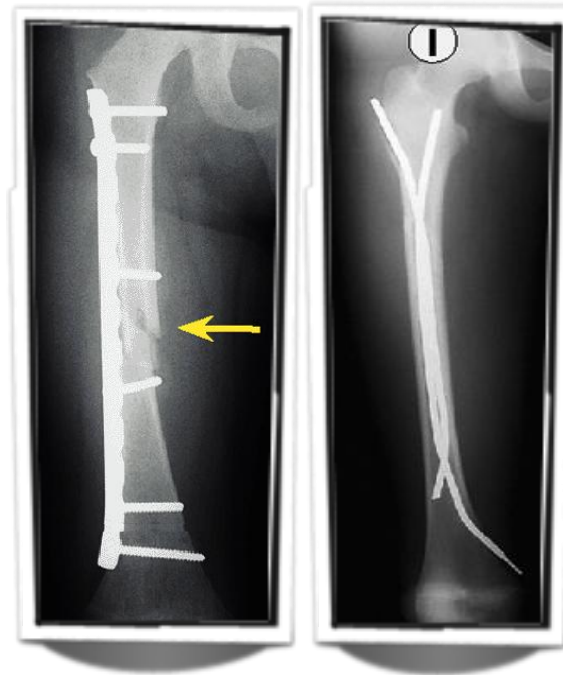


Group A1Ages 6 to 12 Years

- Flexible intramedullary nails.
- External fixation.
- Bridge plating.

Ages 12 to Maturity

- Intramedullary fixation with either flexible or interlocked nails (age > 16y) is the treatment of choice. Or if < 16 it will cause Growth Arrest!



Operative Indications

- Multiple traumas, including head trauma.
- Open fracture.
- Vascular injury.
- Pathologic fracture.
- Uncooperative patient.
- Body habitus (OBESE **PATIENT**) not amenable to spica casting.

| Table 48.1. Acceptable angulation | | | |
|-----------------------------------|---------------------------|---------------------------------|--------------------|
| Age | Varus/Valgus (degrees) | Anterior/Posterior (degrees) | Shortening (mm) |
| Birth to 2 y | 30 | 30 | 15 |
| 2â€"5 y | 15 | 20 | 20 |
| 6â€"10 y | 10 | 15 | 15 |
| 11 y to maturity | 5 | 10 | 10 |

COMPLICATIONS:

- a. Malunion: Remodeling will not correct rotational deformities
 (The **Important Thing to restore is The ALIGNMENT**)
- b. Nonunion –rare.
- c. Muscle weakness.
- d. Leg length discrepancy: Secondary to shortening or overgrowth, Overgrowth of 1.5 to 2.0 cm is common in the 2- to 10-year age.
- e. Osteonecrosis with antegrade IM nail<16year. (So Try to avoid Intramedullary Nail <16)

DONE !

Spinal Injuries

◆ Incidence and Significance

- 50000 cases per year
- 40-50% involving the cervical spine
- 25% have neurologic deficit
- Age: mostly between 15-24 years
- Gender: mostly males (3:1)

◆ Mechanism of Injury

- MVA: 40-55%
- Falls: 20-30%
- Sports: 6-12%
- Others: 12-21%

◆ Anatomy of the Spine

- Bones : vertebrae for protection , bear most of the weight put on your spine.
- Joints : 3 joints :
 - Anteriorly :
 - intervertebral disc: helps absorb pressure and keeps the bones from rubbing against each other. 60-80 % injured.
 - Posteriorly :
 - 2 facet joints
 - Joint give the movement of spine :
 - Flexion .
 - Extension
 - Ateral bending
 - Rotation
- Ligament :
 - Supraspinatous.
 - Infraspinaous.
 - **Legamentum Flavum. (the Most Important)**
 - Ant. Longitudenal Ligament.
 - Post. Longitudenal Ligament .
 - Ligament is IMP. In maintain the flexibility of spine. If injured the x-ray will be normal .
- Muscles: all spinalis muscle .

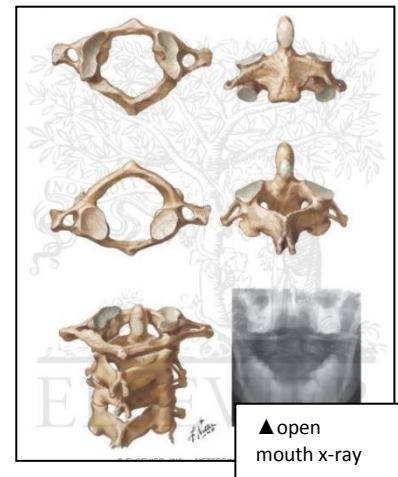


Group A1

◆ Cervical Anatomy:

● C1 & C2

- **C1:**
 - no vertebra. Body
 - Composed of Ant.&Post.arch.
- **C2:**
 - have Ant. Projection is: Odontoid process significant in stability of C1 & C2
- open mouth x-ray , we see the C1 & C2 and their articulation..



● C3-C7

- **C3-C7** are same .
 - Has body +2 Lat.masses (facet joints) .
 - We differ it from the thoracic by Spinal process.

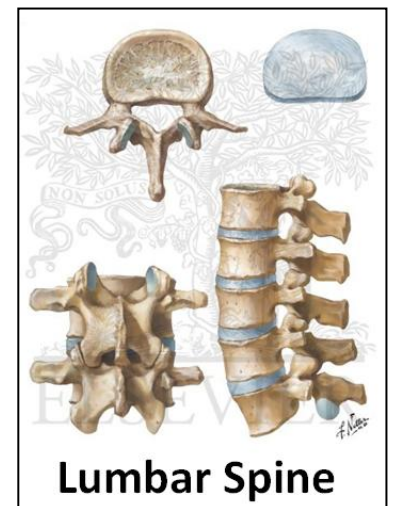
◆ Thoracic Spine

- Articulate with ribs by body and spinal process (downward)



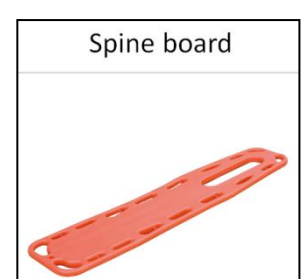
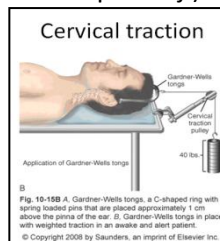
◆ Lumbar Spine

- More IMP.
- Lowest mobile segment .
- Most of ligament .
- More fracture.
- All joint here Ant +Post.
- Most of movement.
- The Three columns **عمود**
 - Ant. Column > Ant. part of body
 - Middle column > Post. Part of body
 - Post. Column > Pivotal + Lamina+ Spinal process.
- Stable injury :
 - one column only
 - (e.g. wedge #in Ant. Column)
 - not required treatment or conservative only
- Unstable injury:
 - 2 or more column .
 - need intervention (surgery , etc..)



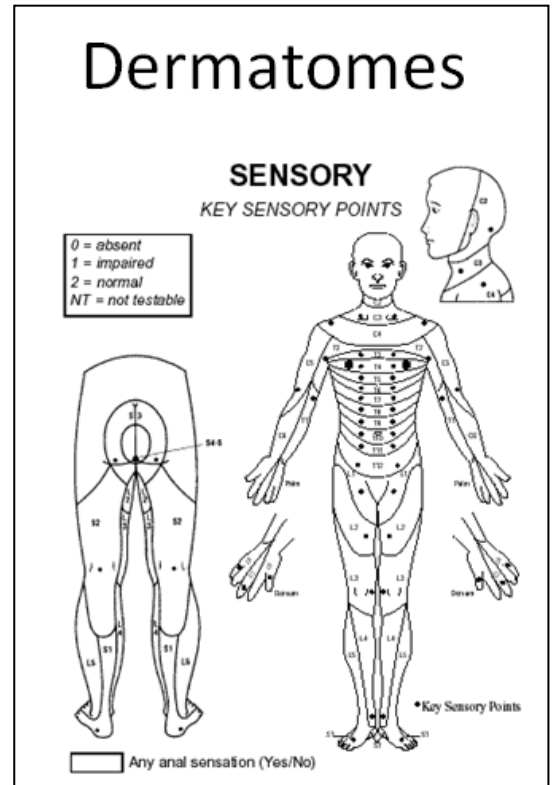
◆ Assessment of the spine injured pt.

- Immobilization(by cervical collar) [Prevent bleeding, pain...]
- History:
 - Mechanism of injury(high or low energy)
 - Head injuries (high incidence of cervical spine inj.)
 - Seat belt injury
- Physical examination
 - Inspection, palpation
 - Neurologic examination



◆ Neurologic examination

- **Spinal cord syndromes :**
 - Complete SCI (spinal cord injury)
 - Flaccid paralysis below level of injury
 - May involve diaphragm if injury above C5
 - Sympathetic tone lost if fracture above T6(bradycardia + hypotension)
 - Bilateral effect.
 - Incomplete SCI: Good prognosis for recovery
 - Central cord syndrome
 - Upper limb > lower limb deficit.(especially in hand)
 - Brown-Sequard syndrome
 - Also called: cord hemi-section (by bone fragment ...)
- Conus medullaris syndrome
 - Mixture of UMN and LMN deficits.
 - Not common .
- Cauda-Equina syndrome
 - Urinary retention, bowel incontinence and saddle anesthesia
 - Usually due to large central disc herniation rather than fracture
- Nerve root deficit:
 - LMN
- Spinal Shock
 - Transient loss of spinal reflexes
 - Lasts 24-72 hours
 - Recovery **may** begin immediately
 - Loss of the Bladder function :**Urinary Retention**
 - Characterised by **Flaccid paralysis**
- Neurogenic shock
 - Reduced tissue perfusion due to loss of sympathetic outflow and un-opposed vagal tone
 - Peripheral vasodilatation
 - Rx.: fluid resuscitation



◆ Imaging

- X-rays :
 - Cervical: 3 views
 - AP, lateral and open mouth
 - Thoraco-lumbar: 2 views
 - AP & lateral
 - Flexion-Extension views
- CT:
 - best for bony anatomy
- MRI:
 - best to evaluate soft tissue

Notes:

- You can palpate for Gaps and steps in the spine C7 called: Cervical Prominence
- So, If there is a gap; you felt C1 then the other one below it deep (not at the same level) then it Is → Steps → spondylotheiasis

Gaps: you will feel one spine then below it space then another Spine → could be due to a rupture if the ligaments .

ASIA Scale :

The Closer the patient to normal (E) the better prognosis

ASIA IMPAIRMENT SCALE

- ☐ **A = Complete:** No motor or sensory function is preserved in the sacral segments S4-S5.
- ☐ **B = Incomplete:** Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-S5.
- ☐ **C = Incomplete:** Motor function is preserved below the neurological level, and more than half of key muscles below the neurological level have a muscle grade less than 3.
- ☐ **D = Incomplete:** Motor function is preserved below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3 or more.
- ☐ **E = Normal:** motor and sensory function is normal

CLINICAL SYNDROMES

- ☐ Central Cord
- ☐ Brown-Sequard
- ☐ Anterior Cord
- ☐ Conus Medullaris
- ☐ Cauda Equina

- Function of the Ligaments:
 - 1- Anterior Ligaments: will prevent hyperextension
 - 2- Posterior Ligaments: will prevent HyperFlexion
- There is No Faced Joints in the Cervical Spines !
- The columns of the Lumbar Spine: 1st and 2nd
- **IN the examination there is no Active Or Passive ROM (apply for any Trauma patient)**
- **Why we stabilize the patient with a Cervical collar and a board ?**
 - If there is a cervical Fracture, and it is unstable, movement of the patient without stabilizing spine will lead to hyperextension and spinal Injury

In Examination:

- You Exam both Front and back
- For Cauda Equina Syndrome: Perform PR and Sensation to that area (around it)
- Sacral Segment:
If there is a complete injury, sacral segment is spared with a normal PR and sensation, it is a good indication that the patient may recover from this!
- NeuroPraxia: Loss of Function, Better Prognosis
- Neurotmesis: Nerve Inside damaged but Neural sheath is intact
- Axonotmesis: Complete Cut, Worst prognosis
- **For Cauda Equina Syndrome:**
 - 1- Red Flag
 - 2- Ask the Patient if he can feel his bladder; can you empty it? (L4 L5, S1)
 - 3- Not issue of tissue Profusion, so Fluids only you give to the patient (Issue of Neurological Function)
- UMNL:
- Patient will have Hyperflexia, Hypertonia and Rigidity. But in spinal Cord injuries the patient is in the first 24-72 Hours will be flaccid and No Reflexes (temporal state) due to SPINAL SHOCK
- Synapses of reflexes:
By Removal of the cortex responsible Injury

◆ Management of Spinal Injuries

- Depends on:
 - Level of injury (thoracic spin inj. Mostly by conservative)
 - Degree and morphology of injury
 - Presence of neurologic deficit
 - Other factors . If the p.t has another injury we can call it (p.t factor)
- Some general rules: مهم جدا
 - Stable injuries are usually treated conservatively
 - Unstable injuries usually require surgery
 - Neurologic compression requires decompression

Notes:

If there is a shear → really bad trauma

Subluxation: Incomplete (Partial)

Dislocation: Complete

(Subluxation in the Spine called: Spondylolysis)

- Thoraco-Lumbar (why is it common?) T11- L2
- Thoracic Spine is very rigid – have some rotation
 Lumbar is very Mobile
- The only part you can feel in the spine is the Spinous Process

Cauda Equina Syndrome (Very Important)

- A surgical emergency
- Requires full neurologic examination *including rectal examination for anal tone*
- Investigations: X-rays initially, but *MRI is mandatory as X-rays are usually unremarkable*
- Treatment: Emergency decompression-usually discectomy- within 24 hours.

Etiology:

- Compression or irritation of Lumbosacral Nerve roots below Conus Medullaris (Below L2 Level)
- Decreased space in the vertebral canal below L2
- Common causes: Herniated Disk or/and Spinal Stenosis, vertebral Fractures, Tumours
- Note: Spinal cord ends at L1-2, Dura ends: S1-2

Clinical Features:

- Usually Acute (develops in less than 24 hours)
- 1. Motor (UMN signs)**
 - Weakness, Reduced deep tendon reflexes (knee or ankle)
- 2. Autonomic:**
 - Urinary retention (Or overflow incontinence) and/or Fecal Incontinence due to loss of anal sphincter Tone.
- 3. Sensory:**
 - Low back pain radiating to legs (sciatica) aggravated by Valsalva Maneuver and by sitting: relieved by lying down.
 - Bilateral sensory loss or pain; depends on the level affected
 - Saddle area(S2-S5) anesthesia
 - Sexual Dysfunction (Late Finding)

Treatment:

- Urgent Investigation and decompression (< 48 H) to preserve bowel, bladder and sexual function and/or to prevent progression to paraplegia

Prognosis:

- Markedly Improves with surgical decompression

MRI Is the Gold standard Investigation

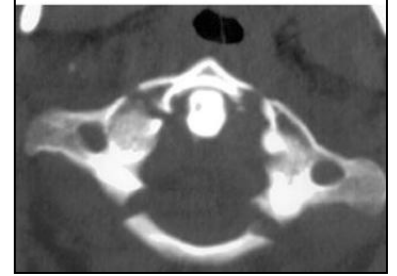
◆ Specific Injuries

● C1

○ JEFFERSON FRACTURE

- Compression force
- Stable fracture, Usually treated conservatively
- Is burst fracture.
- Tx : we need rigid cervical spine.

Jefferson Fracture



● C2

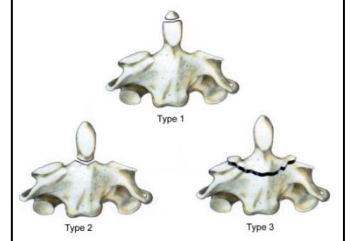
○ ODONTOID FRACTURE

- Management depends on location of fracture.
 - **Fractures of the tip:** short Immobilisation is adequate
 - **Fractures of the base:** will heal well by **adequate** Immobilisation
 - **Fractures at middle** require internal fixation

○ HANGMAN FRACTURE

- Traumatic spondylolisthesis of C2 (#of pars interarticularis)
- Managment depends on displacment and presence of C2-3 subluxation.
- IF displaced leads to **immediate** death by compression of Medulla Oblongata, *So, Surgery as fast as possible*

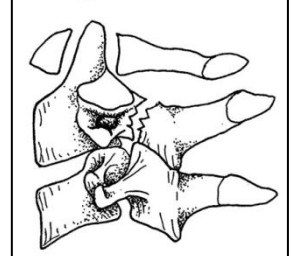
Odontoid Fracture



● C3-7

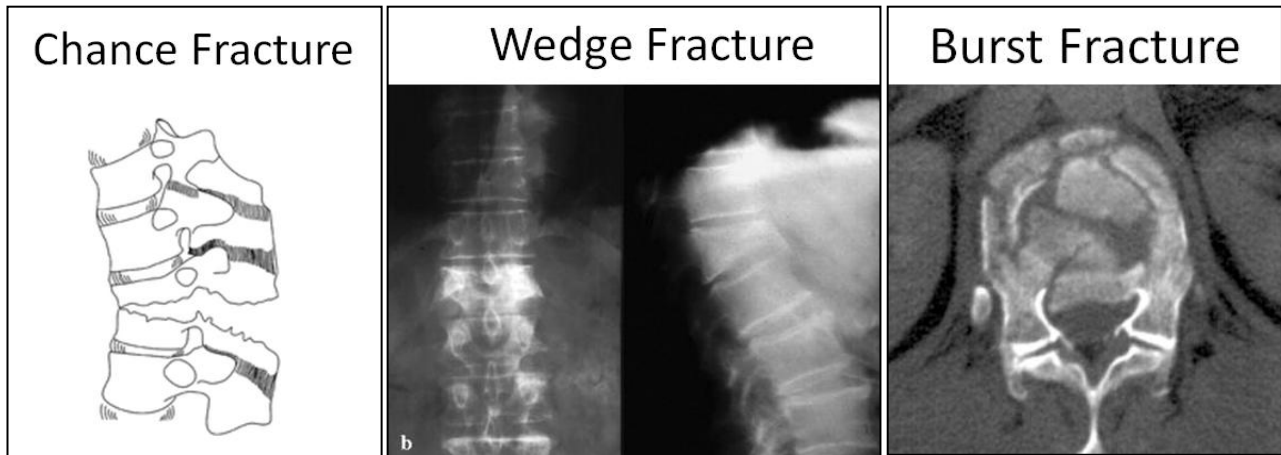
- Descriptive: depends on mechanism of injury
 - Flexion/extension
 - Compression/distraction
 - Shear
- Presence of subluxation/dislocation
- SCI (Spinal Cord Injury):
 - high fracture results in quadriplegia
 - Low fracture results in paraplegia
 - At cervical spine (tetraplegia).
 - Below cervical spine (paraplegia).

Hangman Fracture



◆ Thoraco-Lumbar fractures

- Spinal cord terminates at
 - L1/2 disc in adult ,
 - L2/3 in a child
- 50% of injuries occur at Thoraco-lumbar junction
- Common fractures:
 - **Wedge fracture (flexion/compression)**
 - is a vertebral compression fracture occurring anterior column or middle.
 - In picture , vertebra resembles a wedge.
 - These fractures are more commonly found in the thoracic spine
 - **Burst (compression)**
 - **Chance (flexion/distraction)**



◆ Pathologic fractures

- Due to infection or tumor
- Low-energy fractures
- X-rays: “winking owl” sign



Bone and Joint Infection

◆ Introduction

- Initial treatment → based on presumed infection type → clinical findings and symptoms
- Definitive treatment → based on final culture
- **Glycocalyx**
 - exopolysaccharide coating
 - envelops bacteria
 - enhances bacterial adherence to biologic implants
- According to the host response, infections of the bone are divided into: Pyogenic and granulomatous :
 - Pyogenic infections
 - Acute and chronic osteomyelitis
 - Septic arthritis
 - Granulomatous infections (e.g. TB, syphilis).

"Acute osteomyelitis"

◆ Classification

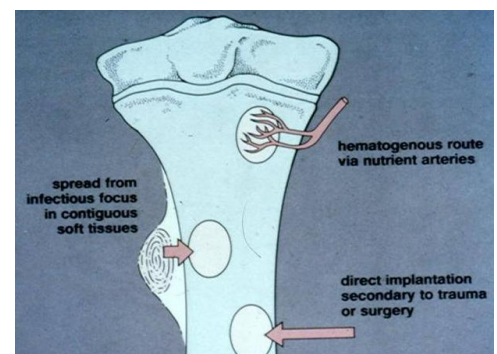
- Duration:
 - Acute, Sub-acute and Chronic
- Route of Infection:
 - Hematogenous
 - Exogenous

◆ Definition:

- Osteomyelitis is an inflammation of bone caused by an infecting organism.
- It may remain:
 - Localized
 - Spread to:
 - Marrow
 - Cortex
 - Periosteum
 - Soft tissue

◆ Organism:

- Neonates: Staph aureus, Strep, E coli
- Children: Staph aureus, E coli, Serratia, Pseudomona (Hem. Infl < 4 yrs)
- Sicklers: Staph aureus, Salmonella (most unique)
- Drug addicts: Staph aureus, Pseudomonas (most unique)
- **Organism**: the commonest is staph. Aureus
- **Source of infection**: Hematogenous, direct extension, direct from outside
- **Incidence**:
 - Age: more in children
 - Sex: Boys > Girls
 - Site of infection: metaphysis
 - Bones: LE > UE. commonest are tibia and femur



Group A1◆ Pathology

- Hematogenous colonisation of the bones by bacteria
- Stage of inflammation
- Spread of infection with pus formation
- Formation of subperiosteal abscess
- Pus tracks towards skin to form a sinus
- Bone infarction (***Sequestrum***)
- Subperiosteal new bone formation (***Involucrum***)

✓ Notes :

- **Sequestrum**= dead bone inside the bone, which looks in the X-ray as a white area within a black area. The black area is the infection while the white area is the necrotic bone
- **Involucrum**, which looks in the X-ray as if the cortex of the bone is doubled with a black space, separates the 2 layers).



Arranged by severity: (d)
the most severe

◆ Pathology and age variation

- **Neonates:**
 - Extensive bone necrosis
 - Increased ability to absorb large sequestrum
 - Increased ability to remodel
 - Epiphysio-metaphyseal vascular connection
 - Secondary septic arthritis

- **Adults:**
 - No subperiosteal abscess
 - Adherent periosteum
 - Soft tissue abscess
 - Vascular connection with the joint
 - Secondary septic arthritis

◆ Clinical Picture

- **History:**
 - Skin lesion
 - Sore throat
 - Trauma
- **Symptoms:**
 - **Pain**
 - Fever
 - Restlessness
 - Vomiting
 - The limb is held still, loss of function.
 - Malaise
- **General signs:**
 - Looks ill
 - Fever
 - Tachycardia
- **Local signs:**
 - Look, feel and move

◆ Laboratory tests

- CBC
- ESR
- C-reactive protein (most sensitive)
- Blood cultures (positive up to 50 %)
- Aspiration (send for Gram stain and C&S)

◆ Radiography

- Plain x-rays (Normal in the first ten days, after that resorption of affected bone and sub-periosteal new bone formation)
- Bone scan (very sensitive but not specific)
- Gallium scan
- Ultrasound
- MRI
- **Radiographic Changes:**
 - soft tissue swelling (early)
 - bone demineralization (10-14 days)
 - **sequestra** → dead bone with surrounding granulation tissue → later
 - **involucrum** → periosteal new bone → later

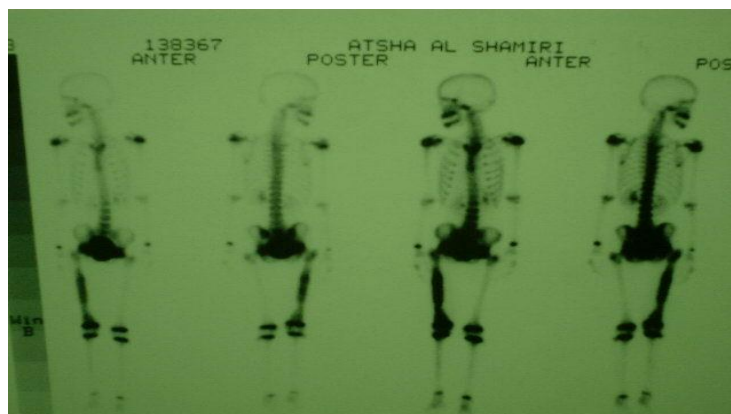


Group A1

An AP radiograph shows the radiolucency of acute osteomyelitis

- **MRI**

- shows changes in bone and bone marrow before plain films
- decreased T₁-weighted bone marrow signal intensity
- **increased post gadolinium fat-suppressed T₁-weighted signal intensity**
- increased T₂-weighted signal relative to normal fat

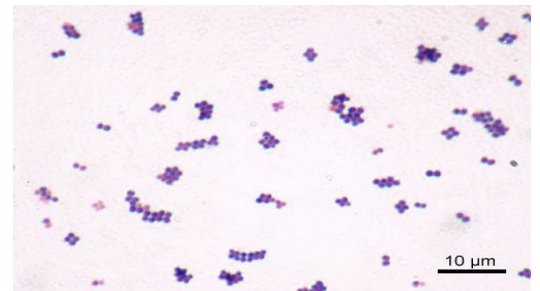


Group A1

- **Differential Diagnosis**
 - Acute septic arthritis
 - Cellulitis
 - Ewing's Sarcoma
 - Sick cell bone crisis
 - Acute rheumatoid arthritis

◆ **Treatment**

- **General:**
 - Admission
 - Hydration
 - Correction of electrolyte imbalance
 - Analgeics
 - Immobilization
- **Treatment Outline**
 - identify the organisms
 - select appropriate antibiotics
 - deliver antibiotics to the infected site
 - halt tissue destruction
- **Empirical Treatment**
 - Before definitive cultures become available
 - based on patient's age and other circumstances
- **Newborn (up to 4 months of age)**
 - The most common organisms:
 - *Staphylococcus aureus*
 - *gram-negative bacilli*
 - *group B streptococcus*
 - Newborns may be afebrile → best predictors are local signs in the extremity
 - Almost 70% of newborn → positive blood cultures
 - Primary empirical therapy includes
 - nafcillin or oxacillin plus
 - 3rd -generation cephalosporin
 - Alternative antibiotic therapy
 - vancomycin + 3rd-generation cephalosporin
- **Children 4 years of age or older**
 - most common organisms
 - *S. aureus*
 - *group A streptococcus*
 - *coliforms* → (uncommon)
 - empirical treatment → nafcillin or oxacillin
 - alternative regimens → vancomycin or clindamycin
 - gram-negative organisms → 3rd -generation cephalosporin
 - **Haemophilus influenzae bone infections → almost completely eliminated → due to vaccination**



Group A1

- **Adults 21 years of age or older**
 - **most common organism** → *S. aureus*
 - wide variety of other organisms have been isolated
 - Initial empirical therapy → includes nafcillin, oxacillin, or cefazolin;
 - Alternative initial therapy → vancomycin

- **Sickle cell anemia**
 - *Salmonella* is a characteristic organism
 - The primary treatment → fluoroquinolones (only in adults)
 - alternative treatment → 3rd -generation cephalosporin

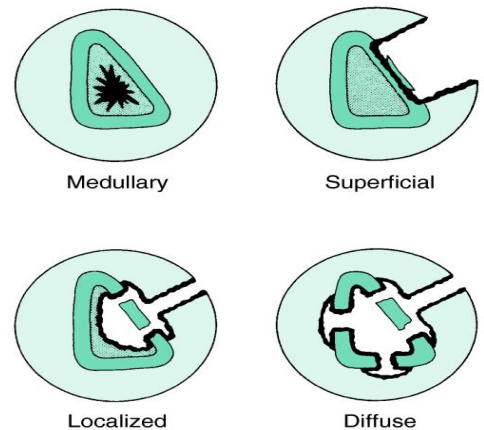


◆ **Operative Treatment**

- started after cultures
- indications for operative intervention
 - drainage of an abscess
 - debridement of infected tissues to prevent further destruction
 - refractory cases that show no improvement after nonoperative treatment

"Chronic osteomyelitis"

- Common in
 - inappropriately treated acute OM
 - trauma
 - immunosuppressed
 - diabetics
 - IV drug abusers
- Anatomical classification → in the picture



◆ **Features**

- Skin and soft tissues involvement
- Sinus tract → may occasionally develop squamous cell carcinoma
- Periods of quiescence → followed by acute exacerbations

◆ **Diagnosis**

- Nuclear medicine → activity of the disease
- **Best test to identify the organisms** → **Operative sampling of deep specimens from multiple foci**

◆ **Treatment**

- **empirical therapy is not indicated**
- **IV antibiotics** → **must be based on deep cultures**
- Most common organisms
 - *S. aureus*
 - Enterobacteriaceae
 - *P. aeruginosa*

Group A1

↓ head size (irregular shape)



"Septic Arthritis"

- May affect any age and any joint
- The hip and knee are the most affected
- **Pathology:** hematogenous or from the bone
 - In neonates: transphyseal vessels
 - In joints where the metaphysis is intracapsular (Hip, shoulder, proximal radius and distal fibula)
- **Symptoms** : like AO
- **Signs:** hot swollen joint which is painful to any motion, inability to bear weight
- **Investigations:** CBC,ESR and CRP
- **Organisms:** similar to AO
- **Rx:** Arthrotomy (Incision into a joint) and washout + Antibiotics (similar to AO)
- **Main DDx:** transient synovitis of the hip



"Tuberculosis"◆ **Causative organism:**

1. **Mycobacterium tuberculosis**
2. Mycobacterium Bovine
3. Mycobacterium africanum

• **Mycobacterium Tuberculosis**

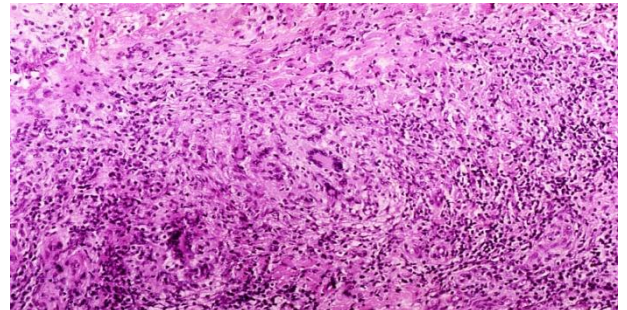
- Thin non-motile rod
- Strictly aerobic
- Acid fast bacillus
- Requires enriched culture medium to grow
- Takes as long as 4-6 weeks to see the colonies
- Known to affect humans from about 5000 BC
- Discovered by Laennec in the early 18th century
- Common in our region and other developing countries
- Endemic in poor non-developed countries
- Increasing in developed countries along with the increase in AIDS

• **Affects:**

1. Anyone at any age!!
2. More common in the immune-compromised (AIDS, chronic renal failure, substance abuser)
3. Usually affects young individuals in developing countries while it affects the older in developed countries

◆ **TB Pathology**

- Inflammation Hyperemia
- TB Follicles (tubercle):
 - LYMPHOCYTE – MONOCYTES
 - ENDOTHELIAL CELLS
 - LANGHANS GIANT CELLS
- Coalesce
- Caseation

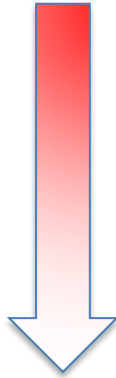
◆ **Musculoskeletal TB**

- Secondary to other **primary TB lesions**
- (Pulm., Renal, LN)
- 1-8% of all T.B
- 50% associated with pulmonary primary site
- Route of spread:
 - Hematogenous *****
 - Direct (much less)
 - * Bone to joint
 - * Soft tissue to bone
- **THE PRIMARY LESION**
 - Quiescent
 - Active: (Apparent, Latent)

Group A1

- **MSK targets:**

1. Spine (50%)
 - Thoracic (50%)
 - Lumbar (25%)
 - Cervical (25%)
2. Pelvis
3. Hip
4. Knee
5. Ankle and shoulder



- **Presentation:**

- Constitutional symptoms
 - Fever
 - Weight loss
 - Night sweats
 - Anorexia
- Pain
- Stiffness
- deformity

- **Spine:**

- Deformity (gibbus, kyphus)
- Neurological compromise (motor>sensory)
- Muscle spasm

- **Joints:**

- Swelling
- Stiffness
- Locking
- Loss of function

- **Bones:**

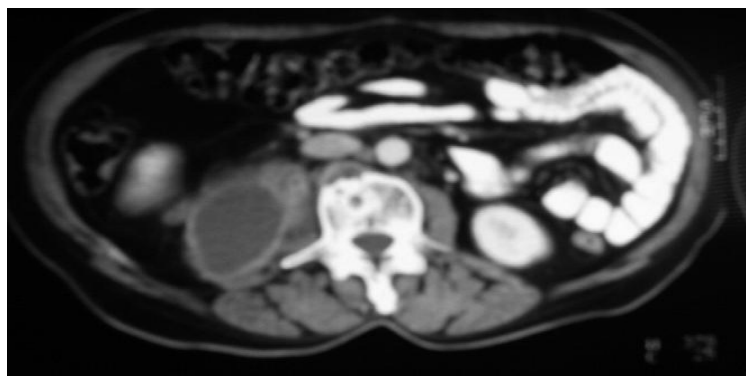
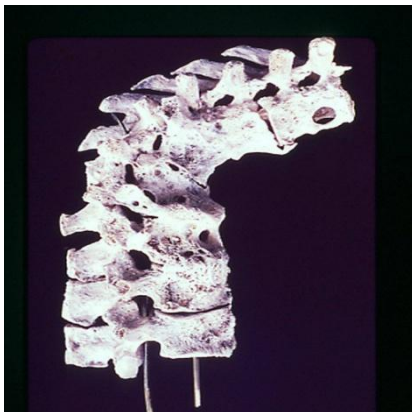
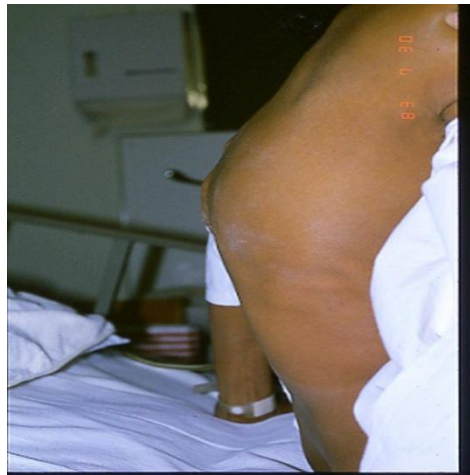
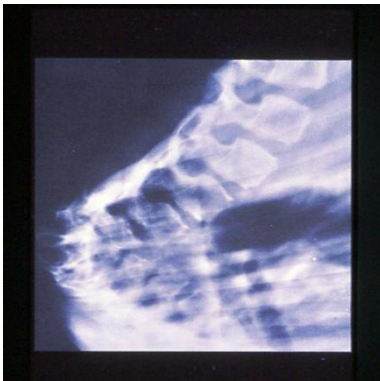
- Ulcers
- Sinuses
- Swelling
- deformity

"T.B of The Spine (Pott's disease)"

- Usually secondary to hematogenous spread
- Can affect two or more adjacent vertebrae
- May skip levels
- Primarily does not affect the disc but eventually the disc is affected
- Affects most commonly the anterior part of the vertebral endplates
- Causing erosion and destruction and finally anterior wedging of the vertebrae
- The disc herniates into the weakened and destructed body and narrowing of the disc height follows
- Infection spreads to adjacent level under the longitudinal ligaments and hematologically
- Eventually a kyphotic deformity occurs

Group A1

- Para vertebral abscess is common and may be distant as well
 - Cervical > retropharyngeal abscess
 - Lumbar > psoas abscess
- Compression of the spinal cord is more likely to occur at the thoracic level
- Neurological deficits occur due to the compression secondary to the deformity, Or compression from the abscess
- Paraplegia may occur
- ***Reversible if treated early***
- ***Mostly treated non-surgically***



◆ **Diagnosis**• **History and physical**

- High risk
- Constitutional symptoms
- Atypical clinical picture

• **Blood work:**

- Lymphocytosis
- Anemia
- Elevated ESR
- ELISA → for antibody
- PCR
- Brucellatitre

• **Radiology:**

- Plain x-rays:
 - Spine:
 - Erosion and destruction of end plates
 - Narrowing of disc space
 - Soft tissue mass shadow
 - Anterior wedging of vertebrae
 - Kyphus deformity
 - Joints: usually monoarticular

Discontinuity of the popliteal artery

- Peri-articular osteopenia
- Subchondral and peripheral erosions affecting both sides of the joint
- Loss of joint space

- Computerized tomography:
 - Further delineate bony destruction and sequestrum
- Magnetic resonance imaging with contrast:
 - Soft tissue mass, abscess
 - Nerve root, cord status
 - Distant abscess
 - Non-enhanced cold abscess with enhanced peripheral ring
- **Special tests:**
 - Mantoux skin test
 - Spine:
 - CT guided needle biopsy
 - Joints:
 - Synovial aspiration---- low yield
 - Should get bone/soft tissue
 - Send for aerobic/non-aerobic bacteria, fungal, AFB, enriched culture media
 - Takes up to 4-6 weeks

◆ **Treatment**

- Mainstay of treatment is combination anti-microbial agents.
- Usually 3-4 medications needed
- Isniazide, Rifampin, Ethambutol, Pyrazinamide are commonly chosen
- Modify according to culture results
- Given for prolonged period of time (6 months up-to 18 months)

Group A1

- **Indications of surgery:**

1. Marked and progressive neurological deficit not responding to medical treatment requiring decompression (kyphectomy-will result in shortening of the spine)
2. Spinal instability requiring stabilization
3. Tissue biopsy to confirm diagnosis
4. Joint lavage and removal of rice bodies
5. Abscess drainage if resistant to conservative treatment

"Brucellosis"

- Milk and milk products
- Back pain and stiffness
 - Muscle spasm
 - Fever – mild
- **SCRO-ILIAC JOINT**
 - less destructive than Tb
- **BRUCELLA TITRE**
- antibiotics e.g. SEPTRIN - OXYTETRACYCLINE

"SYPHILIS"

- Spirochete Treponema Pallidum
- **Congenital Syphilis – Commonest**
- Chronic
 - Osteochondritis
 - Periosteitis
 - Osteitis
- Tibia Lesabre Tibia

"Fungal Infection"

- Chronic – Very Low Grade
- **Feet – Farmers – Thorns.Madura Foot**
- Slow Destruction
- Sinuses – Granules
- Secondary Bacterial Infection
- Resistant To Chemotherapy
- Needs Surgical Debridement
- If Advanced May Need Amputation
- **Note:** Thorn: A short, hard, pointed part of a stem or branch of a woody plant



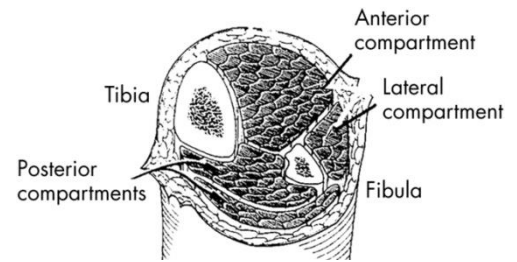
Compartment Syndrome/Acute Joint Dislocation

- **What is a compartment?**

- Area surrounded by fascia and contains muscles, bones, nerves and vessels.

- **What is the tissue pressure normally?**

- Resting compartment pressure: 0-8 mmHg.
- Pressure difference between the tissues in the compartment and capillary bed is what drives the gas exchange/diffusion. Therefore, when there is an increase in the tissue in the compartment, an ischemia occur.



- **Artery>arteriol>capillary bed (diffusion/exchange)>venule> vein**

- ◆ **Pathophysiology:**

- risk factor
- Elevated tissue pressure
- Absence of diffusion at the capillary bed
- Cell damage and swelling
- Further increase in tissue pressure
- Lack of oxygenation
- Vicious circle



- ◆ **Threshold pressure:**

- 30 mm Hg (rigid), (Intracompartment pressure)
- Less than 30 mm Hg difference between compartment pressure and diastolic pressure (clinically relevant)

- ◆ **Risk factors (local):**

- Trauma, crush, fracture (open/closed)
- Injection
- Bleeding
- Prolonged vascular occlusion (reperfusion injury)
- Burns
- Venomous bite
- Intra-osseous fluid replacement
- IV fluid extravasation
- Tight bandage
- Post-surgery

- ✓ **Notes:**

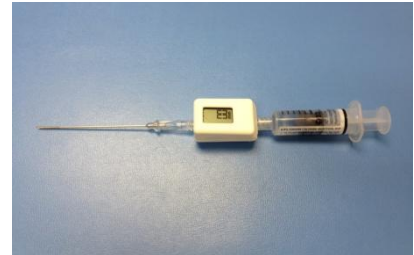
- The risk with open fracture is higher than others, as it requires a high energy force.
- Reperfusion injury is when the blood flow ceases transiently, the flow of the blood the second time can cause leakage of the arterioles → increases intracompartment pressure.
- Burns → fluid collection in third space (interstitial) → increases pressure of the compartment
- Post-surgery: bleeding, DVT (reperfusion injury)
- Heavy weight lifters (body builders) might be a risk factor

◆ **Risk factors (general):**

- Head injury → decreased consciousness!
- Decreased consciousness → late diagnosis
- Hypotension
- ✓ **Note** : Unconscious patients can't alert you when they feel pain (due to compartment syndrome)

◆ **Diagnosis:**

- Early:
 - Pain!!!
 - Pain increase with stretching the involved compartment
 - Presence of risk factor
 - High index of suspicion
 - Measurement of compartment pressure is high
 - The affected limb will be stiff
- Late:
 - Paresthesia
 - Paralysis
 - Pallor
- Severely high pressure:
 - Pulselessness (RARE!)
- Tight, woody compartment
- Tender compartment
- Measurement:
 - Rarely necessary
 - Must be done at area of highest expected pressure
 - May give false low result

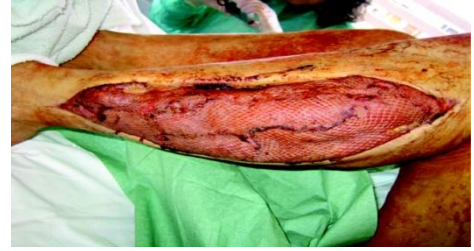


◆ **Management:**

- Initial (undeveloped CS):
 - Maintain normal blood pressure
 - Remove any constricting bandage
 - Keep limb at heart level
 - Regular close monitoring (15-30 minute intervals)
 - Avoid nerve blocks, sedation and strong analgesia to obtain patients feed back
- Fully developed CS
 - Maintain normal blood pressure
 - Remove any constricting bandage
 - Keep limb at heart level
 - Diuresis to avoid kidney tubular injury if late
 - **Urgent surgical decompression (Fasciotomy)**
 - Muscle injury → release of myoglobin → toxic to kidney → Acute Tubular Necrosis

◆ Fasciotomy:

- Releasing the compartment fascia
- Allows swollen muscles to expand in volume
- Results in decreased compartment pressure
- Avoids further damage
- Does not reverse already occurred damage
- Ideally should be done as soon as diagnosis is made
- Should be done as long as there is still viable tissue
- Should not be done if there is no expected viable tissue, Otherwise infection is likely
- Debridement of all necrotic tissue is necessary
- Second and third look surgeries are often required
- Closure of skin is usually achieved after swelling has subsided
- Skin grafting is often required



• **Indications:**

- 6 hours of total ischemia time (ex: arterial embolism)
- Significant tissue injury
- Worsening initial clinical picture
- Delayed presentation with a picture of developed CS
- Absolute Compartment pressure >30 mmHg or <30 mm Hg difference from diastolic pressure
- Is a prophylactic procedure
- Does not reverse injury to permanently damaged tissue
 - So better to have a low threshold!

✓ **Notes:**

- The goal of fasciotomy is prevent further damage and not to regain the function of the affected cells (reperfusion injury)
- The ischemic muscles and nerves will be affected after one hour of the ischemia; however permanent damage will occur after 6-8 hours.

• **Complications:**

- Myonecrosis>Myoglobinemia>Myoglobinuria>Kidney tubular damage
- Loss of function of the involved compartment:
 - Flexion contracture
 - Paralysis
 - Loss of sensation
- The muscle will be replaced by a fibrous tissue (irreversibly damaged limb is not amputated). However, it's prone to infection if it was cut open.

- Leg:
 - Anterior compartment:
 - Drop foot
 - Deep posterior compartment:
 - Clawed toes
 - Loss of sensation in the sole
- Forearm:
 - Volar compartment:
 - Volkmann contracture

✓ **Notes:** Volkmann's ischemic contracture is a permanent flexion contracture of the hand at the wrist, resulting in a claw-like deformity of the hand and fingers.

"Acute Joint Dislocation"

◆ Joint stability:

- Bony stability
 - Shape of the joint (ball and socket vs. round on flat)
- Soft Tissue:
 - Dynamic stabilizer: Tendons/Muscles
 - Static stabilizer: Ligaments ± meniscus/labrum
- Complex synergy leading to a FUNCTIONAL and STABLE joint
- It takes higher energy to dislocate a joint with bony stability than a joint with mainly soft tissue stability
- Connective tissue disorders may lead to increased joint instability due to abnormal soft tissue stabilizers.
- Dislocation of a major joint should lead to considering other injuries.



✓ Notes:

- Shoulder is round on flat (the glenoid surface is flat, however the labrum on top of the surface renders it a round-like structure) → prone to dislocation.
- Connective tissue disorders: lax ligaments.
- Some joints have different positions in which they can be easily dislocated. (i.e. ball-throwing position → risk for shoulder dislocation)
- At risk group:
 - Major trauma victims
 - Athletes and sport enthusiasts
 - Connective tissue disorder patients
- When a joint is subjected to sufficient force in certain directions it might sustain a fracture, a dislocation or a fracture dislocation
- Different joints have different force vectors that may lead to a dislocation
- A joint might dislocate in different directions
- A joint dislocation is described by stating the location of the distal segment

Group A1

- *Anterior shoulder dislocation*: anterior displacement of the humeral head relative to the glenoid
- *Posterior hip dislocation*: posterior displacement of the femoral head relative to the acetabulum

- **Dislocation:**

- Total loss of contact between the articular surfaces of the joint

- **Subluxation:**

- Partial loss of contact between the articular surfaces of the joint

- **Acute joint dislocation**

- **Chronic joint dislocation:** Example of chronic joint dislocation is DDH. Obviously, a recurrent joint dislocation is NOT a chronic joint dislocation.



- **Diagnosis:**

- History of a traumatic event (major trauma or any trauma with the limb in high risk position)
- Pain and inability to use the limb
- Deformity
- Shortening
- Malalignment
- Malrotation
- Should check for other injuries (distracting injury)
- Should always check the distal neurovascular status.
- Should check for compartment syndrome
- Shortening is a hint in diagnosing DDH.

- **X-rays:**

- Should be done urgently without delay if dislocation is suspected
- Two perpendicular views of the involved joint
- Occasionally, special views are required such as the axillary view for shoulder dislocation
- X-rays to the joint above and below

- **Management principles:**

- Must rule out other injuries
- Pain relief
- Urgent reduction
- Check stability and safety zone
- Check neurovascular status after reduction
- X-rays after reduction

Group A1

- Protect the joint
- Rehabilitation
- Follow for late complications

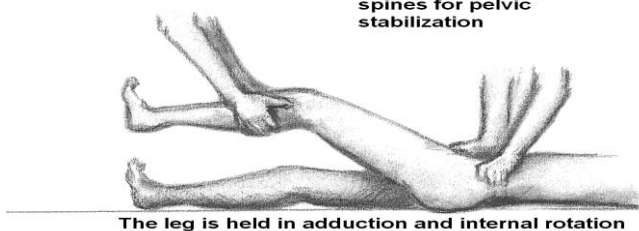
✓ **Notes :**

- Safety zone: The range of motion with stability (no danger of dislocation) For example, 10 degrees flexion and 20 degrees extension. If the patient goes beyond that, the joint will get unstable and might be dislocated.
- Neurovascular status should be checked before and after the reduction. This goes for the x-rays as well.

◆ **Reduction:**

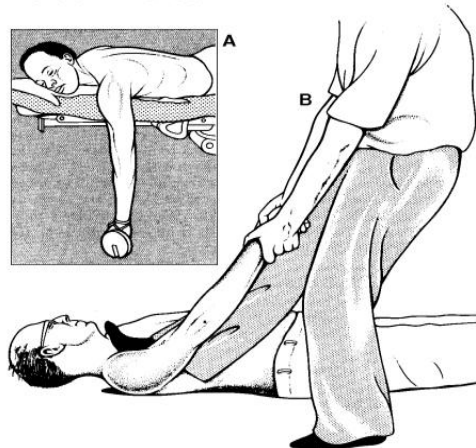
- Monitor vitals
- IV analgesia (opiod)
- IV sedation (to relax the muscles)
- Gradual traction to distract the joint
- Realignment and rotation to reduce the joint based on direction of dislocation
- A palpable clunk well be felt
- Check ROM and stability of the joint
- Muscle relaxant to allow the traction and distracion.
- Once joint is felt to be reduced, check distal NV status
- If it was intact before but not after, farther urgent management is needed
- If it was not present before but intact after, check again later to confirm
- Observe patients vitals until medications wear out
- Stabilize joint and get X-rays
- ***If irreducible or partial reduction only:***
 - Urgent closed reduction under general anesthesia and possible open reduction if closed reduction fails
 - Usually due to
 - Insufficient muscle relaxation
 - Entrapment of soft tissue
 - Fracture dislocation → Open reduction (obviously!)

Longitudinal traction is applied



Posterior traction is applied to the anterior superior iliac spines for pelvic stabilization

TWO METHODS FOR A DISLOCATED SHOULDER



- ***Special considerations:***

- A fracture dislocation is usually reduced in an open fashion in the operating room
- Must confirm concentric reduction on the x-rays, otherwise an open reduction should be performed



- ◆ **Early Complications:**

- Heterotopic ossification
- Neurological injury (reversible or irreversible)
- Vascular injury
- Compartment syndrome
- Osteochondral fracture/injury
- **Note:** Heterotopic Ossification=Myositis Ossificans

- ◆ **Late complications:**

- Stiffness
- Heterotopic ossification
- Chronic instability
- Avascular necrosis
- Osteoarthritis
- **Note:** Avascular Necrosis in hip dislocation mostly.

- **Special considerations:**

- **Hip joint:**

- Posterior dislocation is commonest
- Major trauma with hip flexed (dashboard injury)
- Sciatic nerve injury common
- High incidence of late avascular necrosis
- An orthopedic emergency!!



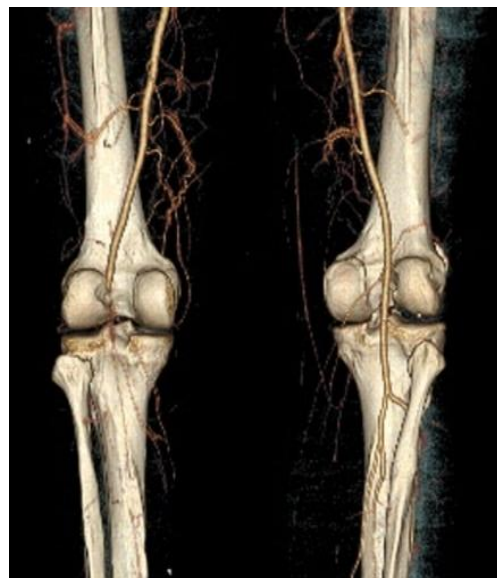
• **Shoulder dislocation:**

- Common
- Anterior dislocation is more common
- Patients with seizures prone to posterior dislocation
- May cause chronic instability
- Can result in axillary nerve injury



• **Knee dislocation:**

- Three or more ligaments
- Severe (high energy) trauma
- May be associated with popliteal artery injury---- Limb threatening
- Very serious emergency
- Needs accurate vascular assessment
- May be associate with peroneal nerve injury
- May be associated with fracture/ compartment syndrome
- Most require surgery either early or late or both
- **Note:** Popliteal artery is attached to the posterior of the tibia → anterior dislocation of the tibia will stretch the artery → Intimal injury or rupture.



Bilateral in-situ pinning to cause fusion (the growth plate is already damaged by SCFE)

Open Fractures & Pelvic Fracture

❖ Open Fractures:

❖ Definition:

- A fracture that at some point communicated with the environment.
 - An open joint is managed similarly
- Usually requires higher injury
- Old patient may fall down and have open fracture because of the bone and tissue weakness, so Not always higher injury!
- Sometimes can be missed, maybe there are small wound and the physician miss it.
- Commonly occurs in bones with minimal soft tissue coverage. (E.g. Tibia)
- Usually higher energy is required in deep bones

❖ Pathology:

- Traumatic energy to the soft tissue and bone (communication with environment)
- Inoculation of organisms
- Necrotic tissue
- Injury to vessels and microvasculature
- Raised compartment pressure
- Ischemia and lack of immune response
- **Infection:**
 - Difficult to eradicate the infection
 - Prolonged antibiotics
 - Multiple surgeries
 - Significant morbidity
 - Significant costs

❖ An open fracture is a usually a “red flag” warning of significant trauma

- Detailed assessment of the patient is necessary

❖ An open fracture is associated with significant morbidity

- Must act quickly

❖ A delay in management is proven to increase the likelihood of complications

- Give urgent priority while triaging, provide initial management and consult urgently

❖ Diagnosis:

- Sometimes obvious!
- Other times, settle,,, be observant
- A wound close to a fracture *is an open fracture* until proven otherwise.
- Whenever a fracture is diagnosed, go back and check the skin
 - A small wound continuously **oozing blood**, especially, if you see **fat droplets** within the blood, is an open fracture!
 - Not always close to the fracture, it may be around it
 - Don't probe!!
 - If in doubt, use good light, if there is a break in the dermis or fat is seen, call it an open fracture
 - Better to overcall than miss it!

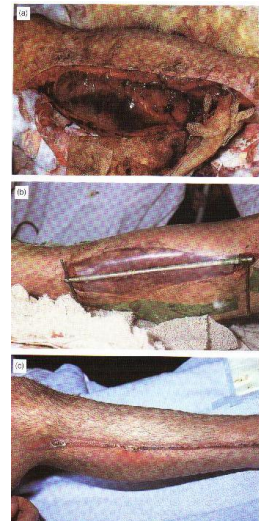


Group A1❖ **Algorithm:**

- Assess and stabilize the patient, ATLS principles
- Assess the condition of the soft tissue and bone to help grade the open fracture
- Manage the wound locally
- Stabilize the fracture
- IV antibiotics
- Tetanus status

❖ **Assessment:**

- If polytrauma, apply ATLS principles
- If isolated injury:
 - Mechanism and circumstances of injury
 - Time since injury
 - PMH/PSH/Allergy/Drugs/Smoking
 - Tetanus vaccination status
 - ♦ If the patient get the tetanus vaccine in the within the past 10 year don't give him any thing
 - ♦ If the patient unconscious or he answers you that he got it in more than 10 years then give him the vaccine.
- Examine the affected region for:
 - ***Soft tissue:***
 - ♦ Degree of contamination
 - ♦ Necrotic and devitalized tissue
 - ♦ Size of wound
 - ♦ Coverage loss
 - ♦ Compartment syndrome
 - ***Bone:***
 - ♦ Comminution
 - ♦ Stripping of bone periosteum
 - ♦ Away from injury to joint above and below
 - ♦ X-rays to joint above and below
 - ***Neurovascular status distally:***
 - ♦ On arrival and post reduction and splinting later.
 - You need to document everything the patient came with to avoid any medico legal problems



36, 23,40 Fasciectomy closure device being used to close a large open fracture over a period of 1 week: (a) intraoperatively; (b) 4 days later; and (c) after healing.

Group A1❖ **Open fracture grade:**▪ ***Grade 1:***

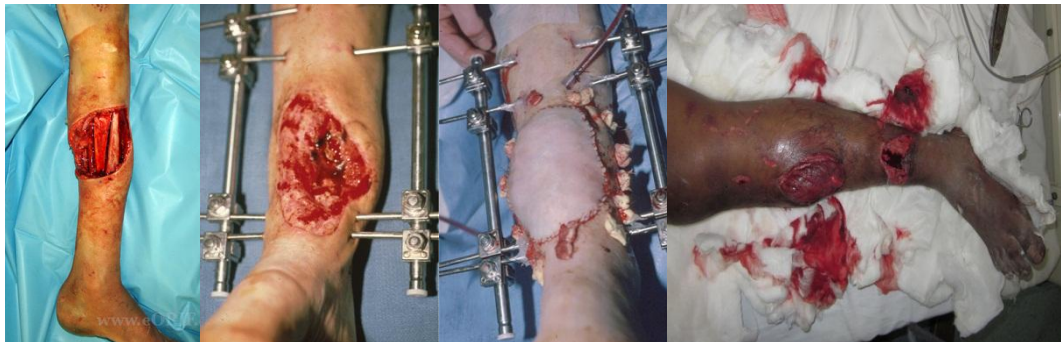
- Less or equal to **1 cm**, it has to be :
 - ♦ Clean
 - ♦ Non-segmental NOR severely comminuted fracture
 - ♦ less than 6 hours since injury

▪ ***Grade 2:***

- > 1cm wound:
 - ♦ Not extensive soft tissue injury or contamination
 - ♦ Non segmental nor severely comminuted fracture
 - ♦ No bone stripping and with adequate soft tissue coverage

▪ ***Grade 3:***

- **3A:** Any size with:
 - ♦ extensive soft tissue contamination or injury but not requiring soft tissue coverage procedure, or with a segmental or severely comminuted fracture, or late presentation more than 6 hours
- **3B:** Any open fracture that requires soft tissue coverage procedure
- **3C:** Any open fracture that requires vascular repair
 - ♦ If you exam patient with grade 3C, you will find him pulseless and when you investigate him there will be vascular injury indicate the pulseless.

❖ **Management**▪ ***Local:***

- Take a picture, to avoid the needing to open it again for examination.
- If dirty, irrigate with normal saline to remove gross contamination
- If bone sticking out try to reduce gently then re-check neurovascular status
- Cover with sterile wet gauze
- If bleeding apply direct pressure on wound
- No culture swabs in ER



Group A1

- **Antibiotics:**

- First generation Cephalosporin for gram positives (Ex: Cefazolin) in all open fractures
- Aminoglycoside to cover gram negatives (Ex: Gentamicin) sometimes not required in grade 1 but *in general it is safer* to give in all grades.
- Add penicillin or ampicillin or clindamycin for clostridium in grade 3 open fractures and all farm and soaked wounds

- **Tetanus prevention:**

- Wound types:
 - ♦ Clean wounds:
 - <6 hours from injury
 - Not a farm injury
 - No significant devitalized tissue
 - Non immersed wound
 - Non contaminated wound
 - ♦ Other wounds



| Clean wounds | | Other wounds | | | |
|-----------------------|-------------------|--------------------------|--|--------------------------------|-------------------|
| Completed vaccination | | Not completed or unknown | | Completed vaccination | |
| Booster < 10 years | Booster >10 years | Td 0.5ml IM | | Booster < 5 years | Booster > 5 years |
| nothing | Td 0.5 ml IM | | | nothing | Td 0.5ml IM |
| | | | | TIG 250U And Td 0.5ml IM | |

- As soon as patient is stable and ready, alert the OR, and consent for surgery
- Plan: Irrigation, debridement and fracture stabilization
- The sooner the less risk of further morbidity

- **In the OR:**

- Extend wound if necessary
- Thorough irrigation
- Debride all necrotic tissue
- Remove bone fragments without soft tissue attachment except articular fragments
- Usually requires second look or more every 48-72 hours
- Generally do not close open wounds on first look



Group A1▪ **Fracture management:**

- Generally avoid internal fixation (plate and screw)
- Generally external fixator is used.
- Femur and tibia fractures can usually be treated immediately with IM nail except severe injuries and contamination
- Observe for compartment syndrome post-operatively

▪ **If all principles applied:**

- 2% complication rate in grade 1
- 10% complication rate in grade 2
- Up to 50% complication rate in grade 3

◆ **Fractures with nerve or vascular injuries:**

- ❖ Don't miss it!
- ❖ Always perform an accurate assessment at presentation, post manipulation and reduction, post-surgical fixation, serially until condition stabilizes
- ❖ Serial examination helpful in deciding line of treatment
- ❖ Serial examination helps avoid confusion
- ❖ High correlation between vascular injury and nerve injury
 - Proximity between them anatomically.

❖ **Mechanisms:**

- Penetrating trauma
- High energy blunt trauma
- Significant fracture displacement
- Keep in mind tissue recoil at presentation

◆ **Vascular injuries:**

- ❖ Direct laceration
- ❖ Traction and shearing



❖ **Assessment:**

- Always check:
 - Pulse, Color, Capillary refill, Temperature, compartment pressure
- Keep high index of suspicion:
 - High energy trauma
 - Associated nerve injuries
 - Fractures/ Dislocations around the knee
- Hard signs > realignment of limb > if persistent >
 - ➔ vascular intervention
- Hard signs > realignment of limb > improved >
 - ➔ Close observation
 - ➔ Realignment can result in unkincking of vessels, lowering compartment pressure, relaxation of arterial spasm
- ABI (ankle brachial index)
 - < 0.9 associated with vascular pathology
 - Rarely can give false negative result (Ex. Profundafemoris)
 - Always used in high risk fractures (knee)
 - If positive > Urgent vascular intervention
- Angiography, CT angiography
- Gold standard
- Not without risks
- Vascular surgeon to arrange with interventional radiologist

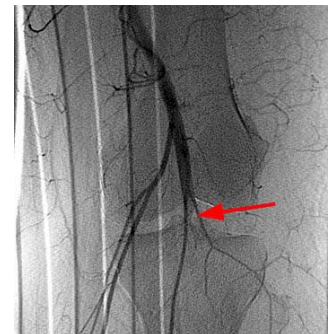
Table 1

Hard and Soft Signs of Vascular Injury Associated With Extremity Trauma**Hard signs**

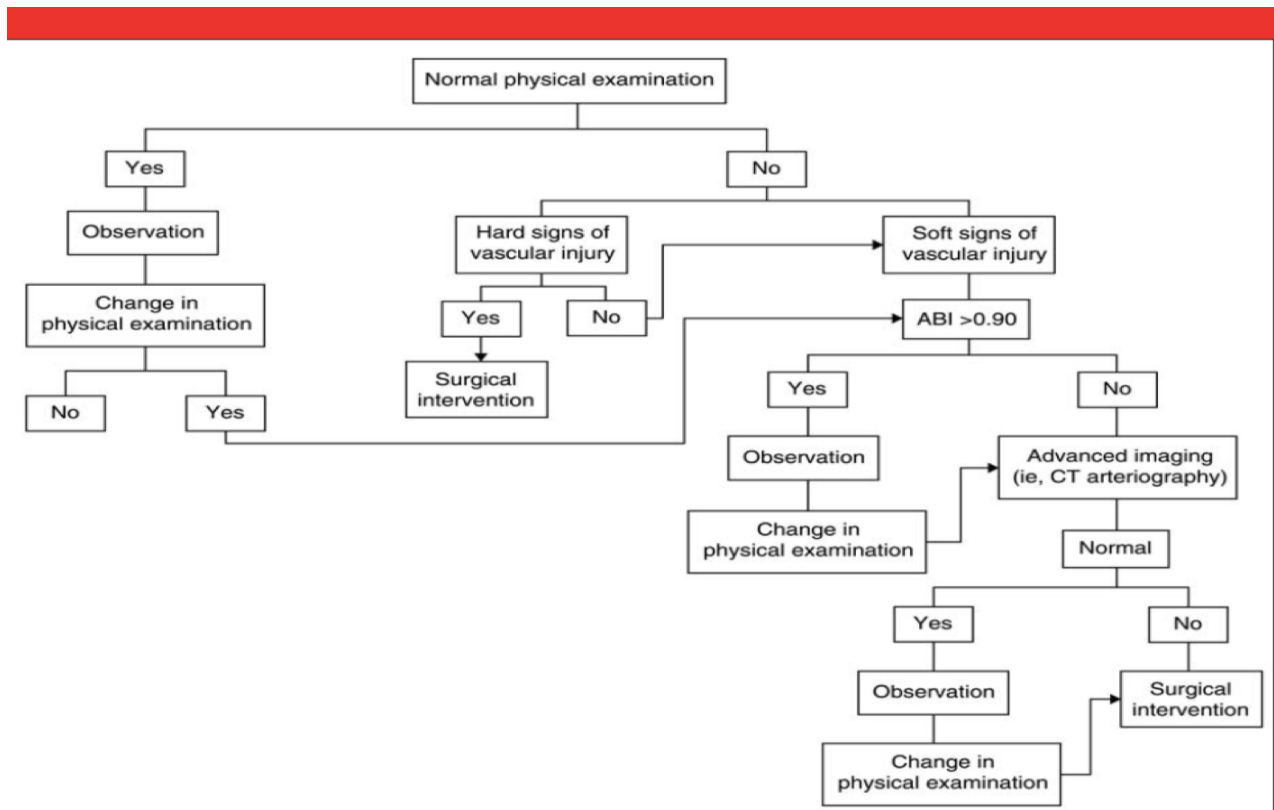
Pulselessness
 Pallor
 Paresthesia
 Pain
 Paralysis
 Rapidly expanding hematoma
 Massive bleeding
 Palpable or audible bruit

Soft signs

History of bleeding in transit
 Proximity-related injury
 Neurologic finding from a nerve adjacent to a named artery
 Hematoma over a named artery

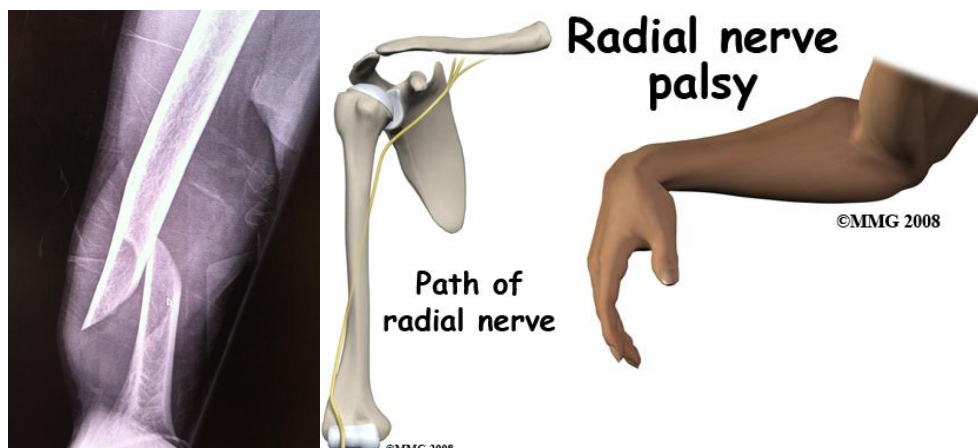
❖ **Management:**

- Once vascular injury is confirmed:
 - Coordination between:
 - ♦ Vascular surgeon
 - ♦ Orthopedic surgeon
 - ♦ General surgeon
 - To emergently re-establish perfusion and protect repair with skeletal stabilization
- Warm ischemia time dictates treatment
 - Warm ischemia: loss of perfusion with having the same of the room temperature.
 - Cold ischemia: like in the OR e.g. cooling limb to survive longer
- Most times, a quick external fixator is applied, followed by vascular repair
- Avoid prolonging warm ischemia to do a perfect job
- Prolonged warm ischemia >6 hours
 - ➔ Prophylactic fasciotomy
- Grade 3C open fractures have the worst outcome
- Amputation may be necessary in severe cases



◆ Nerve injuries:

- ❖ Cause of medico-legal concern
- ❖ Accurate assessment and documentation at presentation, post reduction, post-surgery is essential
- ❖ Remember to examine for motor and sensation prior to sedation
- ❖ Closed fractures not requiring surgery with nerve injuries:
 - Usually good outcome >80%
 - Usually managed conservatively in the early stages
 - Recovery may take more than 6 months
- ❖ Intact nerve before reduction, absent after reduction:
 - Controversial management
 - Usually observe



Group A1

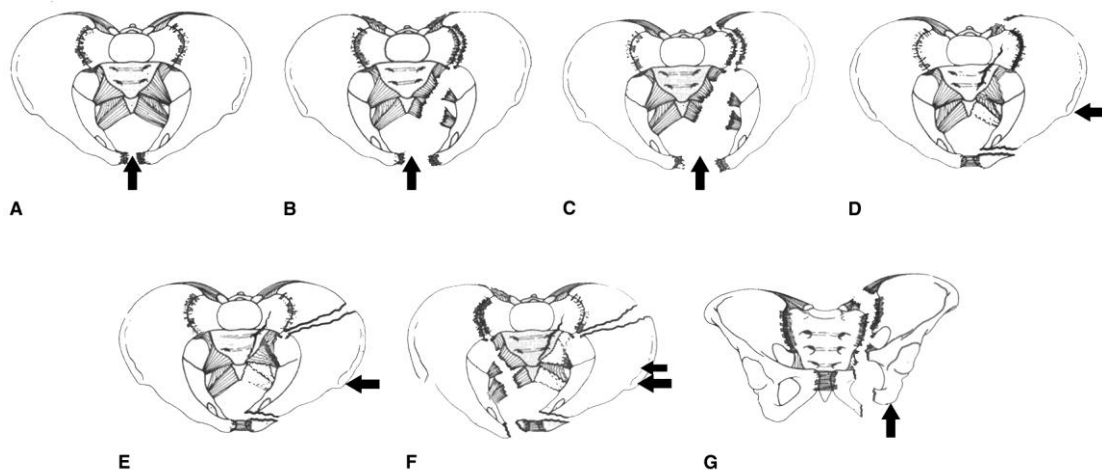
- ❖ Fracture requiring surgery with nerve injury:
 - Limited exploration
- ❖ Open fracture with nerve injury:
 - Explore, tag nerve ends for later repair
- ❖ **Follow up:**
 - Clinically
 - Electro diagnostic assessment start at 6 weeks then serially every 6 weeks
 - If no improvement:
 - Nerve exploration: neurolysis / repair / grafting
 - Tendon transfers to preserve function
- ❖ **Common sites of Nerve injuries:**
 - Shoulder fracture / dislocation > Axillary nerve
 - Distal humeral shaft fracture > Radial nerve
 - Elbow fracture / dislocation > Median>radial>ulnar
 - Hip fracture / dislocation > Sciatic nerve
 - Knee fracture / dislocation > Peroneal nerve



◆ **Pelvic trauma:**

- ❖ It composed of sacrum, coccyx, ilium, ischium and pubic rami
- ❖ Pelvic fractures / instability may cause life threatening bleeding
- ❖ Usually the bleeding in the pelvis is venous it reach 90% of pelvic bleeding
- ❖ Diagnosing pelvic instability can save lives

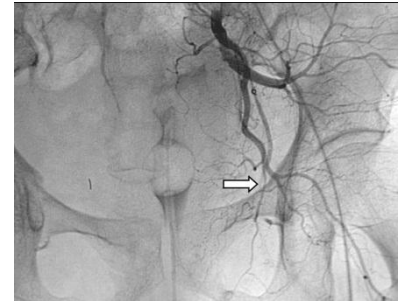
❖ **Pathology:**



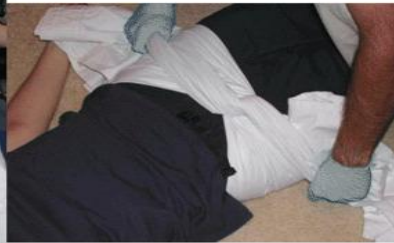
- A- anterior force causing a little opening in the sacro-iliac joint
- B- anterior force causing opening in the sacro-iliac joint and instability
- C- More force cause open book pelvis
- D, E and F lateral compression. e.g. car accident
- G- Vertical shears pelvic fracture.

Group A1❖ **Diagnosis:**

- History: High vs. Low energy trauma
- Mechanism of injury: Anterior vs. Lateral vs. Axial force
- Pelvic skin contusion, bruising
- Short extremity
- Careful neurologic assessment

▪ **Primary survey : part of “C”**

- Assess stability by gentle compression on the ASIS
- Traction on the leg and assess pelvic instability
 - ♦ If unstable or painful:
 - Apply sheet around hips and close the pelvis gently
 - This results in decreased intra-pelvic volume leading to tamponading the bleeding
 - Traction on the leg to stabilize vertical instability
 - This minimizes ongoing vasculature injury and bleeding

▪ **Rectal exam:**

- Bone fragments (be careful)
- High riding prostate
- bleeding
- Blood at the meatus
- Labial or scrotal ecchymosis
- Vaginal exam

❖ **Management:**

- Stabilize pelvis with binder
- If vertically unstable apply traction
- IV resuscitation
- Look for other injuries
- Check response
- If partial response, may require angiography for embolization of bleeders
- May require external fixator and/or pelvic clamp

❖ **Early diagnosis**

- Aggressive resuscitation
- Coordinated team effort
 - Save lives

Spinal Disorders

◆ Degeneration:

- “deterioration of a tissue or an organ in which its function is diminished or its structure is impaired”

❖ Other terms:

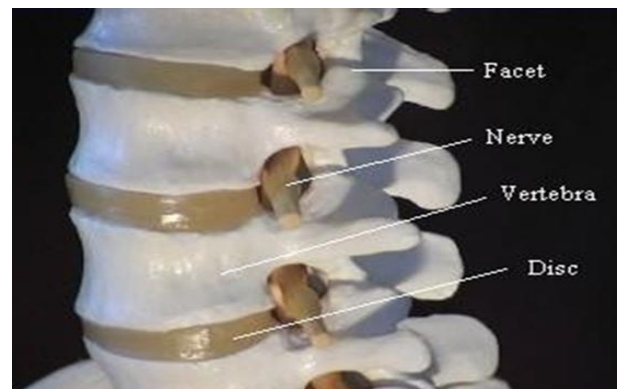
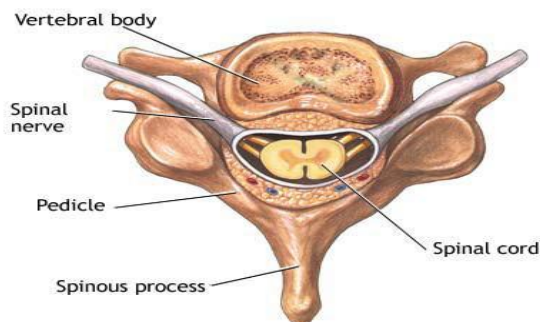
- “Spondylosis”
- “Degenerative disc disease”
- “Facet osteoarthritis”

◆ Etiology

- Multi-factorial
 - Genetic predisposition
 - Age-related
 - Some environmental factors:
- Smoking
- Obesity
- Previous injury, fracture or subluxation
- Deformity
- Operating heavy machinery, such as a tractor

◆ Anatomy

- **Anterior elements:**
 - Vertebral body
 - Inter-vertebral disc
- Degeneration occurs at the disc
- **Posterior elements**
 - Pedicles, laminae, spinous process, transverse process, facet joints (2 in each level)
- Osteoarthritis occurs at the facet joints
- **Neurologic elements:**
 - Spinal cord
 - Nerve roots
 - Caudaequina



◆ **Pathology, inter-vertebral disc:**

- The first component of the **3 joint complex**
- It is primarily loaded in **FLEXION**
- Composed of “annulus fibrosis” and “nucleus pulposus”
- Degeneration of the nucleus causes loss of cellular material and loss of hydration
 - *Movement is impaired-painful- and could become unstable*
- Disc degeneration will also cause
 - Loss of disc height→
 - Abnormal loading of facet joints
 - Stenosis in the inter-vertebral foramen
 - Bulging of the disc into the spinal canal
 - Contributing to spinal stenosis
 - Herniation of the nucleus into spinal canal
 - Causing radiculopathy (e.g. sciatica in the lumbar spine)

◆ **Pathology, facet joints:**

- Scientific name: “zygapophysial joints”
 - Synovial joints
 - 2 in each segment
 - Together with the disc, form the **3 joint complex**
 - Are primarily loaded in **EXTENSION**
 - Pattern of degeneration similar to other synovial joints
 - *Loss of hyaline cartilage, formation of osteophytes, laxity in the joint capsule*
- Facet degeneration will cause:
 - Hypertrophy, osteophyte formation
 - Contributing to spinal stenosis or foraminal stenosis
 - Laxity / Leniency in the joint capsule
 - Leading to instability (degenerative spondylolisthesis)

✓ **Notes :**

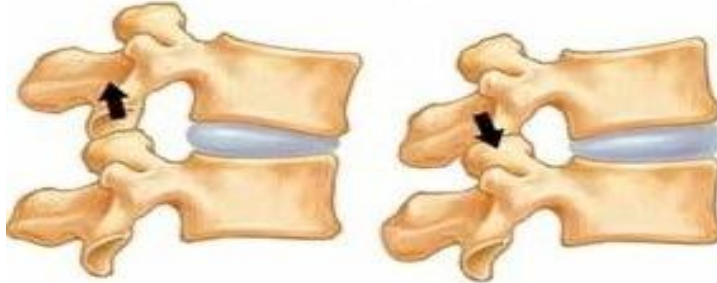
- Forminal : peripheral nerve
- Spinal: the whole spinal cord
- Spondylolisthesis: slipping of the vertebra on the one beneath it, either posteriorly or anteriorly.

◆ **Presentation**

- Falls into 2 catagories:
 - Mechanical pain: due to joint degeneration or instability
 - “Axial pain” in the neck or back
 - Activity related-not present at rest
 - Neurologic symptoms: due to neurologic impingement
 - Spinal cord
 - Presents as myelopathy, spinal cord injury
 - Caudaequina& Nerve roots
 - Presents as radiculopathy (e.g. sciatica) or neurogenic claudication

Group A1

- Mechanical pain
 - Associated with movement
 - Sitting, bending forward (*flexion*):
 - originating from the disc : “**discogenic pain**”
 - Standing, bending backward (*extension*) :
 - originating from the facet joints: “**Facet syndrome**”



- Neurologic symptoms
 - Spinal cord
 - Myelopathy:
 - Loss of motor power and balance
 - Loss of dexterity
 - » Objects slipping from hands
 - UMN deficit (rigidity, hyper-reflexia, positive Babinski...)
 - Slowly progressive “step-wise” deterioration.
 - **Note:** Loss of motor → indication for surgery
 - Spinal cord injury
 - With Spinal stenosis, there is a higher risk of spinal cord injury
 - Complete or incomplete
 - Cauda equina & Nerve roots
 - Radiculopathy
 - LMN deficit
 - Commonest is sciatica, but cervical root impingement causes similar complaints in the upper limb
 - Neurogenic claudication
 - Pain in both legs caused by walking
 - Must be differentiated from vascular claudication

Vascular vs. Neurogenic claudication

| Table – Differentiating neurogenic and vascular claudication | | |
|---|--|--|
| Factors | Neurogenic | Vascular |
| Evaluation after walking | Increased weakness | Unchanged |
| Palliative factors | Bending over, sitting | Stopping |
| Provocative factors | Walking downhill Increased lordosis | Walking uphill Increased metabolic demand |
| Pulses | Present | Absent |
| “Shopping cart” sign | Present | Absent |
| van Gelderen bicycle test | No leg pain | Leg pain |

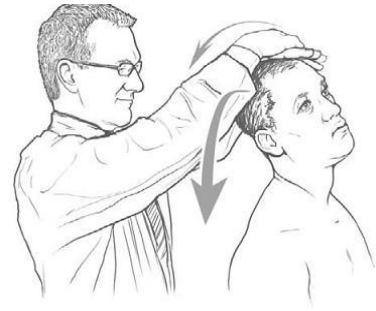
Bending over, sitting: widens the spinal canal

Shopping cart sign: bending on the cart while pushing it.

Bicycle: Bending the back

"The Cervical spine"

- Degenerative changes typically occur in C3-C7
- Presents with axial pain, myelopathy, radiculopathy
- Physical examination:
 - Stiffness (loss of ROM)
 - Neurologic exam
 - Weakness
 - Loss of sensation
 - Hyper-reflexia, hypertonia
 - Special tests: Spurling's sign

◆ **Management**

- Conservative treatment
 - First line of treatment for axial neck pain and mild neurologic symptoms (e.g. mild radiculopathy without any motor deficit)
 - Physiotherapy:
 - Focus on ROM and muscle strengthening
 - Non-steroidal anti-inflammatory medications (NSAID)
 - E.g. Diclofenac, ibuprofen, naproxen
 - Neuropathic medication: for radiculopathy pain
 - E.g. Gabapentin or pregabalin
- Surgical management
 - Indicated for:
 - Spinal stenosis causing myelopathy
 - Disc herniation causing severe radiculopathy and weakness
 - Failure of conservative treatment of axial neck pain or mild radiculopathy
 - Procedures:
 - Anterior discectomy and fusion of bone
 - Posterior laminectomy

Anterior Discectomy and fusion:

The two vertebrae are removed after removing the intervening disc. This procedure will affect the full range of motion; however it will slightly affect the functional range of motion.



"The Lumbar spine"

- Degenerative changes typically occur in L3-S1
- Presents with axial pain, Sciatica, neurogenic claudication
- Physical examination:
 - Stiffness (loss of ROM)
 - Neurologic exam
 - Weakness
 - Loss of sensation
 - Hypo-reflexia, hypo-tonia
 - Special tests: SLRT

✓ Notes:

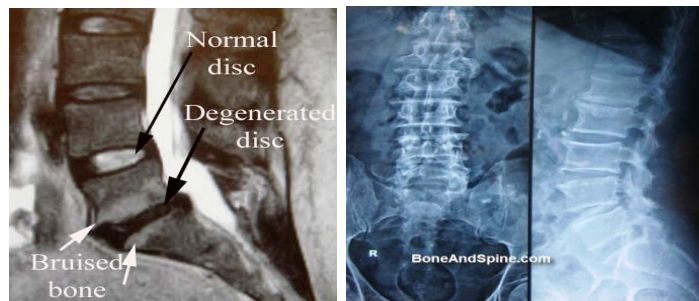
- No myelopathy because the spinal cord ends at L2
- Sciatica is simply radiculopathy of the sciatic nerve
- *Straight Leg Raising Test* (SLRT)

◆ Management

- Axial low back pain
 - Conservative treatment if first-line and mainstay of treatment
 - Physiotherapy: core muscle strengthening, posture training
 - NSAID
 - Surgical treatment indicated for:
 - Instability or deformity

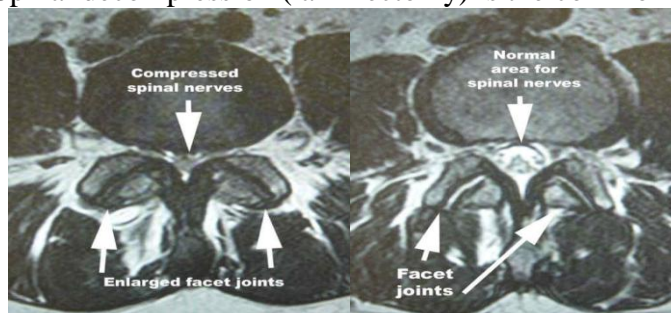
E.g. high-grade spondylolisthesis

- Failure of conservative treatment



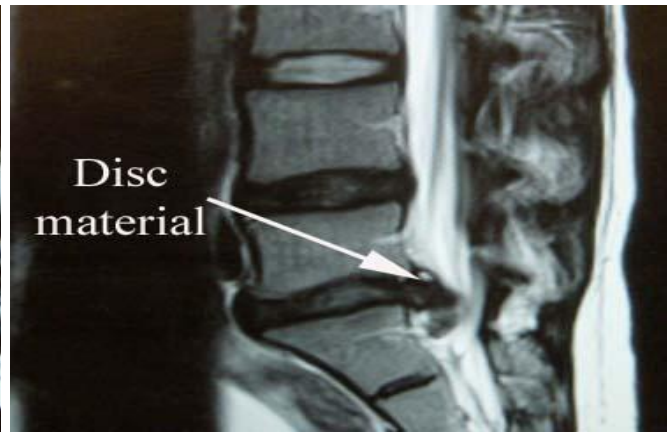
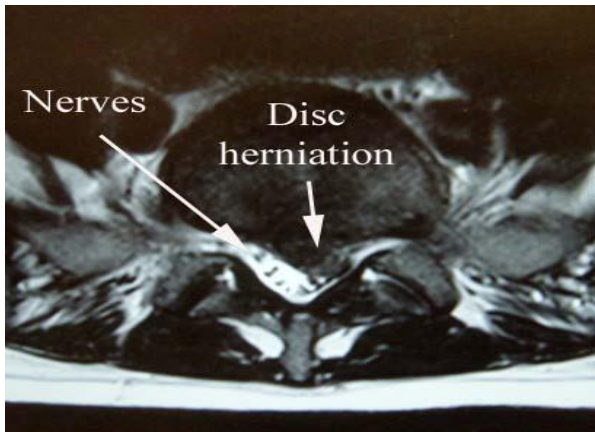
Lumbar spondylosis, Low intensity of the degenerated disc on the MRI

- Spinal stenosis
 - Conservative treatment is first line of treatment
 - Activity modification, analgesics, epidural cortico-steroid injections
 - Surgical treatment
 - Indicated for
 - Motor weakness e.g. drop foot
 - failure of –minimum- 6 months of conservative treatment
 - Spinal decompression (laminectomy) is the commonest procedure



Group A1

- Disc herniation
 - Conservative treatment is first line of treatment for mild sciatica without motor deficit
 - Short (2-3 day) period of rest, NSAID, physiotherapy, epidural cortico-steroid injection
 - 95% of sciatica resolves within the first 3 months without surgery
 - Surgical treatment:
 - Indicated for cauda-equina syndrome, motor deficit, failure of 3 months of conservative treatment
 - Procedure: Discectomy (only the herniated part)



◆ **Osteoporotic Vertebral Fractures**

- Pathologic fractures
- Anterior column (\pm middle column) only compromised (Wedge/Burst Fracture)
- Often missed
- Repetitive fractures result in kyphotic deformity (hunchback)
- Treatment of underlying cause!!

◆ **Spinal Deformities**

- Scoliosis
 - deformity of the spine in the **Coronal plane**
- Kyphosis:
 - deformity of the spine in the **Sagittal plane**
- Spondylolisthesis
 - **Translation**(slippage)of one vertebra over another

❖ **Types of scoliosis**

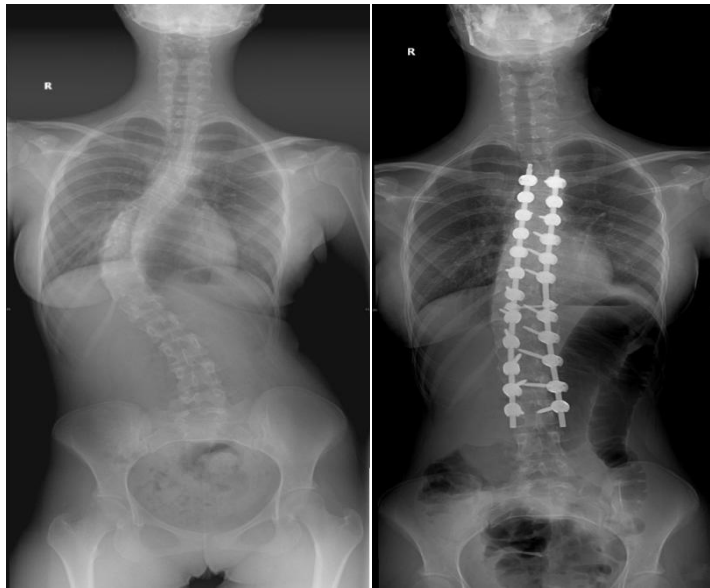
- Congenital
 - Associated with anomalies of the bony vertebral column, e.g. hemivertebra
- Acquired (=secondary)
 - Secondary to other pathology, e.g. tumor , infection, spinal cord anomalies, degeneration
- Idiopathic
 - Most common is adolescent type

Group A1❖ **Adolescent idiopathic scoliosis**

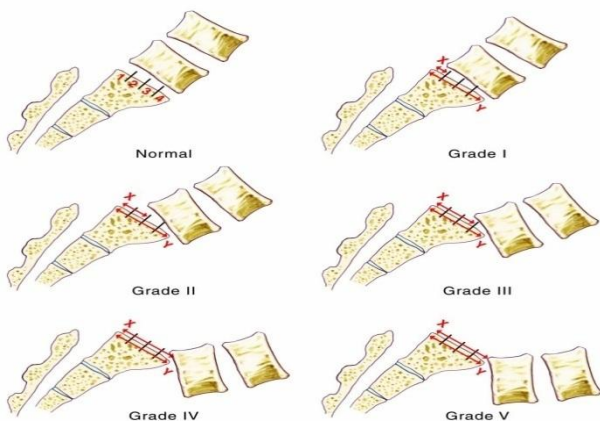
- Three dimensional deformity of the spine
- Vertebral Rotation is the hallmark
- Presents with deformity *with little or no pain*
- Usually noticed by parents/others, not the patient herself/himself
- Examination: neurologically normal, positive Adams test
- Management depends on degree of deformity

✓ **Notes: Adams test**

- The patient bends forward dangling the arms, with the feet together and knees straight. The curve of structural scoliosis is more apparent when bending over. In a patient with scoliosis, the examiner may observe an imbalanced rib cage, with one side being higher than the other, or other deformities.

❖ **Spondylolisthesis**

- Degeneration of the articulating part of a vertebra
- Conservative treatment first
- Surgery if Grade 3 or more or failed conservative management.
- Types:
 - Degenerative Spondylolisthesis
 - Causes spinal stenosis
 - Isthmic spondylolisthesis:
 - Caused by inter-articularis defect (spondylolysis)



Grades are determined by the degree of translocation over the vertebra below, which is assigned by numbers (as shown left in the picture)



❖ **Destructive Spinal Lesions**

- Present with pain at rest or at night
- Associated with constitutional symptoms
- Most common causes
 - Infection
 - Tumors
- Vertebral body and pedicle are the commonest sites of pathology

❖ **Spinal Tumors**

- Primary Spinal tumors:
 - Rare
 - Benign (e.g. osteoid osteoma) or malignant (e.g. chordoma)
 - Management depends on pathology
- Spinal metastasis
 - Very common
 - Biopsy required if primary unknown

❖ **Spinal infections**

- Most common is TB and Brucellosis
- History of contact with TB patient, raw milk ingestion
- Potentially treatable diseases once diagnosis is established and antimicrobials administered



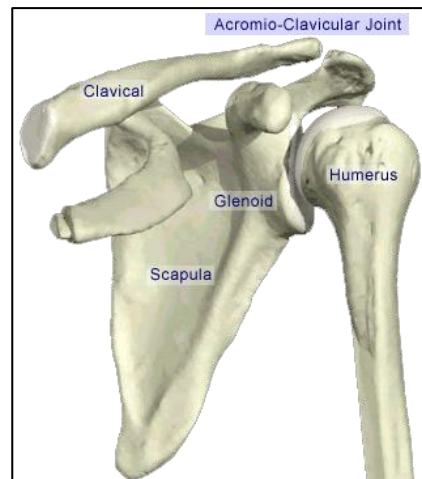
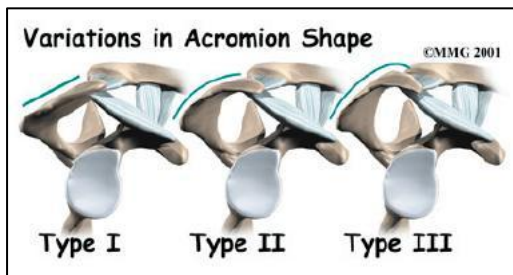
Spinal Tuberculosis (with psoas abscess)

Chronic Shoulder Disorder

Shoulder anatomy

- Bony anatomy:

- 4 different bones participate in the formation of the shoulder. These are:
 - Humerus
 - Scapula
 - Clavicle
 - Sternum
- The scapula has 4 significant bony parts. These are:
 - Glenoid
 - Acromion
 - Coracoid
 - Scapular body
- The acromion can have 3 different presentation:
 - Type 1: Flat.
 - Type 2: Curved.
 - Type 3: Hooked.

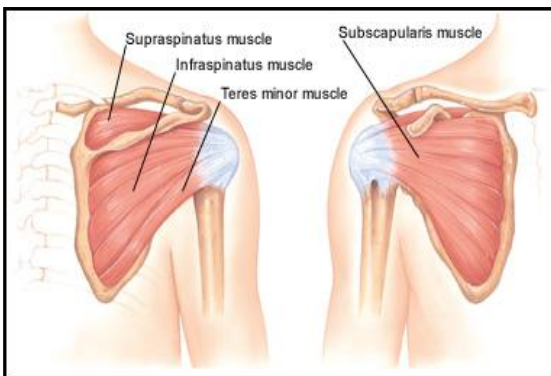


- Joints:

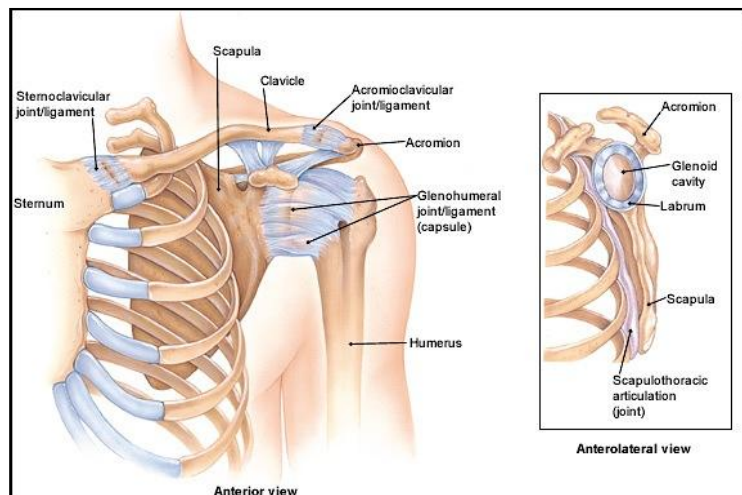
- The shoulder has 4 different joints that play a major role in shoulder movement, as well as stabilizing its different bones. These joints are:
 - Glenohumeral joint: the main joint
 - Acromioclavicular (AC) joint
 - Sternoclavicular (SC) joint
 - Scapulothoracic joint
- The Glenohumeral joint is the most common joint to have a dislocation.
- This is due to its poor articulation, resulting in a lack of bony stability.
- The GH joint is composed of:
 - Fibrous capsule
 - Ligament
 - Surrounding muscles
 - Glenoid labrum

- Rotator cuff muscles:

- The four muscles of the rotator cuff are over half of the seven scapulohumeral muscles.
- They play a major role in the movement, protection and stabilization of the GH (shoulder) joint.
- The stabilization part is mediated by their action in “depressing the humeral head against the glenoid” bone of the scapular.
- The rotator cuff muscles are:
 - Supraspinatus: → Abduct the arm.
 - Infraspinatus: → Externally rotate the arm.
 - Teres minor: → Externally rotate the arm.
 - Subscapularis: → Internally rotate the humerus.
- The supraspinatus tendon, which is just beneath the acromion, is the most common site for “wear and tear” injury, producing what is called impingement syndrome.



(Rotator cuff Muscles)



(Shoulder Joints)

- Other musculatures:

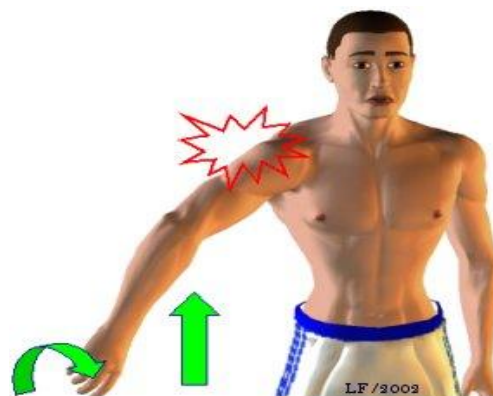
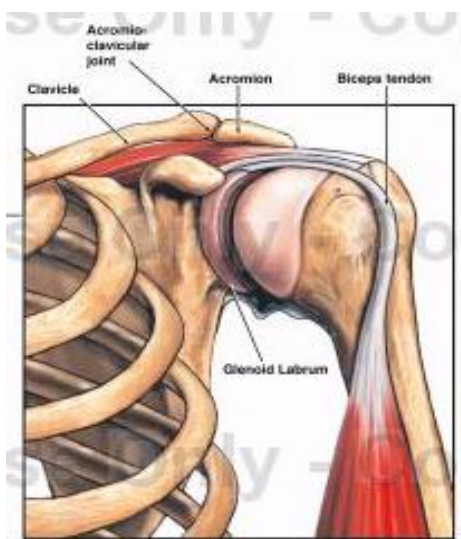
- Deltoid muscle:
 - This is the largest and strongest muscle of the shoulder.
- Others include: Pectoralis major, latissimusdorsi, biceps, rhomboids, trapezius, levator scapulae, serratus anterior

- Subacromial bursa

- Between the acromion and the rotator cuff tendons.
- Protects the acromion and the rotator cuff from grinding against each other.

Impingement Syndrome

- Describes a condition in which the supraspinatus and bursa are pinched as they pass between the head of humerus (greater tuberosity) and the lateral aspect of the acromion
- Risk factors
 - Age (middle and older age; 40-85y)
 - Overhead activities (e.g. lifting, swimming, tennis)
 - Bursitis and supraspinatus tendinitis
 - Acromial shape: type II & III acromion
 - AC joint pathology
 - AC joint arthritis or osteophytes may result in impingement and mechanical irritation to the rotator cuff tendons.
 - Rotator cuff weakness.
- Symptoms
 - Pain in the acromial area when the arm is flexed and internally rotated
 - → This means inability to use the overhead position.
 - The pain may result from subacromial bursitis or rotator cuff tendinitis
 - → This result in narrowing, or even complete loss, of the subacromial space, and hence a friction between the bony acromion and the delicate supraspinatus tendon.
 - Pain when sleeping on the affected side.
 - Pain will often become worse at night,
 - As the subacromial bursa becomes hyperemic after a day of activity
 - Decreased range of motion especially abduction
 - Weakness



- Differential diagnosis

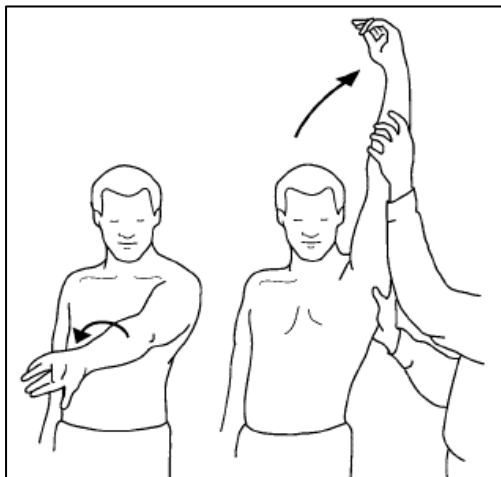
- Rotator cuff tears
- Calcific tendinitis
- Biceps tendinitis
- Cervical radiculopathy
- Acromioclavicular arthritis
- Glenohumeral instability
- Degeneration of the glenohumeral joint.

- Physical examination

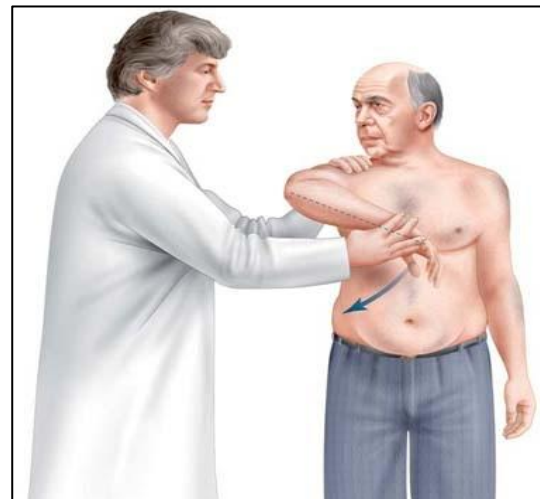
- Atrophy of rotator cuff muscles.
- Decreased range of motion (esp. internal rotation & adduction)
- Weakness in flexion and external rotation.
- Pain on resisted abduction and external rotation.
- Pain on “**impingement tests**”.

- Impingement tests

| | | |
|--------------------------|----------------------------------|--|
| Impingement tests | Neer's impingement test | Passive elevation of the internally rotated arm in the sagittal plane (shoulder forward flexion). |
| | Hawkins' impingement test | With the elbow flexed to 90 degrees, the shoulder passively flexed to 90 degrees and internally rotated. |



(Neer's Test)



(Hawkins test)

- Radiological findings

- Plain X-rays:

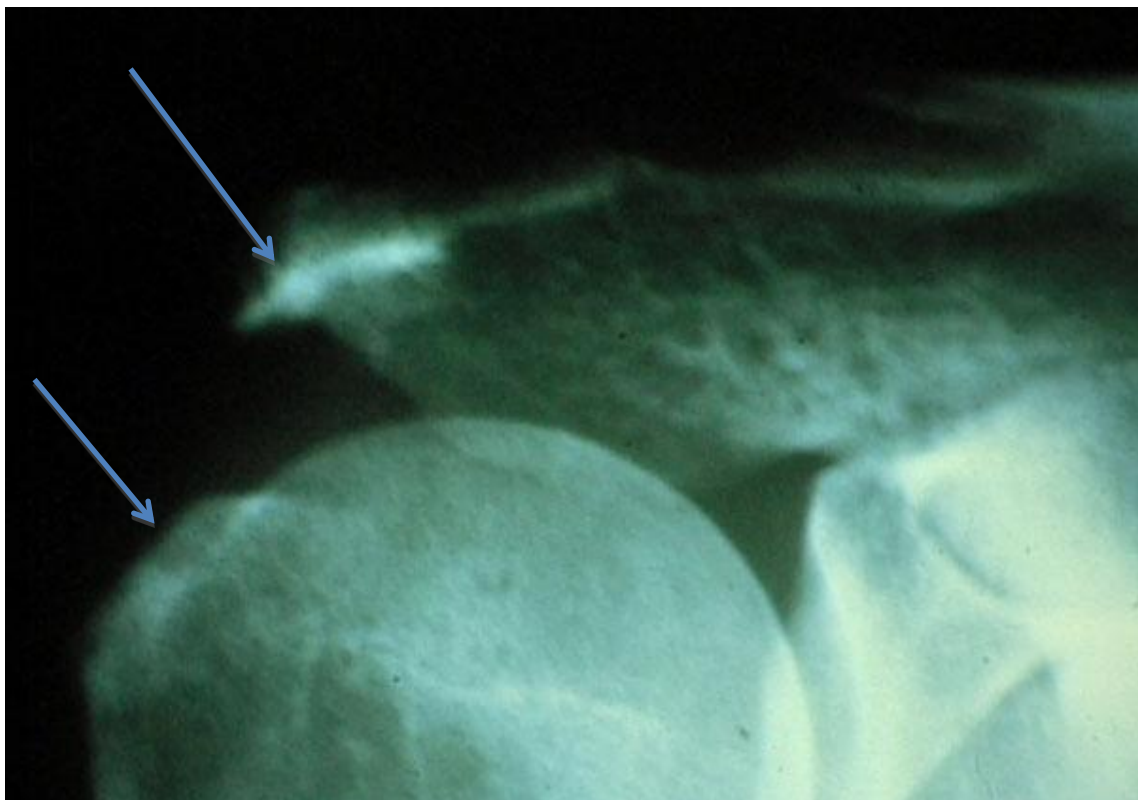
- Acromial spurs
 - AC joint osteophytes
 - Subacromial sclerosis
 - Greater tuberosity cyst
 - Acromion shape

- ✓ *Supraspinatus outlet view is useful in determining the type of acromion shape.*

- ✓ *Please remember that round and hooked types are commonly associated with impingement syndrome.*

- MRI:

- To confirm the diagnosis and rule out rotator cuff tear.



Group A1

Supraspinatus outlet view: Round acromion

- Management

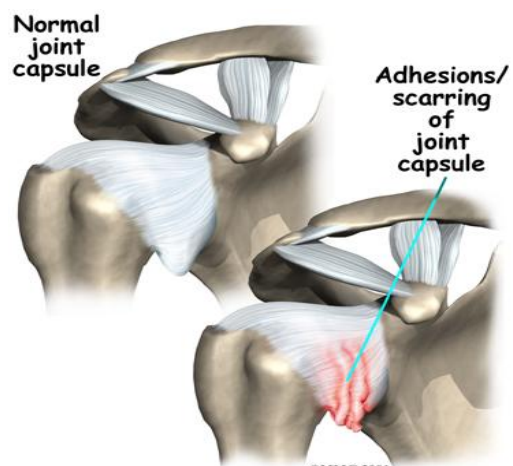
- Conservative treatment: (Always to begin with)
 - Avoid painful and overhead activities
 - Physiotherapy:
 - Stretching and range of motion exercises
 - Strengthening exercises
 - NSAIDs → to reduce the inflammation
 - Steroid injection into the subacromial space
- Operative: (when conservative measures fail)
 - The goal of surgery is to remove the impingement and create more subacromial space for the rotator cuff
 - Indicated if there is no improvement after 6 months of conservative treatment
 - The anterolateral edge of the acromion is removed
 - Open (called: Acromioplasty) or arthroscopic technique (called subacromial decompression)
 - Success rate 70-90%

Rotator Cuff Tears

- Causes:
 - A. Intrinsic factors:
 - Vascular
 - Degenerative (age-related)
 - B. Extrinsic factors:
 - Impingement
 - Acromial spurs
 - AC joint osteophytes
 - Repetitive use
 - C. Traumatic (e.g. a fall or trying to catch or lift a heavy object)
- Diagnosis
 - History
 - Physical examination
 - X-rays
 - MRI
- Wide spectrum presentations:
 - Partial tear
 - Complete tear
 - Small
 - Large
 - Massive (irreparable)
- Treatment
 - Degenerative type: (always start with non-operative)
 - Rest
 - Physio
 - NSAIDs
 - Steroid injection
 - ✓ If no improvement within 6 months, surgical repair (open or arthroscopic) is indicated
 - Traumatic type: (acute surgical repair)
 - If not treated → chronic pain and loss of motion and with time becomes irreparable → rotator cuff arthropathy
 - Complications of surgery: not improving, stiffness

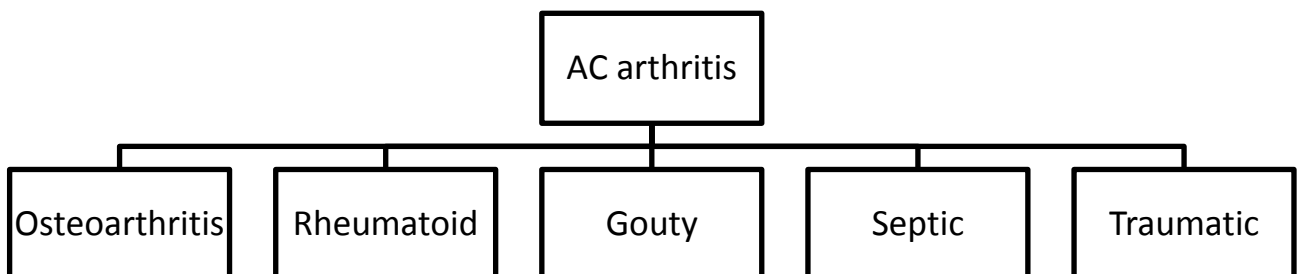
Adhesive Capsulitis

- Also called “frozen shoulder”
- “Global stiffness” → It is characterized by pain and restriction of all movements of the shoulder
- Usually self-limiting (typically begins gradually, worsens over time and then resolves but may take >2 years to resolve)
- 10 % is bilateral
- Risk factors:
 - DM (esp. insulin dependent)
 - Hypo and Hyperthyroidism
 - Following injury or surgery to the shoulder
 - High cholesterol
- Diagnosis:
 - Mainly clinical
 - X-rays and MRI to rule out other pathologies
- Stages:
 - Pain (freezing stage)
 - Stiffness (frozen stage)
 - Resolution (thawing stage)
- Treatment
 - Resolves if untreated over 2-4 years
 - Physiotherapy
 - Pain and anti-inflammatory medications
 - Steroid injections
 - Manipulation under anesthesia
 - Arthroscopic capsular release



Acromioclavicular Pathology

- The AC joint is different from joints like the knee or ankle, because it doesn't need to move very much.
- The AC joint only needs to be flexible enough for the shoulder to move freely.
- It just shifts a bit as the shoulder moves.
- The joint is stabilized by three ligaments
- AC Arthritis
 - Joints have a smooth cartilage that allows the bones to move smoothly.
 - Arthritis is a condition characterized by loss of cartilage in the joint, leading to friction and inflammation of the affected bones.
 - Motions that aggravate arthritis at the AC joint include reaching across the body toward the other arm.
 - Causes of AC arthritis:
 - Degenerative osteoarthritis. (wear and tear in old aged people)
 - Rheumatoid arthritis.
 - Gouty Arthritis.
 - Septic Arthritis.
 - A traumatic distal clavicle osteolysis in weight lifters.
 - ✓ Result from repeated movements that wear away the cartilage surface found at the acromio-clavicular joint
 - Post-traumatic osteolysis of lateral end of clavicle.(like dislocation or a fracture)



- **AC osteoarthritis:**

- Signs and Symptoms

- Pain, which worsens with movement and progressively worsens.(the patient may suffer a night pain which is a sign of arthritis)
 - It is commonly associated with impingement syndrome

- Diagnosis:

- Clinical and by x-rays

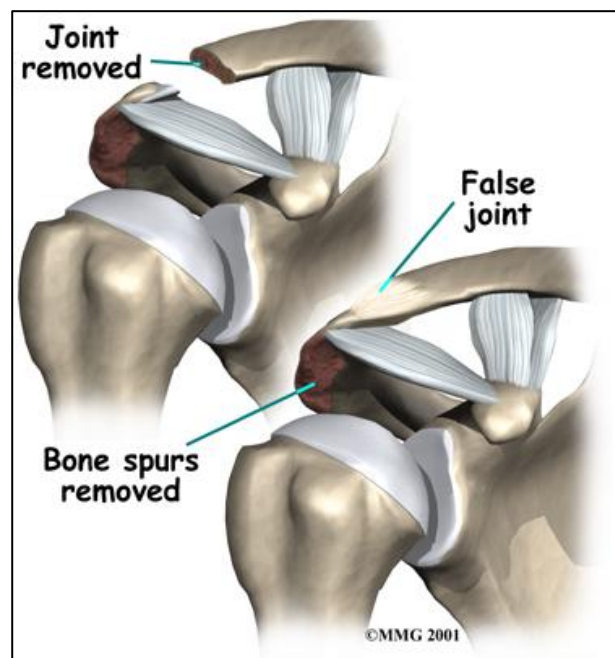
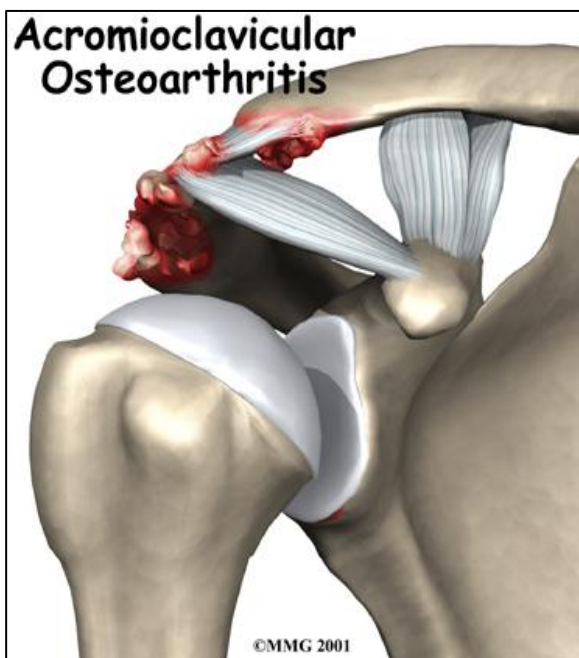
- Treatment:

- a) Non-surgical Treatment

- Rest, avoid weightlifting and push-ups
 - Pain medications and NSAID to reduce pain and inflammation

- b) Surgical treatment:

- It involves removing of the AC joint applying an artificial joint.
 - The bone spurs must also be removed.



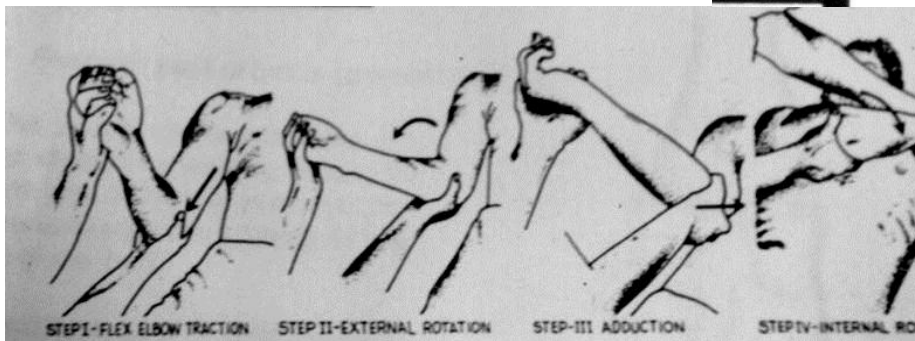
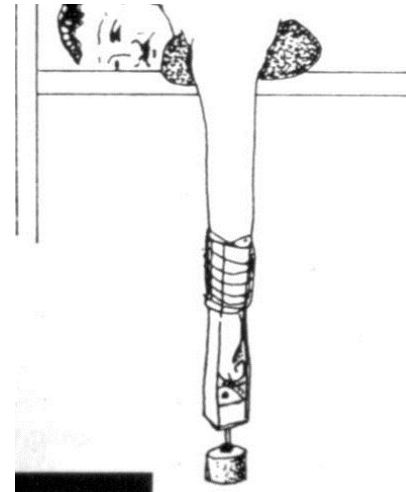
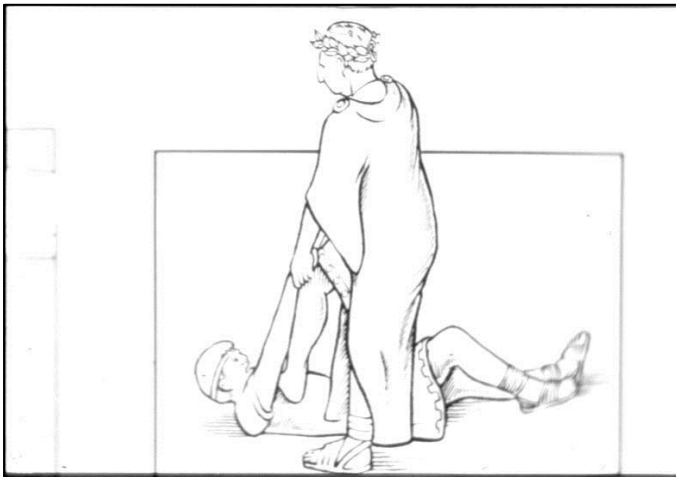
Dislocation of the Shoulder

- Mostly **Anterior** > 95 % of dislocations
- **Posterior** Dislocation occurs < 5 %
- True **Inferior** dislocation (luxatio erecta) occurs < 1%
- ✓ **Habitual** Non traumatic dislocation may present as Multi directional dislocation due to generalized ligamentous laxity and is **Painless**
- Anterior shoulder dislocation:
 - It is usually caused by **an indirect** fall on an abducted and extended shoulder.
 - ✓ May be direct when there is a blow on the shoulder from behind
 - Usually also inferior.
 - **Bankart's Lesion**
 - Clinical Picture
 - Patient is in pain
 - Holds the injured limb with other hand close to the trunk
 - The shoulder is abducted and the elbow is kept flexed
 - There is loss of the normal contour of the shoulder
 - Loss of the contour of the shoulder may appear as a step
 - Anterior bulge of head of humerus may be visible or palpable
 - A gap can be palpated above the dislocated head of the humerus



Anterior
Shoulder
dislocation:
there is a loss
of the contour
of the shoulder
appears as a
step

- Associated injuries of anterior Shoulder Dislocation
 - Injury to the neuro vascular bundle in axilla
 - Injury of the **Axillary Nerve** (Usually stretching leading to temporary neuropraxia)
 - Associated **fracture**
- Axillary nerve injury
 - It is a branch from posterior cord of Brachial plexus
 - It hooks close round neck of humerus from posterior to anterior
 - It pierces the deep surface of deltoid and supply it and the part of skin over it
 - Injury can will result in a loss of abduction and sensation over the lateral arm
- Management of Anterior Shoulder Dislocation
 - Is an **Emergency**
 - It should be reduced in less than 24 hours or there may be Avascular Necrosis of head of humerus
 - Following reduction the shoulder should be immobilized strapped to the trunk for 3-4 weeks and rested in a collar and cuff
- Methods of Reduction of anterior shoulder Dislocation
 - **Hippocrates Method**
 - → A form of anesthesia or pain abolishing is required
 - **Stimpson's technique**
 - → Some sedation and analgesia are used but No anesthesia is required
 - **Kocher's technique**
 - → Is the method used in hospitals under general anesthesia and muscle relaxation

Group A1**Complications of anterior Shoulder Dislocation****Early**

- Neuro vascular injury (rare)
- Axillary nerve injury
- Associated Fracture of neck of humerus or greater or lesser tuberosities

Late

- **Avascular necrosis** of the head of the Humerus (high risk with delayed reduction)
- **Recurrent shoulder dislocations**

Common Pediatric Hip Problem

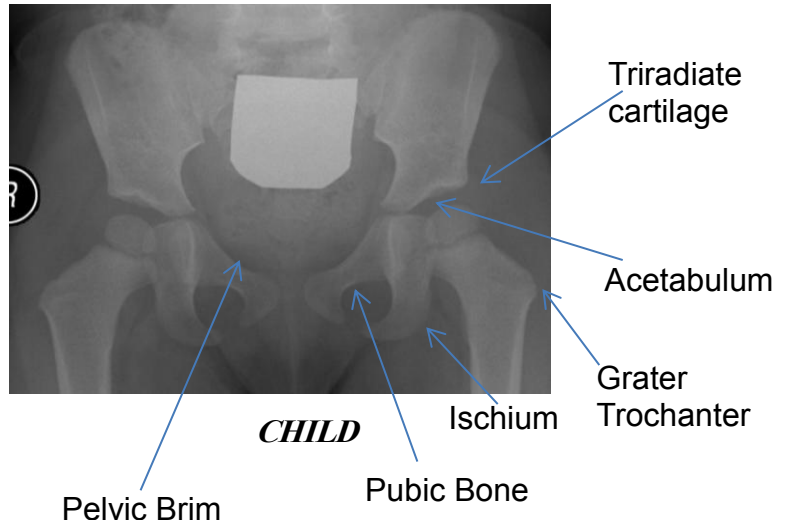
◆ Nomenclature:

- **DDH** : Developmental dislocation of the hip
- **CDH** : Congenital Dislocation of the Hip
- **DDH** : Developmental Dysplasia of the Hip
- **SCFE** : Slipped capital femoral epiphysis
- **Perthes**

◆ Normal pelvis



ADULT
Lesser Trochanter



CHILD

✓ Notes:

- **Triradiate cartilage** (growth plate) connects three bones: acetabulum + ischium + pubic bone
- **Head of femur**: in children it's not called head of femur (because not fully developed) only in adult
- **Arterial** supply of the femur anterior and posterior circumflex artery that supply the head of femur
- **Ligamentum teres** is attached to the inside of the head of the femur, the ligament also contains artery. So arteries inside and outside the bone

"DDH"

Normal Hip

Dislocated Hip

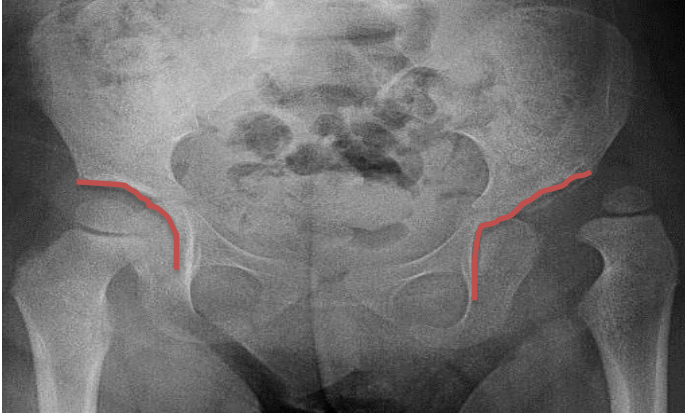


✓ Notes:

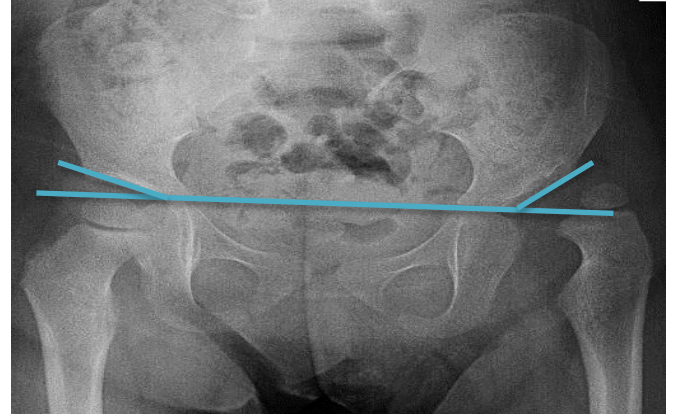
- The head of femur is not articulating/attached to the acetabulum. Notice the under developed epiphysis
- The acetabulum is shallow (dysplastic acetabulum) not curved (cannot hold the head)
- DDH is not due to injury during delivery (not congenital)

Patterns of disease

- Dislocated
- Dislocatable → high risk of dislocation
- Subluxated
- Acetabular dysplasia



Shallow acetabulum. Notice the curvature



Larger angle in the dislocated hip
A dislocated hip is reduced (not healed) by abduction not adduction (increases the risk of dislocation)

Causes (multi factorial)

- Hormonal
 - Relaxin, oxytocin
- Familial
 - Lig.laxity diseases
- Genetics
 - Female 4 X male --- twins 40%
- Mechanical
 - Pre natal
 - Post natal

Still Unknown
the cause

Mechanical causes

- Pre natal
 - Breech , oligohydramnios , primigravida , twins
 - (torticollis , metatarsus adductus)
- Post natal
 - Swaddling , strapping

✓ **Notes:**

- **Breech:** The fetus head should be caudal in position and the legs should be cephalic in position. Any other position is called breech (renders the place tight)
- **Oligohydramnios:** little amniotic fluid
- **Primigravida:** first pregnancy (inflexible uterus)
- All of the abovementioned factors decreases the space for the fetus in the uterus → increased risk for DDH
- **Torticollis:** a twisted neck in which the head is tipped to one side
- **Metatarsus adductus:** foot deformity
- **Swaddling and strapping:** induces adduction of the hip (risk of dislocation, previously discussed)

Infants at risk:

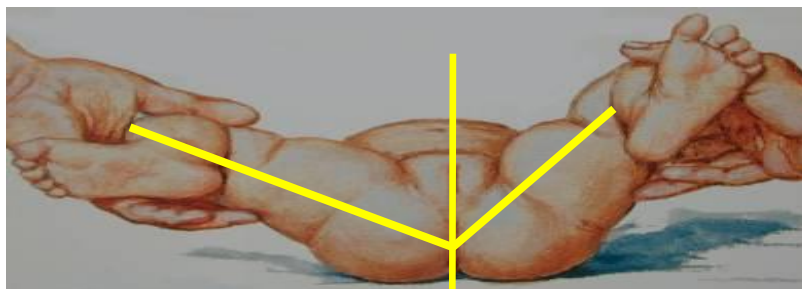
- Positive family history: 10X
- A baby girl: 4-6 X
- Breech presentation: 5-10 X
- Torticollis: CDH in 10-20% of cases
- Foot deformities:
 - Calcaneo-valgus and metatarsus adductus
- Knee deformities:
 - hyperextension and dislocation
- When risk factors are present, the infant should be reviewed
 - Clinically
 - radiologically
- During history taking, ask about all of the risk factors

Clinical examination

- The infant should be
 - quiet
 - comfortable
- Look:
 - External rotation
 - Lateralized contour
 - Shortening *of the affected limb*
 - Asymmetrical skin folds
 - Anterior – posterior



- Move
 - Limited abduction

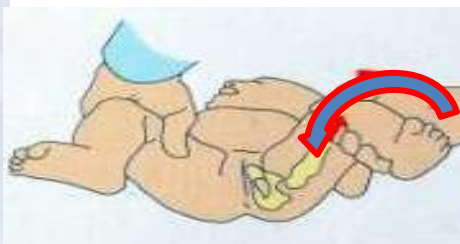


Group A1

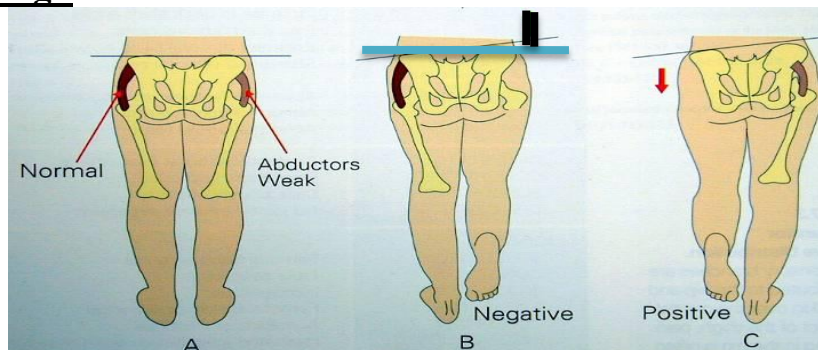
- Special test
 - Gaiiazzi
 - Ortolani , Barlow test
 - Trendelenburgh sign
 - Limping (waddling gait if bilateral)
 - Only ortolani and Barlow tests are important

Gaiiazzi testOrtolani test

- Pull and **abduct**
- A clunk will be felt after reduction. The hip will soon be dislocated again (not a treatment, just to test for DDH)
- Cannot be done on dislocatable DDH → Do barlow test

Barlow test

- Pull and **adduct**

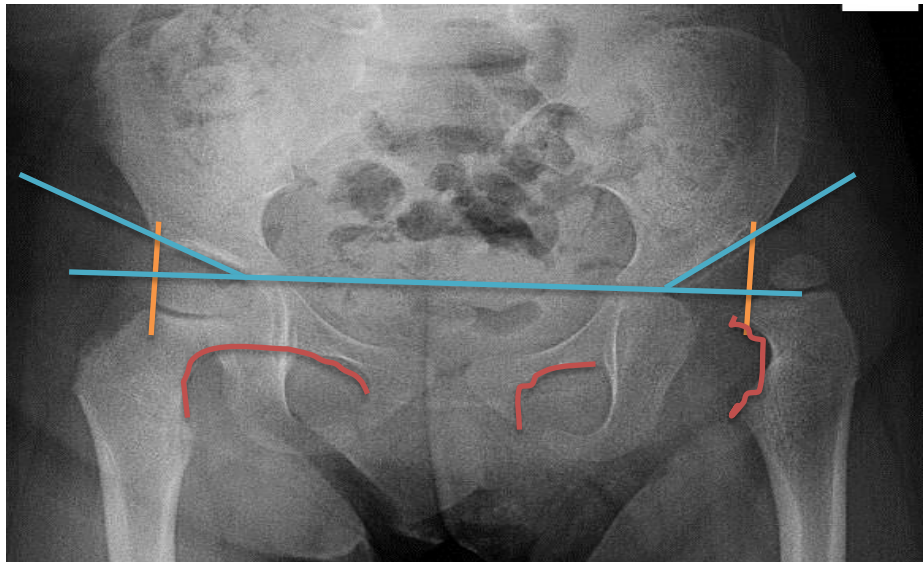
Trendelenburgh sign

Investigations

- -3 months U/S: most of the head and neck are cartilage (not clear on x-ray)
- > 3months X-ray pelvis AP + abduction

**Radiology**

- After 6 months: reliable

✓ **Notes**

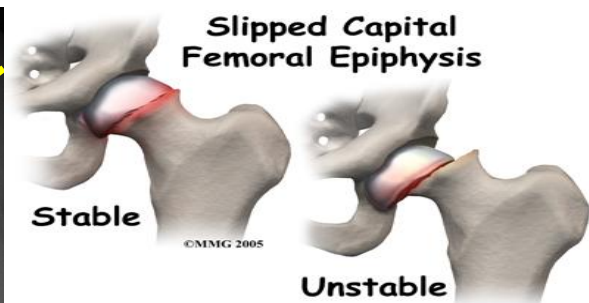
- **Red: Shenton line** (disrupted in DDH)
- **Blue: Hilgenreiner's line** (through the triradiate cartilage). Notice the angle marking the acetabulum
- **Orange: Perkin's line**: it draws vertically and perpendicular to **Hilgenreiner's line** starts at the lateral acetabulum
- **Hilgenreiner's line + Perkin's line** form four quadrants. In the normal limb, the head of the femur is found in the bottom inner quadrant, unlike the affected limb, where the head is in the top outer quadrant.
- Five signs of DDH on x-ray: **MCQ**
 1. Disrupted **shenton's line**
 2. Wide acetabulum angle on **Hilgenreiner's line**
 3. Head of femur located on the top outer quadrant when **Perkin's line** is drawn
 4. Shallow acetabulum
 5. Ossification center/head of femur is smaller than the one in the other limb

Treatment - Aims

- Obtain concentric reduction
- Maintain concentric reduction
- In a non-traumatic fashion
- Without disrupting the blood supply to femoral head
- Method depends on age
- The earlier started, the easier it is
- The earlier started, the better the results are
- Should be detected EARLY
- Either surgical or non-surgical
- **Way:** Refer to pediatric orthopedic clinic



After treatment

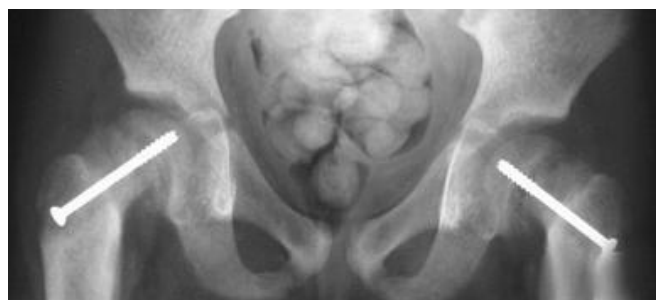
"SCFE"

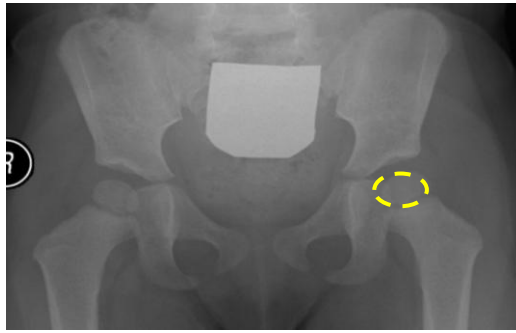
- ***Slipped Capital Femoral Epiphysis***. In reality, it's not the capital of the femur that is slipped; it's the neck and shaft that are slipped.
- Where → at level of growth plate
- Why →
 - ? Hormonal
 - ? Metabolic (as in osteoporosis, Hyper Parathyroidism etc.)
 - ? Mechanical, obesity
 - ? Trauma
 - ? Unknown
- **Typical :**
 - 8-12
 - ↑ in males
 - ↑ in obese
 - ↑ in black
 - ↑ if other side affected
- **History:**
 - Hip pain/knee pain (*radiating*)
 - Minor trauma
 - no trauma
 - Limping (painful)

- **On Examination:**
 - Hip in ER (external rotation)
 - ↓ IR (internal rotation)
 - ↓ Abduction
 - Usually painful ROM (Range of motion)
 - Limping (painful)
 - **Investigation:**
 - X-ray
 - Pelvis – slippage positive or
- ↑↑ Growth plate space
[Pre slip phase]
- Knee
 - If not clear but still doubtful MRI can help



- **Treatment:**
 - Refer to orthopedic as emergency case
- What they will do?
- In situ pinning – to prevent further damage to the vascularity
 - Protected weight bearing for 3-4 weeks then full weight bearing
 - No sport for 6 months



"Perthe's Disease"

- **Where:** at the level of head of femur
- **Why:** ↓ vascularity of head of femur (avascular necrosis)
- **Cause** → **unknown**
- **Typical :**
 - 4-8 years (Younger age than SCFE)
 - ↑ in males
 - ↑ in obese

Severity of the disease depends on: the amount of femoral head involvement

**History:**

- Hip pain or knee pain
- Minor trauma or no trauma
- Painful limping

On Examination:

- ↓ Abduction
- ↓ IR (internal rotation)
- Usually painful range of motion ↓↓↓
- Limping (painful)

Investigation:

- X-ray: - knee
- Pelvis → ↓ head size (irregular shape)
- If early, MRI can help

Treatment:

- Very controversy
- Refer to pediatric orthopedics as an urgent case
- Guidelines of treatment:
 - Control pain
 - Maintain ROM
 - Hip containment



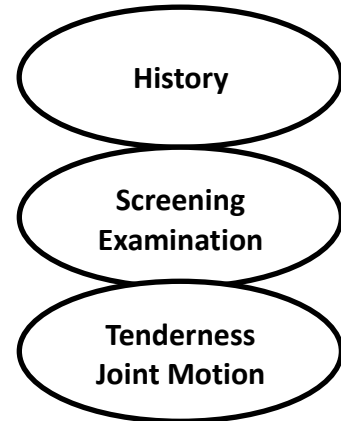
Treated DDH

Common Pediatric Lower Limp Disorders

The lecture notes will be at page 145

❖ Leg Aches:

- What is leg aches?
 - Growing pain
 - Benign
 - No functional disability
 - Resolves spontaneously
 - Unknown cause
- Clinical features
 - *Diagnosis by exclusion*

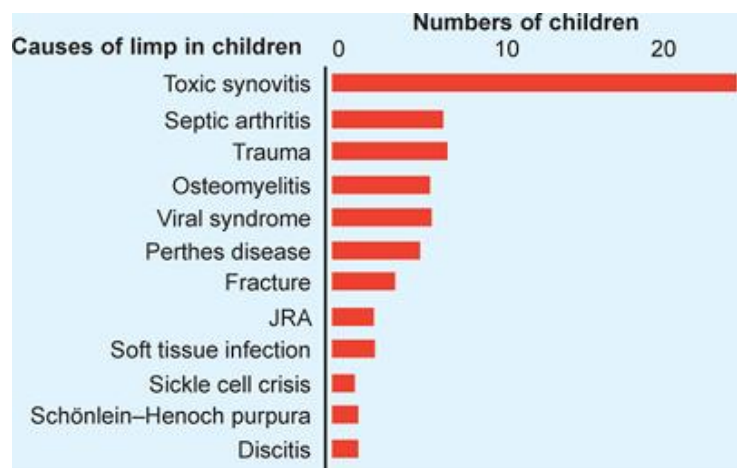


- Differential Diagnosis from serious problems mainly tumor
 - Osteoid osteoma
 - Osteosarcoma
 - Ewing sarcoma
- Management
 - Symptomatic
 - Reassuranc

| Feature | Growing Pain | Serious Problem |
|-------------------------|--------------|-----------------|
| History | | |
| Long duration | Often | Usually not |
| Pain localized | No | Often |
| Pain bilateral | Often | Unusual |
| Alters activity | No | Often |
| Causes limp | No | Sometimes |
| General health | Good | May be ill |
| Physical Examination | | |
| Tenderness | No | May show |
| Guarding | No | May show |
| Reduced range of motion | No | May show |
| Laboratory | | |
| CBC | Normal | ± Abnormal |
| ESR | Normal | ± Abnormal |
| CRP | Normal | ± Abnormal |

❖ Limp:

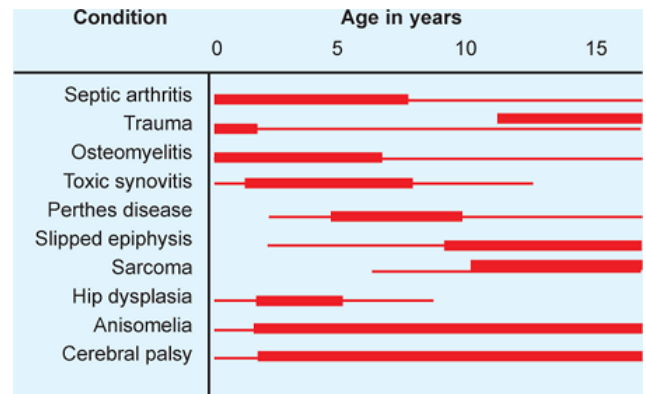
- Abnormal gait due to:
 - pain
 - weakness
 - Deformity
 - Others



Group A1

- Limp Evaluation

- History (Mainly age of onset)
- Observation
 - Evaluate the limp by studying the child's **gait** while the child walks in the clinic hallway

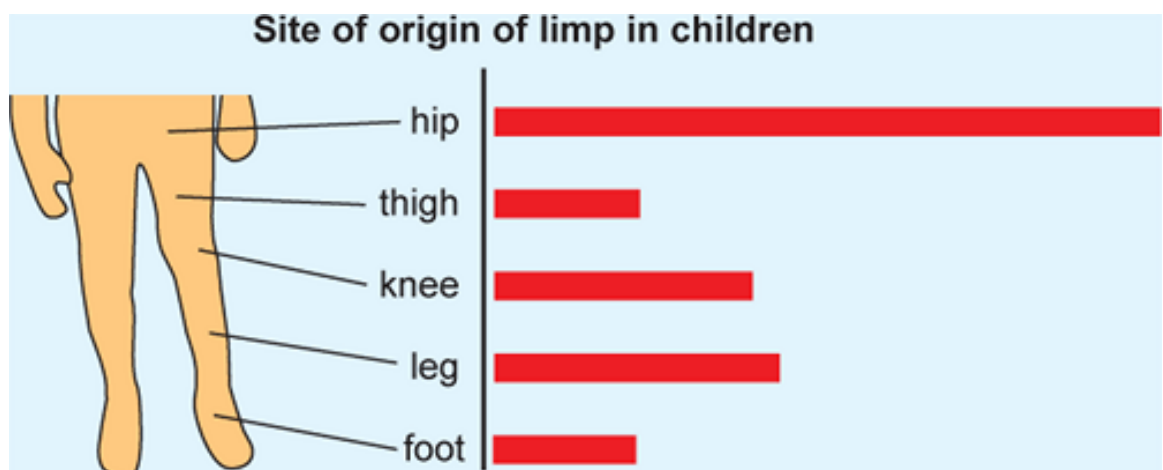


- Types of limp:

| <div style="text-align: center;"> Limp ↓ Gait observation ↓ </div> <div style="display: flex; justify-content: space-around;"> <div>Shortened stance phase</div> <div>Abductor lurch</div> <div>Toe-to-heel gait</div> <div>Circumduction during swing phase</div> </div> | | | | |
|---|--|---------------------------------|---|---|
| Gait type | Antalgic Gait | Abductor Lurch | Equinus Gait | Circumduction Gait |
| Physical examination | Tenderness Reduced range of motion | Trendelenburg sign | Heel-cord contracture Neurological exam needed | Assess limb lengths Neurological exam Check range of motion |
| Tests | Radiographs ? bone scan | Pelvis radiographs | | Orthodiagrams |
| Common examples | Trauma Toddler's fracture Overuse syndrome Infection Inflammations | Hip dysplasia Cerebral palsy | Cerebral palsy Idiopathic toe walker Clubfoot | Painful foot Leg length inequality |

- Management

- Generalization regarding management cannot be made
- **Treatment of the cause**



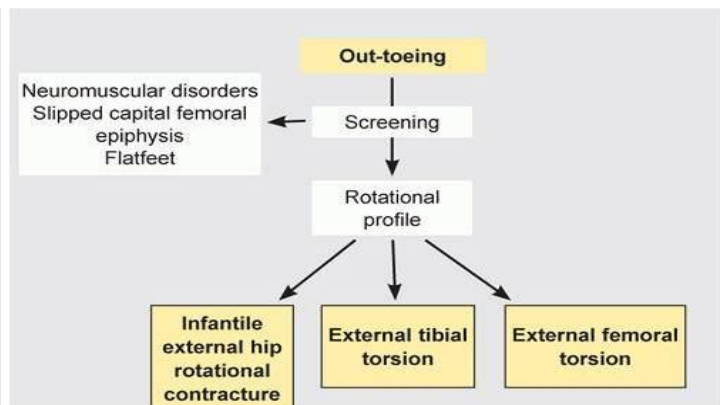
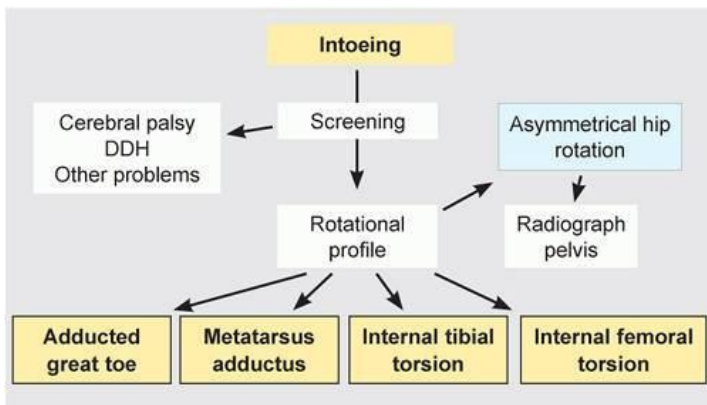
❖ In-toeing and Out-toeing:

▪ *Terminology*

- Version
 - Describes normal variations of limb rotation
 - It may be exaggerated
- Torsion
 - Describes abnormal limb rotation
 - Internal or external
 - It may be complex if there is compensatory torsion

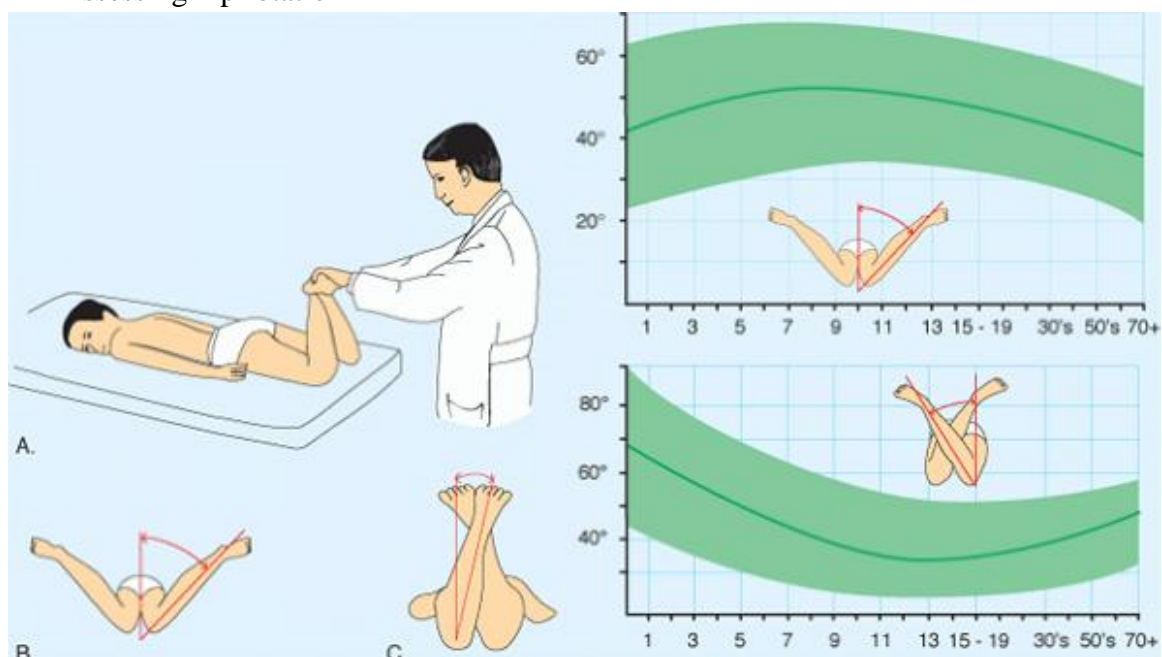
▪ *Evaluation*

- History
- Screening examination
- Rotational profile

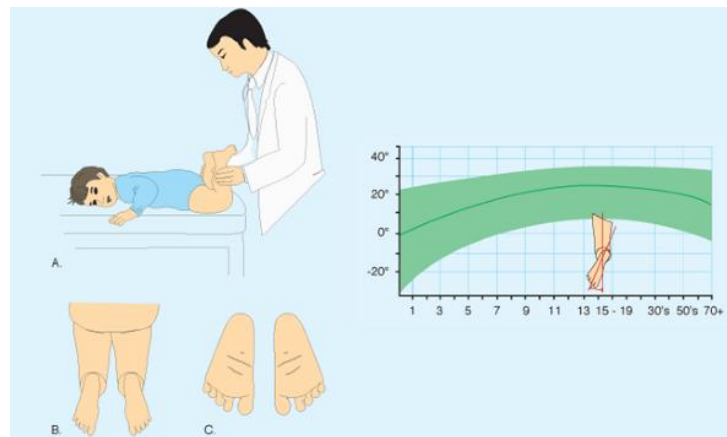


▪ *Special tests*

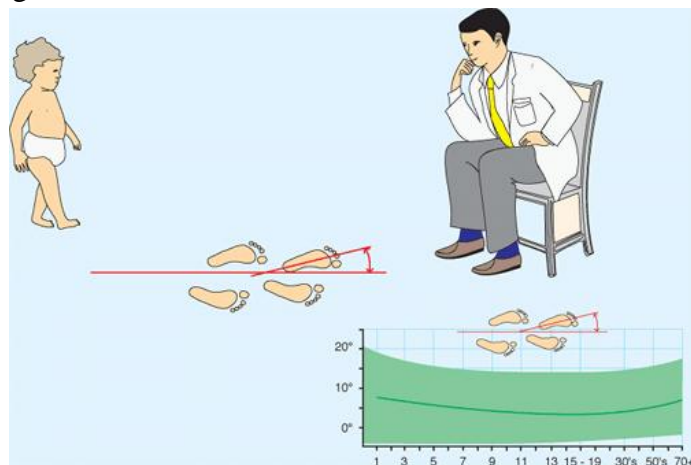
- Assessing hip rotation



- Assessing rotational status of tibia and foot

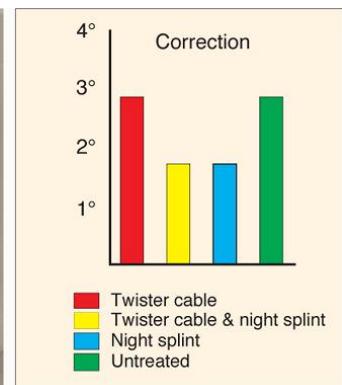


- Foot progression angle:



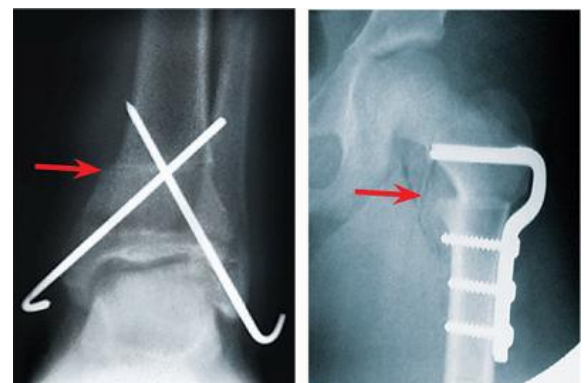
■ **Management principles**

- Establishing correct diagnosis
- Allow spontaneous correction (observational management)
- Control child's walking, sitting or sleeping is extremely difficult and frustrating
- Shoe wedges or inserts are ineffective
- Bracing with twister cables limits child's activities
- Night splints have no long term benefit



■ **Operative correction**

- Indicated for children above the age of 8 years with significant cosmetic and functional deformity

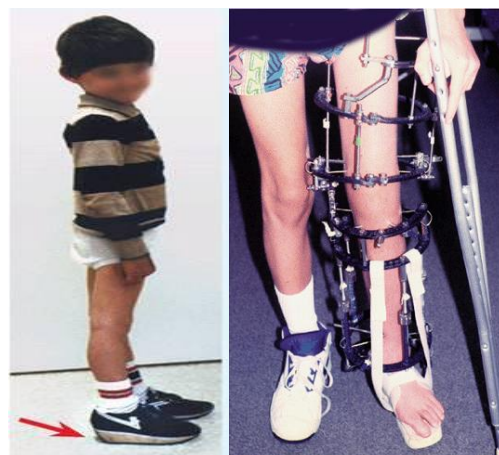
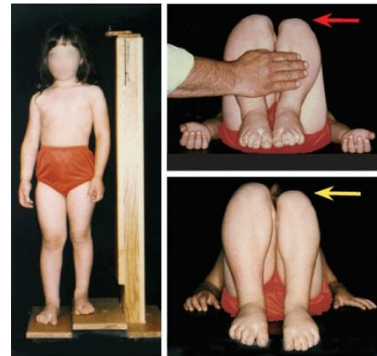


❖ **Limb Length Inequality:**

- True and apparent
- Etiology

| Category | Short | Long |
|------------|--|-------------------------------------|
| Congenital | Aplasia Hypoplasia Hip dysplasia Clubfoot | Hyperplasia |
| Neurogenic | Paralysis Disuse | Sympathectomy |
| Vascular | Ischemia Perthes disease | AV fistular |
| Infection | Physeal injury | Stimulation |
| Tumors | Physeal involvement | Vascular lesions |
| Trauma | Physeal injury Malunion | Fracture stimulation Distraction |

- Gait
- Adverse effects
 - Back pain
 - Scoliosis
- Evaluation
 - Screening examination
 - Clinical measures of discrepancy
 - Imaging methods (Centigram)
- Management principles
 - Severity
 - Lifts
 - Shortening
 - Epiphysiodesis
 - Lengthening



❖ **Genu Varum and Genu Valgum:**

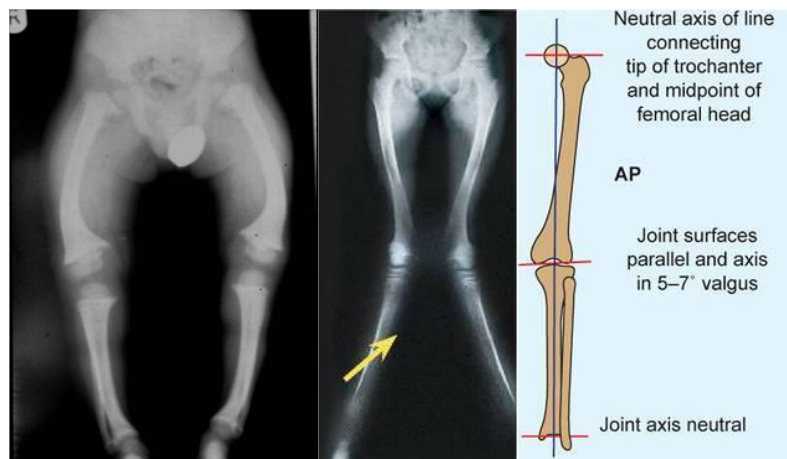
- Definitions
 - Bow legs
 - Knock knees

| Feature | Physiologic | Pathologic |
|------------------|--|---|
| Frequency | Common | Rare |
| Family history | Usually negative | May occur in family |
| Diet | Normal | May be abnormal |
| Health | Good | Other MS abnormalities |
| Onset | Second year for bowing Third year knock-knees | Out of normal sequence Often progressive |
| Effect of growth | Follows normal pattern | Variable |
| Height | Normal | Less than 5th percentile |
| Symmetry | Symmetrical | Symmetrical or asym |
| Severity | Mild to moderate | Often beyond ± 2 SD |

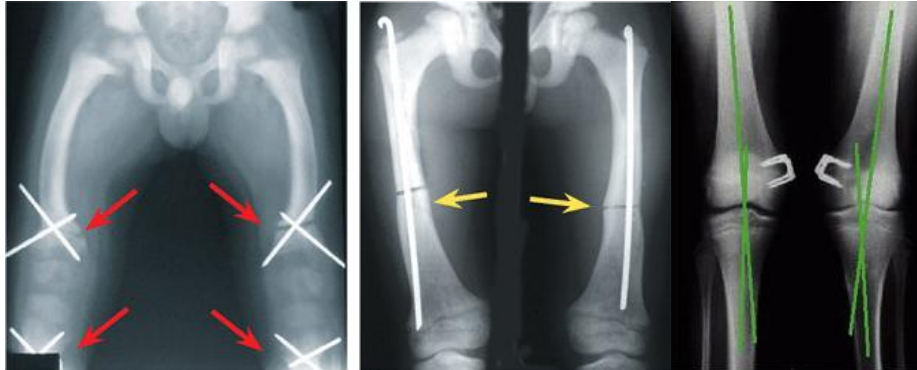
- Evaluation
 - Etiology

| Cause | Genu Valgum | Genu Varum |
|---------------|--------------------------------------|---------------------------|
| Congenital | Fibular hemimelia | Tibial hemimelia |
| Dysplasia | Osteochondrodysplasias | Osteochondrodysplasias |
| Developmental | Knock-knee >2 SD | Bowing >2 SD Tibia vara |
| Trauma | Overgrowth Partial physeal arrest | Partial physeal arrest |
| Metabolic | Rickets | Rickets |
| Osteopenic | Osteogenesis imperfecta | |
| Infection | Growth plate injury | Growth plate injury |
| Arthritis | Rheumatoid arthritis knee | |

- History
- Examination (signs of Rickets)
- Laboratory
- Imaging

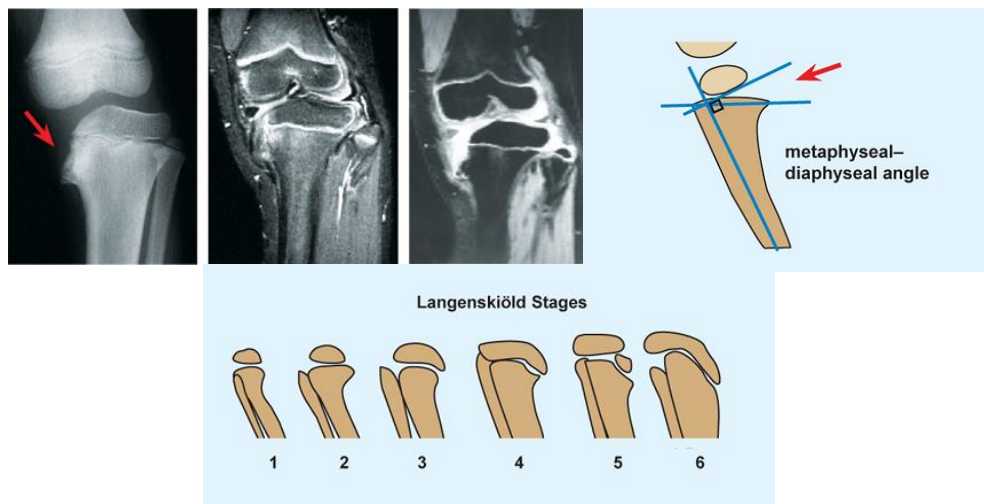


- Management principles
 - Nonoperative?
 - Epiphysiodesis
 - Corrective osteotomies



❖ Tibia Vara:

- Blount disease
 - Damage of proximal medial tibial growth plate of unknown cause



❖ Clubfoot:

- Normal foot
 - **Stable:** for supporting the body weight in standing
 - **Resilient:** for walking and running
 - **Mobile:** to accommodate variations of surface
 - **Cosmetic**
- Etiology
 - Postural
 - Idiopathic (CTEV)
 - Secondary



- Clinical examination

Exclude

- Neurological lesion that can cause the deformity “Spina Bifida”
- Other abnormalities that can explain the deformity “Arthrogryposis, Myelodysplasia”
- Presence of concomitant congenital anomalies
“Proximal femoral focal deficiency”
- Syndromatic clubfoot
“Larsen’s syndrome, Amniotic band Syndrome”

Characteristic Deformity:**Hind foot**

- Equinus (Ankle joint)
- Varus (Subtalar joint)

Fore foot

- Forefoot Adduction
- Cavus

- Short Achilles tendon
- High and small heel
- No creases behind Heel
- Abnormal crease in middle of the foot
- Foot is smaller in unilateral affection
- Callosities at abnormal pressure areas
- Internal torsion of the leg
- Calf muscles wasting
- Deformities don’t prevent walking



- **Management**

- **The goal of treatment for clubfoot is to obtain a plantigrade foot that is functional, painless, and stable over time**
- **A cosmetically pleasing appearance is also an important goal sought by the surgeon and the family**
- Manipulation and serial casts
 - Validity, up to 12 months!
 - Technique “Ponseti”
 - Avoid false correction
 - When to stop?
 - Maintaining the correction
 - Follow up to watch and avoid recurrence
- Indications of surgical treatment
 - Late presentation, after 12 months of age!
 - Complementary to conservative treatment
 - Failure of conservative treatment
 - Residual deformities after conservative treatment
 - Recurrence after conservative treatment
- Types of surgery
 - Soft tissue
 - Bony
 - Salvage

❖ **Lower Limb Deformities in CP Child:****Physiological classification**

- Spastic
- Athetosis
- Ataxia
- Rigidity
- Mixed

Topographic classification

- Monoplegia
- Paraplegia
- Hemiplegia
- Triplegia
- Quadriplegia or tetraplegia
- Bilateral hemiplegia
- Diplegia

- Hip
 - Flexion
 - Adduction
 - Internal rotation
- Knee
 - Flexion
- Ankle
 - Equinus
 - Varus or valgus
- Gait
 - Intoeing
 - Scissoring
- Management principles
 - Multidisciplinary
- Options of Surgery
 - Neurectomy
 - Tenotomy
 - Tenoplasty
 - Muscle lengthening
 - Tendon Transfer
 - Bony surgery Osteotomy/Fusion



Common Pediatric Lower Limb disorder lecture Note

Notes:

- Terminology is Important
- Femoral antversion is normal in the Femur bone only
- Torsion is abnormal at the Tibial Bone
- In-Toeing is more common than Out Toeing
- Metatarsus adduction may called: forefeet adduction

Special Test:

◆ Assessing hip Rotation:

- Prone Position better so, the Femur will be supported
 - If Internal rotation = Rotation --> NORMAL
 - If Internal rotation More than Rotation --> In-Toeing
 - If Internal rotation less than Rotation --> Out-Toeing
- W-sitting position: Internal rotation --> Lead to In-Toeing (Prevent the child from sitting like this)
If the Patient is walking, In-Toeing, Patella Facing Forward --> Means Tibial Problem

◆ Thigh-foot Axis

◆ Foot-Progression angle:

- Number 7 is the normal position
- Number 11 is beginning of In-Toeing
- Number 8 is sever Rotation

Note that:

In-Toeing could be Hemilateral

Tibial Correction is done by surgery

• **Limb Length InEquality: (LLI) or discrepancy:**

HemiHypertrophy --> the only condition that is long, Mostly is shortening

• **Genu Varum, Genu Valgum**

Since the baby is born, Normal position is Varus (o-2 years)

From (2-4 years) is Valgus

Then when the max Valgus is reached, the normal Return (there is a little Valgus Remaining)

• **Tibial Vara:**

From Hip --> Knee is normal

Blount Disease: only happen to patient who walk

- Club Foot:

Etiology

- May be Neurological Disease: lead to strong muscle in one side and weak in the other side
- If it is stretchable then it is a Postural Disease
- Idiopathic: there is no neurological Defect

There is Supination in the Fore-Foot

- Cerebral Palsy:

- ◆ Brain Insult During Two First years of life

- ◆ Types:

- Physiological
- Topographic
- Distress during Delivery, Uterine Contaction (HR Decreased lead to CP+ breech Position) must do C-section

Depending on the site affected in the brain.

- Most common orthopedics problems associated with CP:

1. Hip: will be flexed, tight adductors + internal Rotation
2. Knee: will be flexed (tight Hamstring)
3. ankle: equionous (tight tendon achlies)

Examine all Then rehabilitation

Done !

Sport & Soft tissues injuries

❖ Soft tissues injuries:

- Muscle, Tendon, Ligament, Meniscus
- Knee, Shoulder, Ankle

❖ Muscle injury:

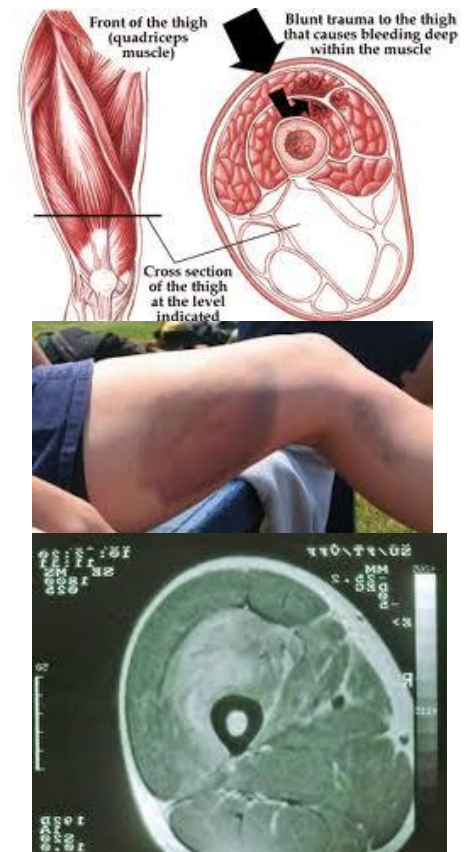
- The muscles most at risk are those in which the origin and the insertion **cross two joints**. e.g. (Gastrocnemius, Quadriceps and Hamstring muscles).
- Frequently injured muscles act in an **eccentric fashion** (i.e., lengthening as they contract).
- Frequently injured muscles have a relatively high percentage of **type II (fast-twitch) fibers**.

▪ **Muscle Strain :**

- The most common muscle injury suffered in sports.
- Immediate pain associated with diminished function.
- Both complete and incomplete muscle tears can occur by passive stretch of an activated muscle.
- Muscle tears also typically occur at or near to the myotendinous junction
- It can be partial or complete. Usually presents with immediate pain.
- Treatment:
 - RICE (Rest, Ice, Compression and Elevation)
 - NSAID
 - physical therapy

▪ **Muscle Contusion:**

- Caused by anon-penetrating blunt injury (direct blow) to the muscle resulting in hematoma and inflammation.
- **Quadriceps** and **Brachialis** muscles are common involved regions.
- Clinical features:
 - Pain with active and passive motion +/- swelling.
 - Decreased range of motion of joints spanned by the injured muscles.
 - Occasionally a permanent palpable mass.
 - Redness and hotness
- Mild forms take a few days to resolve conservatively.
- MRI shows bleeding inside the muscles.
- Treatment:
 - **Short period** of immobilization
 - Followed by early mobilization and Physiotherapy
 - NSAID



▪ **Muscle Laceration:**

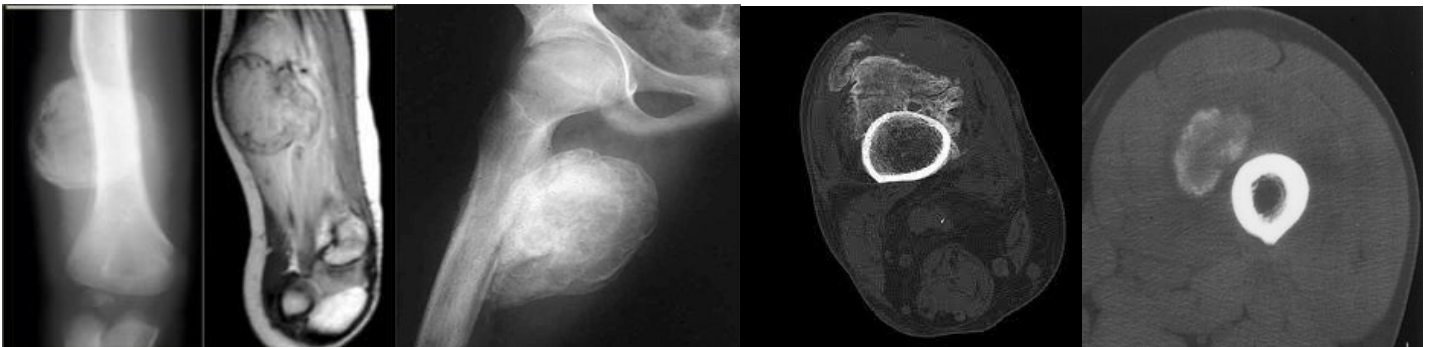
- I&D followed by suture repair of the fascia, if possible (debridement of debris).

▪ **Delayed-onset soreness:**

- Structural muscle injury leads to progressive edema formation and resultant increased intramuscular pressure.
- Is primarily associated with eccentric loading–type exercise.
- The pain and stiffness felt in muscles several hours or days after strenuous exercise. Soreness is usually found 24-72 hours after exercise.
- Clinical features: muscular pain that occurs 1-3 days after vigorous exercise.
- Treatment :
 - Will resolve in a few days
 - NSAID

▪ **Complications of Muscle Injuries:**

- **Scar formation and muscle weakness.**
- **Compartment syndrome:**
 - At the level of the muscle fibers, capillary bleeding and edema can lead to hematoma formation and can cause compartment syndrome in areas in which the volume is limited by the fascial envelope.
 - Patient with **Bleeding disorders** is at high risk
- **Myositis ossificans:**
 - Bone formation within muscle (outside the skeleton) secondary to blunt trauma.
 - CF:
 - ♦ Early:
 - ♦ Pain, swelling and decreased ROM
 - ♦ Erythema, warmth, induration, tenderness,
 - ♦ Late: painless swelling with decreased ROM
 - This sometimes mimics osteogenic sarcoma on radiographs and biopsy .
 - Increased ESR and serum alkaline phosphatase Myositis ossificans becomes apparent approximately 2 to 4 weeks post-injury
 - Treatment is excision of ossifications when mature.



❖ **Overuse Tendon injuries:**

- Function—to transfer force from muscle to bone to produce joint motion.
- Type of injuries:
 - Overuse tendinopathies
 - Tendon rupture
- **Overuse Tendinopathies:**
 - **Osteotendinous junction** is the most common site of overuse tendon injury.
 - Tendons are relatively hypo vascular proximal to the tendon insertion. This hypovascularity may predispose the tendon to hypoxic tendon degeneration and has been implicated in the etiology of tendinopathies.
 - Tendinopathy not tendinitis (degeneration and not inflammation)

Most Common Diagnoses and Locations of Chronic Tendinopathies

| Diagnosis | Location |
|---|--|
| ▪ Rotator cuff Tendinopathy | ▪ Supraspinatus tendon insertion |
| ▪ Lateral epicondylitis (tennis elbow) | ▪ Common wrist extensor tendon origin (mainly involved ECRB) |
| ▪ Medial epicondylitis (“golfer’s elbow”) | ▪ Common wrist flexor tendon origin (when making a golf swing this tendon is stressed) |
| ▪ Hamstring Tendinopathy | ▪ Hamstring tendon origin |
| ▪ Quadriceps Tendinopathy | ▪ Quadriceps tendon insertion |
| ▪ Patellar Tendinopathy (jumpers knee) | ▪ Patellar tendon origin |
| ▪ De Quervain’s disease | ▪ Sheath/pulley of abductor pollicis longus |
| ▪ Achilles Tendinopathy | ▪ Sheath, midsubstance, or calcaneal insertion |

- **Overuse Tendinopathies treatment:**
 - Goal: reduce pain and return function.
 - Mainly is conservative Rx:
 - ♦ Rest
 - ♦ Ice (Cryotherapy)
 - ♦ PT (stretching and eccentric strengthening)
 - ♦ Analgesics
 - ♦ Corticosteroids injection
 - ♦ Orthotics and braces
 - ♦ Other modalities: U/S, ESWT, iontophoresis and phonophoresis.
 - Surgical treatment:
 - ♦ Failed conservative treatment (at least 3-6 months)
 - Excision of abnormal tendon tissue and performance of longitudinal tenotomies to release areas of scarring and fibrosis.

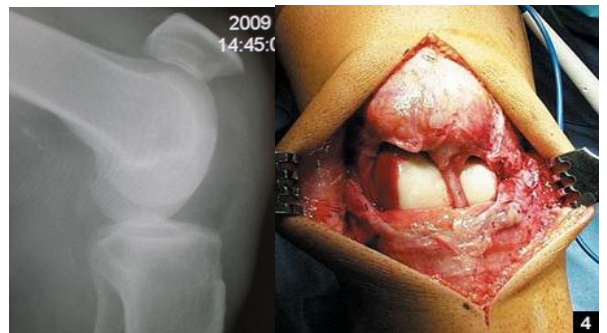
Group A1

- **Tendon rupture:**

- Knee extensor mechanism
 - Quadriceps tendon
 - Patella tendon
- Achilles tendon
- Partial vs. complete

- **Patella/Quadriceps tendon rupture:**

- Predisposing factors:
 - ♦ **Steroid**, chronic disease, and tendinopathy
- Age: Patella<40>Quads
- Location: at the tendon attachment to the patella.
- Physical examination:
 - ♦ Tenderness at the site of the injury, hematoma and a palpable defect in the tendon.
 - ♦ Unable to extend the knee against resistance or to perform a straight-leg raise (Decrease Range of motion of active extension)
- X-ray
 - ♦ Patella-alta > P.T rupture
 - ♦ Patella-infra > Q.T rupture
- Rx: usually surgical



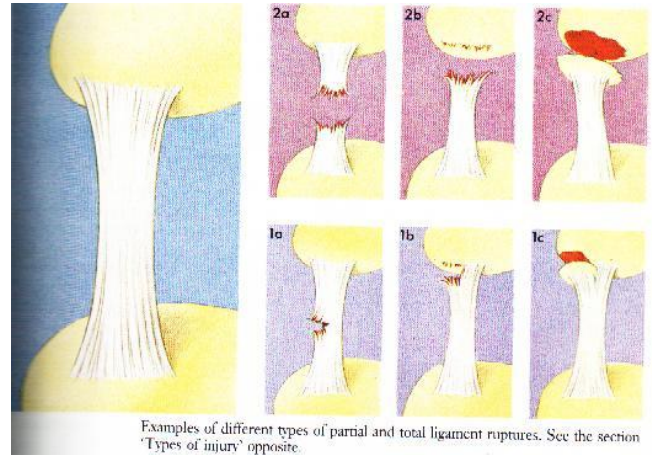
- **Achilles tendon rupture:**

- **Most ruptures (75%) occur during sporting activities .**
- Usually due to eccentric load, rupture occurs while performing actions requiring acceleration e.g. jumping, pushing off
- Injury happens during dorsiflexion or plantar flexion of foot.
- History:
 - ♦ The patient reports a “pop” or the sensation of being kicked in the heel during the injury.
 - ♦ Weakness and difficulty walking.
- Examination:
 - ♦ Increased resting dorsiflexion with the knees flexed, a palpable gap, weak plantar flexion, and an abnormal Thompson test (lack of plantar flexion when squeezing the calf)
 - ♦ Thompson test positive
- Diagnosis is clinical, but MRI or ultrasound can confirm.
- Rx: usually surgically



Group A1❖ **Knee:**

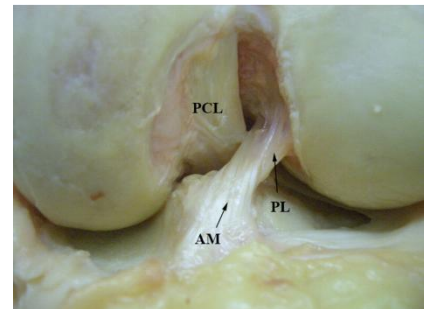
- Mid-substance tear of ligaments usually occur in adults.
- Proximal
- Avulsion
- Ligament intact
- Usually occurs in pediatric age group in the tibia, because ligament is stronger than bone.

❖ **Anterior Cruciate Ligament Injury:**➤ **Anatomy:**

- Originates from notch of the distal femur, proximal fibers travel to the medial wall of the lateral epicondyle. Needed when you change direction immediately or performing rough movements.

➤ **Mechanism of Injury:**

- Noncontact, most common causes (70%)
- Cutting or Pivoting
- Contact = MCL
- Sports-Related (80%) , soccer is the commonest sport to cause this accident
- Patient hears a “POP” sound (70%).
- Female: 2-4x > Male

➤ **Symptoms:**

- Instability “giving way episodes” – تخوني رجلي
- Swelling (Hemarthrosis) is noted within a 1-2 days of the injury.
- Pain if associated with meniscus tear (moderate to severe)

➤ **Physical examination:**

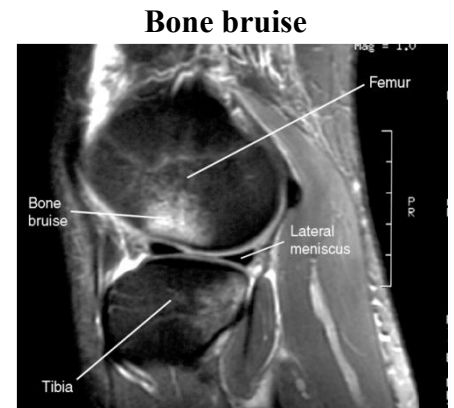
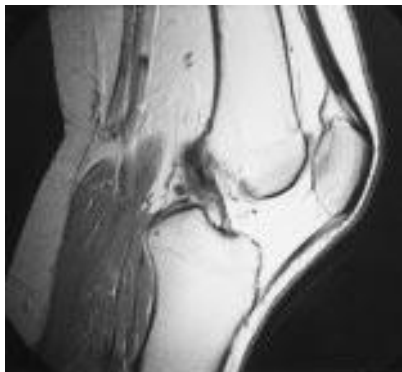
- The patient needs to be relaxed and comfortable.
- Must be compared with those of the normal knee.
- A moderate to severe effusion is usually present
- ROM: in acute injury the range of motion may limited by:
 - Pain
 - Effusion
 - Hamstring spasm,
 - ACL stump impingement,
 - Meniscal pathology.
- Special tests:
 - Lachman's test
 - ADT (Anterior drawer test)
 - Pivot shift test: is pathognomonic for ACL injury (best in the chronic setting)

Group A1➤ **Investigations:**

- **X-ray**, is done to rule out bone, joint fracture, or avulsion injury.
 - Rule out:
 - ◆ Second fracture: fracture of the lateral tibial condyle, usually result of abnormal varus (bowing). Associated with ligamentous and meniscal injury.
 - ◆ Tibial avulsion in children. (wedge shaped)
 - ◆ Treatment of avulsion: if reduced when closed, put a cast. If not reducible, treat surgically.



- **MRI**, only performed in acute injury, shows:
 - Bone contusion
 - Posterior part of tibia hits the femur, called kissing lesion.
 - Usually not needed



- In the skeletally mature patient, the femoral insertion or midsubstance is usually the site of disruption .
- In the skeletally immature patient, the tibial attachment may be avulsed with or without a piece of bone.

➤ **Injuries associated with ACL disruption:**

- Injuries of the ACL rarely occur in isolation. The effects of other injuries, including:
 - Other ligament sprains (MCL)
 - Meniscal tears
 - Articular cartilage injuries
 - Bone bruises ,
- Complicate the treatment and eventual outcomes of ACL disruptions.
- Long term complication with meniscal damage result in Osteoarthritis.

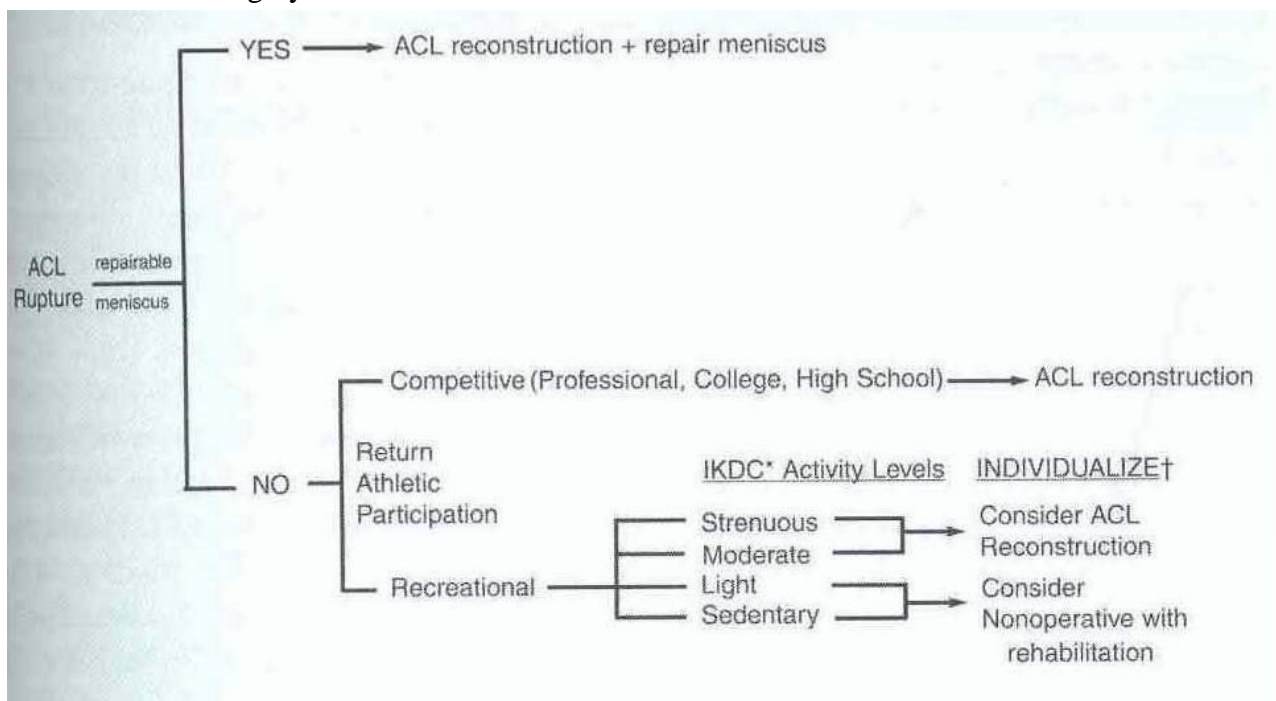
➤ **Treatment:**

• Nonsurgical treatment:

- Appropriate for asymptomatic patients with partial injuries to the ACL.
- Patients who are older or less physically active may elect to modify their activities and proceed with nonsurgical treatment. If nonsurgical treatment fails or knee instability persists, surgery can be performed.
- Nonsurgical treatment involves rehabilitation to strengthen hamstrings and quadriceps, as well as proprioceptive training.
- Activity modification is also an important part of nonsurgical management, as patients who avoid cutting and pivoting sports are at lower risk for knee instability.
- ACL sports braces are available as well. However, they have not been shown to prevent abnormal anterior tibial translation. Functional braces and simple knee sleeves improve proprioception, which may give patients a sense of improved knee function and stability.

• Surgical:

- Athletes with ACL injuries rarely return to cutting and pivoting sports, such as basketball, football, soccer, squash, and handball, without first undergoing surgery. For individuals who wish to return to such sports, surgery is generally recommended to avoid instability and secondary meniscal and/or articular cartilage damage.
- Individuals who work in occupations that may involve physical combat, such as police officers, or risk, such as firefighters, should have ACL reconstruction before returning to work .
- Most patients can function well and perform activities of daily living (ADLs) (without instability after a complete ACL injury. However, some have difficulty performing even simple ADLs because of ACL deficiency-related instability, and they may require surgery.



❖ Medial collateral ligament injury

- The main function of MCL is to resist valgus and external rotation loads.
- The **Tibial MCL is the most commonly injured** ligament of the knee. The true incidence may be underestimated due to a lack of reporting for lesser grades of injury.
- Concomitant ligamentous injuries (95% are ACL) occur in:
 - 20% of grade I: sprain: mild, no instability clinically, only associated with tenderness.
 - 52% of grade II: partial: tenderness and gapping on the medial knee, partial tear of the ligament
 - 78% of grade III: complete ligamentous tear. Associated with ACL injury
- Concurrent meniscal injuries have been noted in up to 5% of isolated medial ligamentous injuries.
- Usually result from contact injury like a direct blow to the lateral aspect of the knee.
- Can be partial or complete



➤ Physical examination:

- Valgus stress test should be performed with the knee at 0° and 30° of flexion (*The leg extended and the examiner's hand on the knee, and abducting the leg with the other hand. An attempt is then made to force the leg at the knee into valgus.*).
 - Laxity at 30°: isolated MCL
 - Laxity at both 0° and 30°: concurrent injury to the posteromedial capsule and/or cruciate ligaments.
- Rule out associated injuries (ACL and M. Meniscus)



➤ Investigation

- Is a clinical diagnosis and most of the time does not need further investigation.
- If the injury is severe or suspecting associated injuries (e.g. significant knee effusion) then the **MRI** will be modality of choice.
- X-ray: to rule out fracture (lateral tibia plateau fracture)

➤ Treatment:

- Conservative Rx
- Is the mainstay of treatment for the isolated MCL injuries
- Indications:
 - All isolated grade I and II injuries
 - Grade III injuries that are stable in extension without associated cruciate injury
- Crutches, ice, compression, elevation, and anti-inflammatory/pain medication
- No brace is usually required for grade I injuries; crutches can be used as necessary. A knee immobilizer (comfort) or hinged brace (for walking) is recommended for grade II and grade III injuries.
- Timing of return to sports is directly related to the degree of injury: Grade I injuries, 5 to 7 days; grade II injuries, 2 to 4 weeks; grade III injuries, 4 to 8 weeks.
- Surgical Rx: if failed Rx+ grade III+ associated with other ligaments injury

❖ **Lateral collateral Ligament injury:**

- The LCL is the primary restraint to varus stress at 5° and 25° of knee flexion.
- Less commonly injuries than MCL
- Injuries to the lateral ligament of the knee most frequently result from motor vehicle accidents and athletic injuries.
- Rx:
 - Isolated injury: non operative
 - Combined injury: surgical

❖ **Posterior cruciate Ligament injury:**

- The PCL is the primary restraint to posterior tibial translation in the intact knee.
- Mechanism of injury:
 - A direct blow to the proximal aspect of the tibia is the most common cause of PCL injury.
 - Dashboard injury
 - In athletes>fall onto the flexed knee with the foot in plantar flexion, which places a posterior forces on the tibia and leads to rupture of the PCL.
- PCL insufficiency significantly increased the risk of developing medial femoral condyle and patellar cartilage degeneration over time .
- Rx
 - Non operative
 - Surgical if combined ligament injury

❖ **Knee dislocation "Multi ligament Knee Injuries":**

- Multi ligament knee injuries are usually caused by high-energy trauma and are often considered knee dislocations.
- Less frequently, low-energy trauma or ultra-low-velocity trauma in obese patients can also result in this injury pattern.
- Abicruciate (ACL+PCL) injury or a multiligament knee injury involving three or more ligaments should be considered a spontaneously reduced knee dislocation.
- Knee dislocation should be considered a limb-threatening injury, and careful monitoring of vascular status after the injury is imperative.
- Popliteal artery (estimated at 32%) or peroneal nerve injury (20% to 40%) also can occur.
- Describe distal part in relation to the proximal part.



Group A1

➤ Vascular examination:

- Critical in an acutely dislocated knee.
- Pulse and ankle-brachial index (ABI) should be carefully assessed. An ABI of less than 0.90, and most certainly less than 0.80, should be considered abnormal.
- If there is any concern about an abnormal vascular examination, there should be allowing threshold for ordering an angiogram.
- If pulses are still abnormal or absent following reduction of the dislocation, immediate vascular surgery consultation with intraoperative exploration should be the next step in management.
- Avascular injury in a knee dislocation is a limb-threatening injury and needs to be corrected within 6 to 8 hours. If not corrected, amputation may be required.

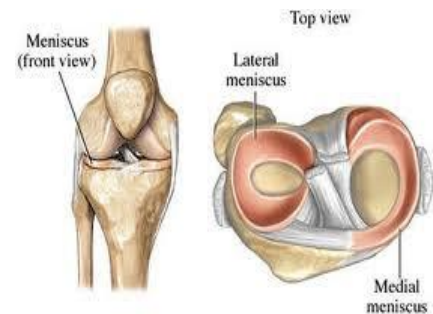


- Neurologic examination: is also critical, as peroneal nerve injury can occur with multi ligament injuries, particularly in concomitant lateral/posterolateral corner injuries.
- Management: **Emergent Closed Reduction** and splinting or bracing should be performed immediately. Post-reduction radiographs should be taken to confirm knee reduction and don't forget to do neurovascular assessment before and after reduction (IMP)

❖ Meniscus:

➤ Anatomy:

- The menisci are crescent-shaped, with a triangular appearance on cross-section.
- The lateral meniscus covers 84% of the condyle surface; it is 12 to 13 mm wide and 3 to 5 mm thick.
- The medial meniscus is wider in diameter than the lateral meniscus; it covers 64% of the condyle surface and is 10 mm wide and 3 to 5 mm thick and it is injured more than the lateral meniscus.

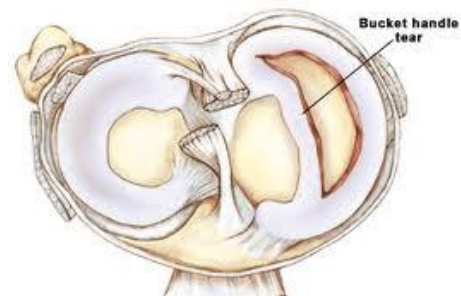


➤ Meniscus function

- The meniscus provides stability, absorbs shock, increases articular congruity, aids in lubrication, prevents synovial impingement, and limits flexion/extension extremes.
- The most important function of the meniscus is load-sharing across the knee joint, which it accomplishes by increasing contact area and decreasing contact stress.

❖ **Meniscus tear:**

- Epidemiology of meniscus injuries:
 - Meniscus injuries are among the most common injuries seen in orthopedics practices.
 - Arthroscopic partial meniscectomy is one of the most common orthopedics procedures.
- Incidence:
 - Meniscus tears are unusual in patients younger than age 10 years.
 - Most meniscus tears in adolescents and young adults occur with a twisting injury or with a change in direction.
 - Middle-aged and older adults can sustain meniscus tears from squatting or falling.
- History:
 - Within acute meniscus tear, an effusion may develop slowly several hours after injury. This differs from an anterior cruciate ligament (ACL) injury, where swelling develops rapidly within the first few hours.
 - Patients with meniscus injuries localize pain to the joint line or posterior knee and describe mechanical symptoms of locking or catching.
 - Locking.
 - Chronic meniscus tears demonstrate intermittent effusions with mechanical symptoms
- Physical examination:
 - Small joint effusions and joint line tenderness with palpation are common findings with meniscus tears.
 - Manipulative maneuvers, including the **McMurray** and **Apley tests**, may produce a palpable or audible click with localized tenderness, but they are not specific for meniscal pathology.
 - Range of motion is typically normal, but longitudinal bucket-handle tears may block full extension of the knee joint.
- Investigation:
 - Standard knee radiographs should be obtained for evaluating for
 - Bone injuries or abnormalities.
 - Osteoarthritis.
 - **MRI** remains the noninvasive diagnostic procedure of choice for confirming meniscal pathology.



➤ Differential diagnosis:

- Differential diagnosis Prior to MRI, several large studies demonstrated accuracy of the clinical diagnosis of meniscus tears to be 70% to 75%.
- The differential for meniscus tears includes intra-articular and extra-articular diagnoses.
 - **Intra-articular** possibilities include osteochondritis dissecans, medial patella plica, patellofemoral pain syndromes, loose bodies, pigmented villonodular synovitis, inflammatory arthropathies, and osteonecrosis.
 - **Extra-articular** possibilities include collateral ligament injuries, slipped capital femoral epiphysis, bone or soft-tissue tumors, osteomyelitis, synovial cyst, pes or medial collateral ligament bursitis, injury, reflex sympathetic dystrophy, lumbar radiculopathy, iliotibial band friction, and stress fracture.

➤ Treatment:

- **Nonsurgical Management**
 - Not all meniscus tears cause symptoms, and many symptomatic tears become asymptomatic.
 - Tear types that commonly may be managed nonsurgically include:
 - Stable longitudinal tears <10mm in length with <3 to 5 mm displacement
 - Degenerative tears associated with significant osteoarthritis
 - Short (<3mm in length) radial tears
 - Stable partial tears
- Nonsurgical management can include ice, non-steroidal anti-inflammatory drugs, or physical therapy for range of motion and general strengthening of the lower extremities.
- **Surgical indications:**
 - Failure of conservative treatment
 - Locked knee
 - Concomitant ACL surgery
- Type of surgical intervention:
 - Excision (Arthroscopic partial/subtotal/ or total meniscectomy)
 - Repair

❖ **Ankle sprain:**

- Ankle sprain is a common sports related injury.
- Lateral sprains accounting for 85% of all such injuries.

➤ **Classification of Acute Lateral Ankle Sprains:**

| Grade | Description |
|------------|---|
| I | Mild injury to the lateral ligamentous complex. No frank ligamentous disruption is present. Mild swelling, little or no ecchymosis on the lateral aspect of the ankle, and no or mild restriction of active ROM. Difficulty with full weight bearing is sometimes seen. No laxity on examination. |
| II | Moderate injury and partial tear to the lateral ligamentous complex. Restricted ROM with localized swelling, ecchymosis, hemorrhage, and tenderness of the anterolateral aspect of the ankle. Abnormal laxity may be mild or absent. May be indistinguishable from a grade III injury in the acute setting. |
| III | Complete disruption of the lateral ligamentous complex. Diffuse swelling, ecchymosis on the lateral side of the ankle and heel, and tenderness over the anterolateral capsule, LCL. |

➤ **History and physical examination:**

- History suggestive of inversion injury
- Localized tenderness, swelling, and ecchymosis over the anterior talofibular ligament (ATFL) and/or calcaneofibular ligament (CFL)
- Examination should localize pain to the lateral ankle.
- The anterior drawer test may demonstrate anterior talar subluxation.
- The talar tilt stress test may demonstrate positive tilt to inversion stress.
- Sulcus sign (skin indentation) may be positive with inversion test.

➤ **Investigations:**

- X-ray ankle to rule out associated injuries (lateral process of talus, anterior process of calcaneus, and fifth metatarsal base).
- MRI and MR arthrography can show ligamentous disruption or attenuation, but they provide no distinct advantage over physical examination.
- MRI is most useful when looking for other pathology (peroneal tear, osteochondral lesions of the talus). Consider MRI if pain persists 8 weeks after ankle sprain.

➤ **Associated injuries:**

- Osteochondritis dissecans lesions (15% to 25 %)
- Loose bodies (20 %)
- Peroneal pathology (up to 25 %)



➤ **Treatment:**

- Nonsurgical
 - Initial treatment consists of rest, ice, compression, and elevation (RICE)
 - Early weight bearing and use of a protective brace during functional activities facilitates recovery better than non-weight bearing or immobilization.
 - Functional instability may result and should be treated with a course of physical therapy, emphasizing isometrics and resistive training, peroneal strengthening, range of motion, and proprioceptive training.
 - Maximizing the resistive function of the peroneal musculature can offset mechanical ligamentous instability.
 - Residual mechanical instability may be managed effectively with bracing or taping.
 - Patients may return to unrestricted activity when cutting, running, and hopping on the affected leg are no longer painful.
 - Ninety Percent of acute ankle sprains resolve with RICE and early functional rehabilitation.
- Surgical—Surgery is a reasonable option when an adequate trial of nonsurgical treatment fails to control symptoms.



A

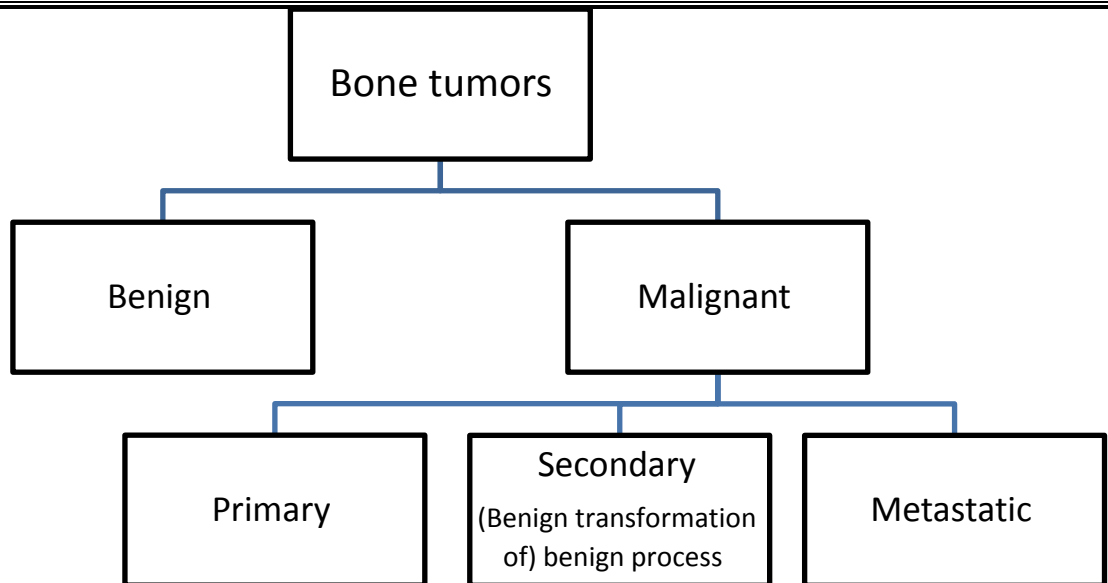


B



C

Musculoskeletal Tumors

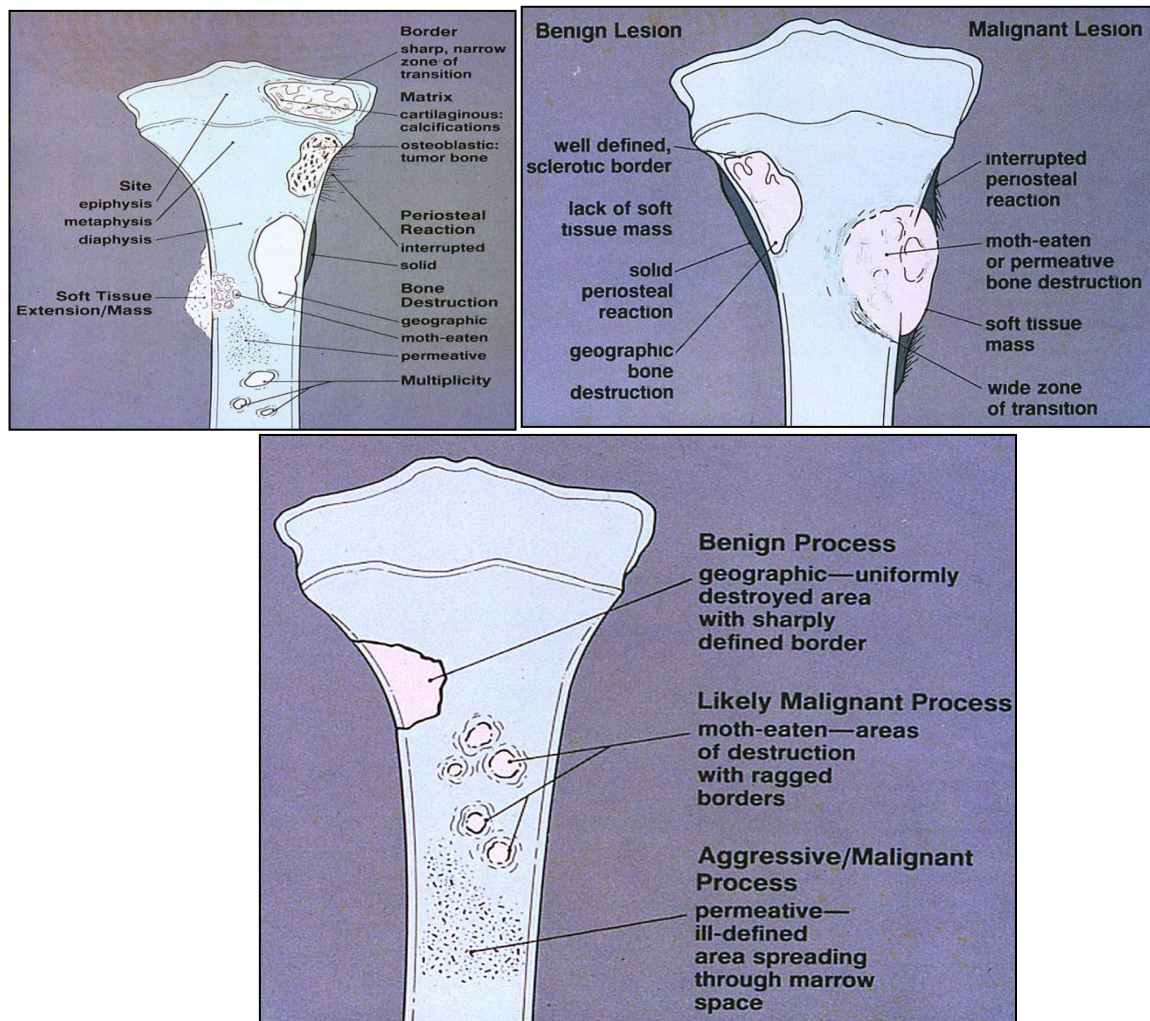


- ⊙ Most common **bone Tumors** → BENIGN.
- ⊙ Most common **benign** tumors → OSTEO CHONDROMA.
- ⊙ Majority of **Malignant tumors** → METASTATIC of other tumors elsewhere in the body.
- ⊙ Most common **primary malignant** tumors → M. MYELOMA THEN OSTEOSARCOMA.
- ⊙ **Malignant Bone tumors** are called SARCOMA
- ⊙ **Primary Malignant bone tumors** is minority
- ⊙ **Benign bone tumors** do not invade the soft tissue nor do they affect the cortex
- ⊙ Certain tumors have predilection for some bones (favorite places) it can recognized by X-ray.
E.g.: **Ewing's sarcoma** most commonly in the DIAPHYSIS. **Giant cell tumors** are almost always found in a subarticular position, i.e. METAPHYSIC location.

◆ Classification according to the cell origin:

| Tissue of origin | Benign | Malignant |
|-----------------------------|---|--|
| Bone (osteogenic) | Ostoidosteoma Osteoblastoma | Osteosarcoma (most common in epiphysis) |
| Cartilage (chondrogenic) | 1- Enchodroma 2- Chondroblastoma | Chondrosarcoma |
| Bone & cartilage (both) | Osteochondroma | |
| Fibrous (fibrogenic) | Fibrous cortical defect | |
| Bone marrow (hematopoitic) | Gaint cell tumor | 1- Multiple myeloma 2- Ewing's sarcoma (most common in diaphysis) |
| Unknown (lesion like tumor) | 1- Simple cyst. 2- Aneurismal bone cyst (ABC). | |
| Metastasize | | Metastasis |

◆ How to describe bone tumors?



- 1- **Site:** Epiphysis, Diaphysis or Metaphysis which most of the tumor arises from metaphysis.
- 2- **Centric** (away from the border) or **eccentric** (in the bone border).
- 3- **Border** of the tumor:
 - a. Well define & sharp border → usually in benign tumors.
 - b. Ill-defined → usually in malignant.
 - c. Sclerotic margin: sign of benign tumors.
- 4- **Matrix** of the tumor :
 - a. Sclerotic: it means forming bone .so on x-ray → opaque.
 - b. Lytic: it means forming tissue other than bone (it may be cartilage, fibrous tissue or cyst) on X-ray → translucent.

N.B. this calcification (lytic and sclerotic) helps in the differentiation b/w the tumors .i.e. you can't say from this calcification that this tumor is benign or malignant.
- 5- **Periosteal reaction** :

-occur in some bone tumors:

 - A. Characteristic periosteal reaction: mostly occur with malignant tumors (teeth like)
 - B. Smooth periosteal reaction: with benign tumor.
- 6- **Geographic appearance** :

Describe the tumor: e.g. oval shape, surface tumor, multiple tumor, etc.
- 7- **Soft tissue extension:** occurs mostly with malignant tumors or aggressive benign.

◆ Benign VS malignant:

| Description | Benign | Malignant |
|--------------------------|---|--|
| Border | Well-defined | Ill –defined |
| Periosteal reaction (PR) | Smooth PR | Characteristic PR |
| Matrix | Lytic or sclerotic | Lytic & sclerotic |
| Soft tissue extension | No | Usually |
| Geographic app. | Uniform shape | Doesn't have specific shape |
| Symptoms | Usually swelling, proceed the pain | Usually the pain proceed the swelling |

Tumor like lesions

1) Simple bone cyst (unicameral cyst)

- The most common tumor like lesion
- Usually in children age group up to 20 years old ,Male > Female
- After 20 Male=Female
- Not progressive

■ Sites

- Common in the end of long bones (e.g. proximal humerus).
- Upper & lower femur
- Pelvic (iliac crest)
- Calcenum
- Scapula
- Patella

■ Presentation:

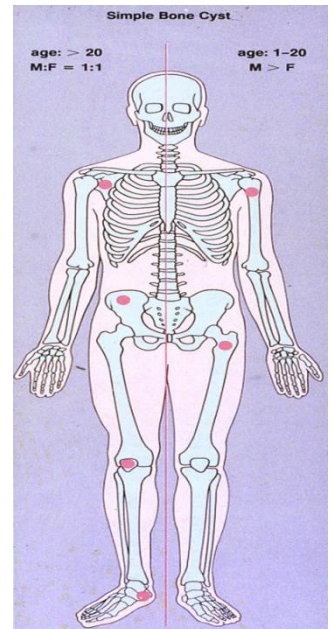
- The patient may present with pathological fracture → cause pain (after trauma , & cyst may correct after fracture)
- **Usually its presentation is incidental.** (Most resolve within 2 yrs.)

■ Radiological feature :

- (x-ray is the main investigation in benign tumors)
 1. Metaphysic lytic lesion.
 2. Sclerotic margin, well define.

■ Treatment

- X-ray of pathological fracture in child age group
- Nothing to do it except conservative treatment for the fracture ,& till the patient that you may have fracture in this area
- The same fracture in older age with displacement & angulation
- ORIF (Open Reduction and Internal Fixation) + Bone graft to fill the space



2) Aneurysmal bone cyst

- Aggressive and balloon-like.
- Progressive tumor like lesion.
- Arteriovenous formation.
- Recurrence rate is high.
- Fusiform cyst.
- Aneurysmal cysts have bloody content, while simple cysts have straw colored fluid.

■ Site (common site) :

- Upper humerus.
- Upper femur.
- Spine (neural arch: lamina & pedicle) may give pressure effect.
- Proximal tibia.
- Scapula.

■ Presentation :

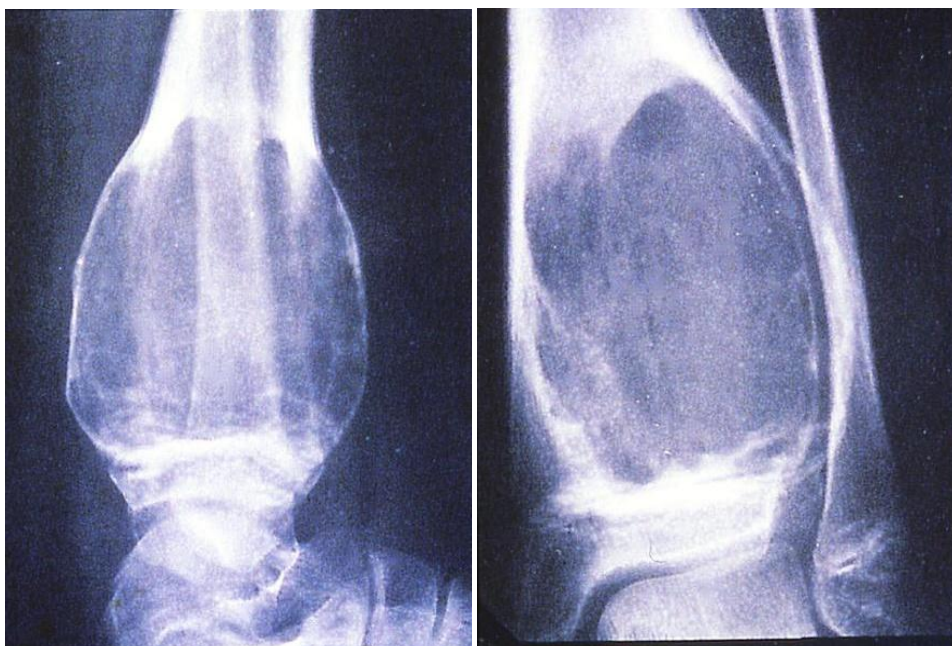
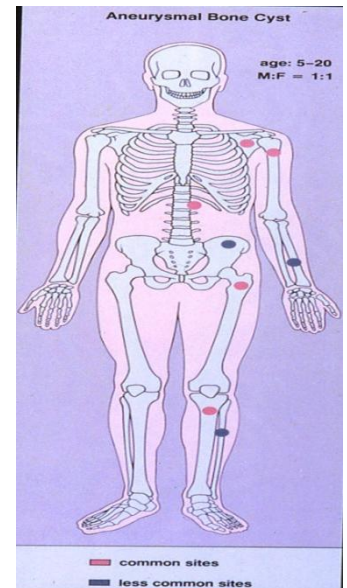
- The usual presentation is **swelling**.
- Patient may present with pathological fracture → pain.

■ Radiological feature:

- X-ray shows different content inside aneurysmal cyst unlike simple cysts.
- Metaphyseal lytic lesion.
- Well- defined, sclerotic margin.
- Expansile → thin cortex (like egg shell)

■ Treatment

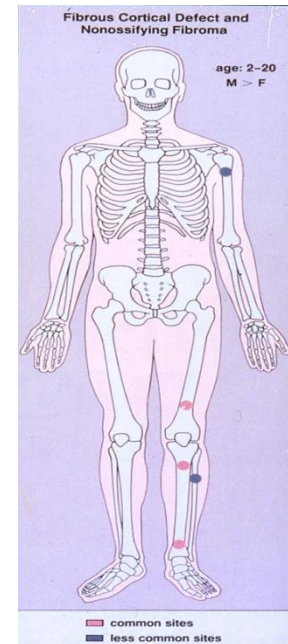
- ORIF + BONE graft (from fibula as support BCZ lesion is very big)
- Sequestration = divide it to small chambers
- Aspiration with alcohol ,phenol & steroid



Benign tumors

1) Fibrous Cortical Defect (Non Ossifying Fibroma)

- **Benign** lesion since birth
 - Not site for fracture.
 - Never transfer to malignant.
 - Ec-centric lesion.
- **Site:**
 - Around knee: (lower femur, upper tibia).
 - Lower tibia.
 - **Presentation :**
 - **Asymptomatic** (no pain, no swelling & no pathological fracture) → discovered incidentally.
 - **RADIOLOGICAL FEATURE :**
 - Metaphyseal lytic lesion (inside the cortex)♯
 - Well defined, sclerotic margin.
 - **Treatment :**
 - Self-limited, healed by itself.
 - Reassurance is the Rx.
 - If pain-full → curettage +bone graft.



2) Osteoid Osteoma:

- Benign tumor which has different behavior → main presentation is pain.
- Usually affects young patients 10-35 and more common in males.
- May arise in the cortex of long bones, or occasionally in the cancellous bone of the spine and less commonly talus

■ Presentation

- Usually well localized pain that is **worse at night** and prevents patients from sleep.
- Character of pain :
 1. Pain at the site of tumor.
 2. Aggravated by activity.
 3. Relieved by aspirin & NSAID.

■ Radiological features :

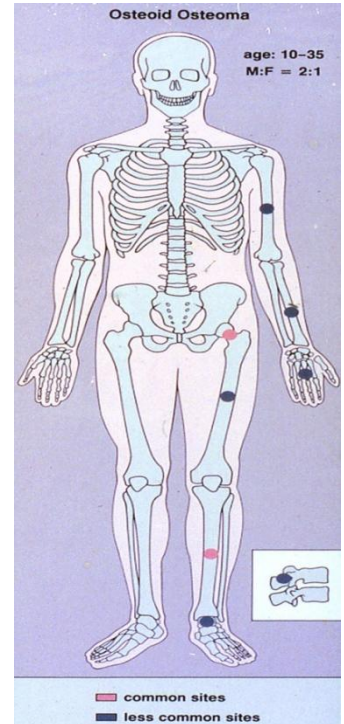
- Metaphyseal or diaphyseal lesion.
- Lytic lesion inside patch of sclerosis.
- The lytic lesion called ((nidus)) , nidus is the part which surrounded by a reactive zone of dense sclerotic *new bone formation*, therefore in the treatment → we **remove nidus only**.

■ Investigation:

1. X-ray → a nidus surrounded by a **thick cortex** (sclerosis).
2. CT scan → nidus
3. Bone scan used sometimes. → ↑ uptake.

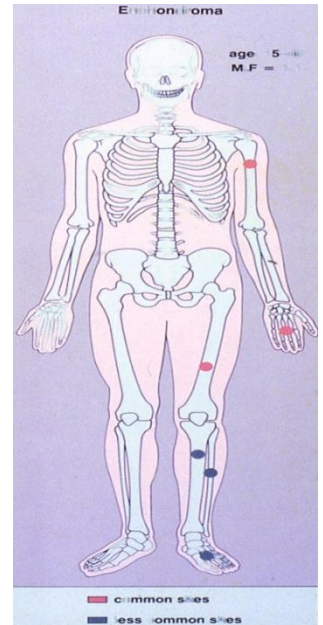
■ Treatment

- NSAIDs for 3-6 weeks
- If not relieved A CT-guided needle can be inserted in to the nidus and the lesion ablated with radiofrequency coagulation (also called radiofrequency ablation).
- If it easy to access > excise it & label it then send it to histopathologist to make sure all the lesion was excised



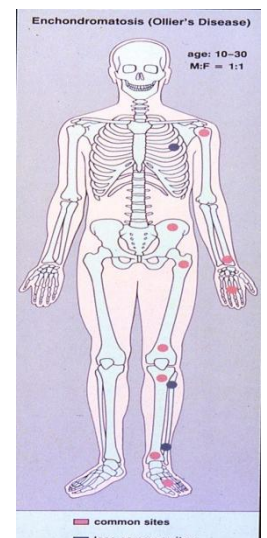
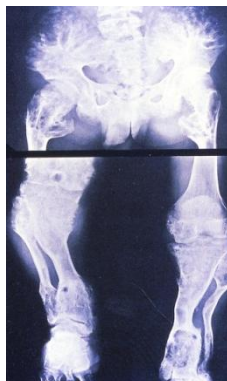
3) Enchondroma

- 15-50 age group
- Tumor grows within the bone and expands it (**ballooning**)
- It composed of translucent hyaline cartilage and content inside **enchondroid**.
- The affected bone is expanded by the tumor and its cortex is thinned.
 - Sites
 - **Mainly small bone** e.g. phalanges in hand & foot ...etc.
 - Fairly common in Femur, humerus and less commonly tibia & fibula
 - Presentation
 - Usually found incidentally
 - Swelling.
 - **Pathological fracture** which may cause pain.
 - Affect one side e.g. one hand
 - Radiological features
 - Metaphyseal or diaphyseal lytic lesion.
 - Well defined.
 - Sclerotic margin.
 - Multicentric
 - Location and contents is different than aneurismal bone cysts. X- RAY of enchondroma is more hyperdense due to the chondroid.
 - Treatment
 - If it symptomatic (pain , become bulky) >> surgery (curettage + bone graft) and fixation



- Enchondromatosis

- Multiple enchondroma of the major long bones occur mainly in the rare condition called multiple enchondromatosis.
- Benign ,affect both sides ,low grade destructive lesion
- Usually starts in children, and carries a high risk of becoming a secondary tumor (malignant transformation).



4) Osteochondroma

- **Commonest benign tumor of bone.**
- The only surface tumor, (outside the bone) .therefore, we call it exostosis or pedunculated.
- It is a combination of both bone & cartilage.
- Usually in 10-20 age group and Male > Female.
- Painful in children due to growth plate compression and pressure effects on adjacent nerve or vascular structures.

- **Sites**

- The commonest are(around knee) distal femur + proximal tibia
- Scapula, neck of femur.

- **Presentation:**

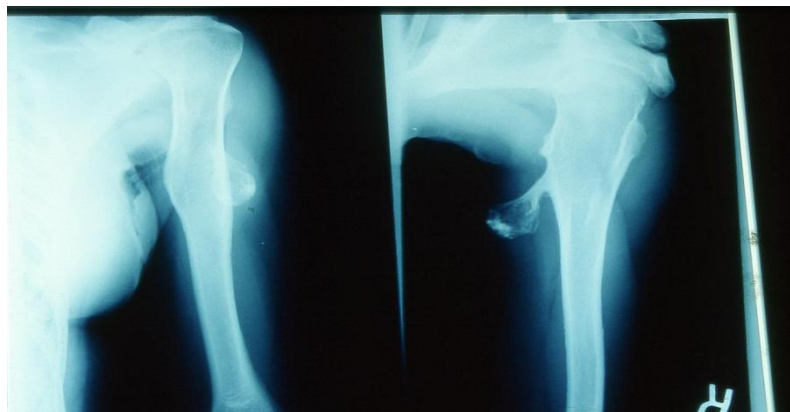
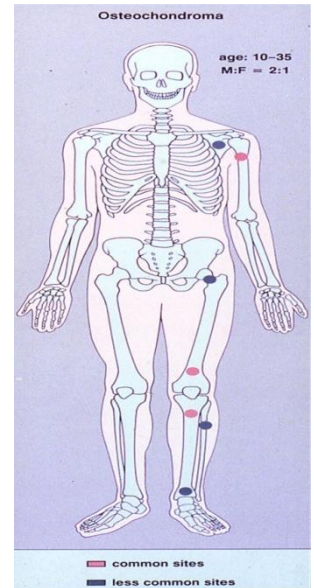
- a. Swelling : it can reach huge size .(keeps on growing)
- b. Symptom of complication :
 - 1- Pressure symptom:
 - Pseudo-aneurysm.→ artery.
 - Hypothesis or parasesthesia →nerve.
 - Rendering the movement → tendon.
 - Restrict the movement of the movement nearby the joint
 - Adventitia bursea.
 - 2- Fracture especially with pedunculated type.
 - 3- If transfer to malignant

- **Radiological feature:**

- Metaphyseal lesion.
- Mushroom-like stalk of the bony tumor. (connected to the bone)
- On x-ray the cartilaginous cap: which is the cartilaginous part of the tumor not seen (translucent).it is located around the bony part.
- Direction of the tumor →away from the bone.
 - Start from the growth plate & in the direction of Ms. Tendon.
 - Stop growing when patient stop to growth usually at 18 yrs.
- According to the shape of the neck of the tumor , we divide it into :
 - 1- Pedunculated type: has long & thin neck.
 - 2- Sessile type: has short & thick neck.

- **Treatment**

- Usually we do nothing, just reassure the patient.
- Surgery (just excision , no need for bone graft b/c it is surface tumor) & the surgery is indicated in :
 - a. When there is complication.
 - b. Cosmetic.



5) Giant cell tumor

- From bone marrow
- Occurs most commonly in young adults, 20-40 age groups.
- Benign aggressive tumor.
- It's only the benign bone tumors that can metastases to the lung. So it's important to get chest x-ray.
- Origin: osteoclast, therefore it is sometimes called **osteoclastoma**.
- Very destructive tumor

■ Sites

- Most common distal epiphysis of radius
- Less common are distal tibia ,sacrum
- Very bad one in sacrum because it will affect nerve roots

■ Presentation

- Mostly patient present first with: pain, then swelling & later on pathological fracture.
- Not clear
- Osteopenia.

■ Radiological feature :

- Epiphyseal lytic lesion.
- No new bone formation b/c this new bone will be eaten by the osteoclast.
- Ill define margin.
- Radiograph shows lucent regions, lytic destruction of the bone with expansion of the cortex, without a sclerotic rim.
- Ill-defined borders when aggressive or pre-malignant
- Usually looks like a bone cyst, definite diagnosis made by biopsy.
- No marginal sclerosis.
- Soft tissue extension.

■ Investigation :

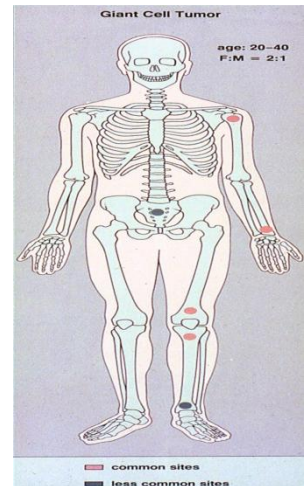
- The assessment depends on :
 - a. Soft tissue extension: by MRI.
 - b. Joint extension: the articular cartilage is a very resistant against progression of the tumor from going to the joint.
 - c. Bone extension: by CT scan.
 - d. Further investigation :
 - Bone scan: for metastasis.
 - CBC: FOR ASSESMENT of general condition of patient.
 - Biopsy: for confirmation it doesn't convert to malignant tumor.

■ Treatment

- No place for conservative treatment.
- In general we do : excision followed by either : (depend on the site of the tumor)
 - 1- Bone graft.
 - 2- Prosthesis.
 - a. If the tumor in non-weight bearing area (e.g. lower radius) → radical excision + bone graft + arthrodesis for nearby joint
 - b. If the tumor in weight bearing area (e.g. lower femur) →excision + prosthesis (N.B. no bone graft here).

■ Radiotherapy & chemotherapy are indicated in :

- 1- Frank malignancy.
- 2- Recurrence of the tumor.
- Recurrence rate is 50% ,it will be more aggressive with metastasis



So, the tumor will not destruct the joint. But the surgeon during treatment will destruct the joint b/c he has to remove the entire region around the joint.



Malignant tumors

1- Ewing's sarcoma

- Origin: from the **endothelial lining of the bone marrow canal**.
- Most of the Ewing's sarcoma is miss-diagnosed firstly as acute osteomyelitis. (Mimic the OA) because of systemic symptoms and elevated ESR.
- Young age group 5-25
- Pulmonary metastasis can occur.

■ Sites:

- It is the only bone tumor which takes its origin **from diaphysis** → so; we will find a diaphyseal lesion.
- The diaphyses of the femur are the most common sites, followed by the tibia and the humerus.

■ Presentation :

Very characteristic:

- 1- Febrile patient.
- 2- High WBC's.
- 3- Local Pain & redness
- 4- Ulceration of skin.
- 5- swelling

like the presentation of infection

+ Scapula, less commonly clavicle.

■ Radiological feature:

X-ray: peel onion reaction.

--- You think it is AOM → YOU do aspiration for drainage of pus → there will be no pus & you will find tumor tissue → biopsy → Ewing's sarcoma.

- So, it is a diaphyseal lytic lesion (not sclerotic).
- Ill- defined.
- Sometimes → soft tissue extension.
- N.B: you can't differ it from osteosarcoma unless you do biopsy.

■ Investigation :

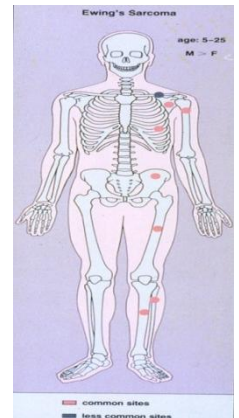
- Definite diagnosis made by MRI and biopsy.

■ Management

- In history usually asymptomatic unless it causes pressure in vital structures or in late stage
- Blood investigations , ESR
- Radiology (X-ray ,bone scan ,CT,MRI)
- Biopsy –same surgeon who will do surgery should take the biopsy- To avoid contamination then spreading the tumor

■ Treatment

- It is sensitive to chemotherapy
- So start with chemotherapy –to decrease the tumor in size so it will be easy to excise it & to control metastasis (microcell) everywhere in the body as in bacteremia.
- Tumor treated by operative excision and disarticulation and You may need amputation



2- Osteo sarcoma

- Most common primary malignant tumor .{ remember the most common malignant tumor is metastatic }

- More common than Ewing's sarcoma
- 10- 25 year old and Male > Female

■ Sites

- Arises from primitive bone-forming cells
- Around the knee.
- Common in the lower femur, upper tibia, and upper humerus.
- Less commonly clavicle

■ Presentation :

- Patient present firstly with pain, then swelling, lastly pathological fracture (typical presentation of malignant tumor). Overlying skin is warm due to high vascularity.
- May present as cachectic (in lated& advanced case).

■ Radiological presentation

- Very dense
- Irregular medullary and cortical destruction of the metaphysis.
- Sun rise periosteal reaction (surrounded by low dense)
- Could be lytic or sclerotic."mixed"
- Ill defines no sclerotic margin.
- Metaphyseal lesion.
- Definite diagnosis made by biopsy

■ Investigation :

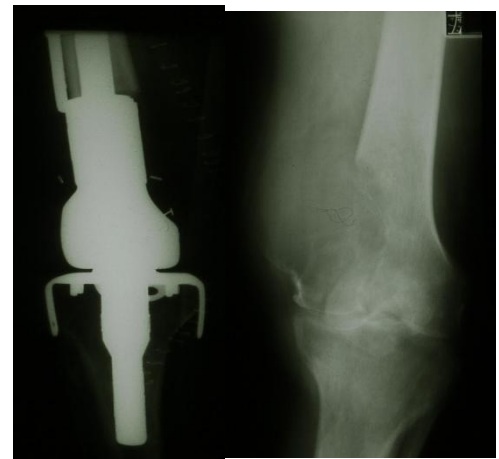
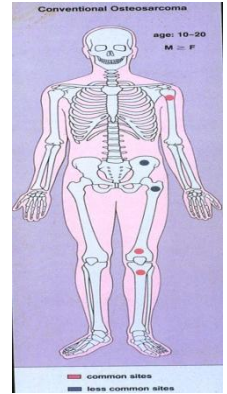
- 1- CT scan = bone extension.
- 2- MRI = soft tissue extension.
- 3- Bone scan = metastasis.
- 4- Searching for metastasis

■ Treatment

- Surgical intervention :

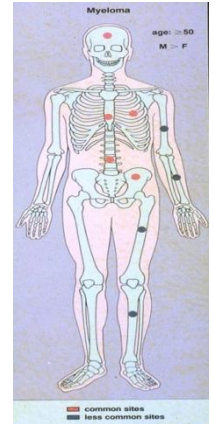
- 1- **Limb salvage procedure:** which is radical excision of the affected bone & the affected compartments (e.g. flexor compartment of thigh , adductor compartment of the thigh ... etc)around the bone + followed by reconstruction (reconstruction may be :prosthesis , bone graft , or bone cement) + lastly we do radiotherapy &chemotherapy .
- 2- **Amputation** : is indicated:
 - a. The whole compartment around the bone is involved (e.g. the flexor, adductor & extensor compartment of the thigh). If there the Vessels involved you can do bypass graft
 - b. Pathological fracture.
- 3- in all stages: chemotherapy → surgery → chemotherapy
- 4- survival rate is 80 %

N.B. CHEMOTHERAPY TO AT LEAST ↓ED SIZE OF THE MASS.



3- Multiple myeloma

- Arise from plasma cells in the bone marrow. Plasma cells are responsible for antibodies production (gamma globulins).
- The most common primary malignant tumor.
- Arises from the plasma cells of the bone marrow
- Tumor of bone marrow, occurring in older adults > 50 and predominantly Males.
- **Bence Jones proteins test** found in 24-hour urine collection.
- Disseminates too many parts of the skeleton through the blood stream, thus usually multiple.



■ Site:

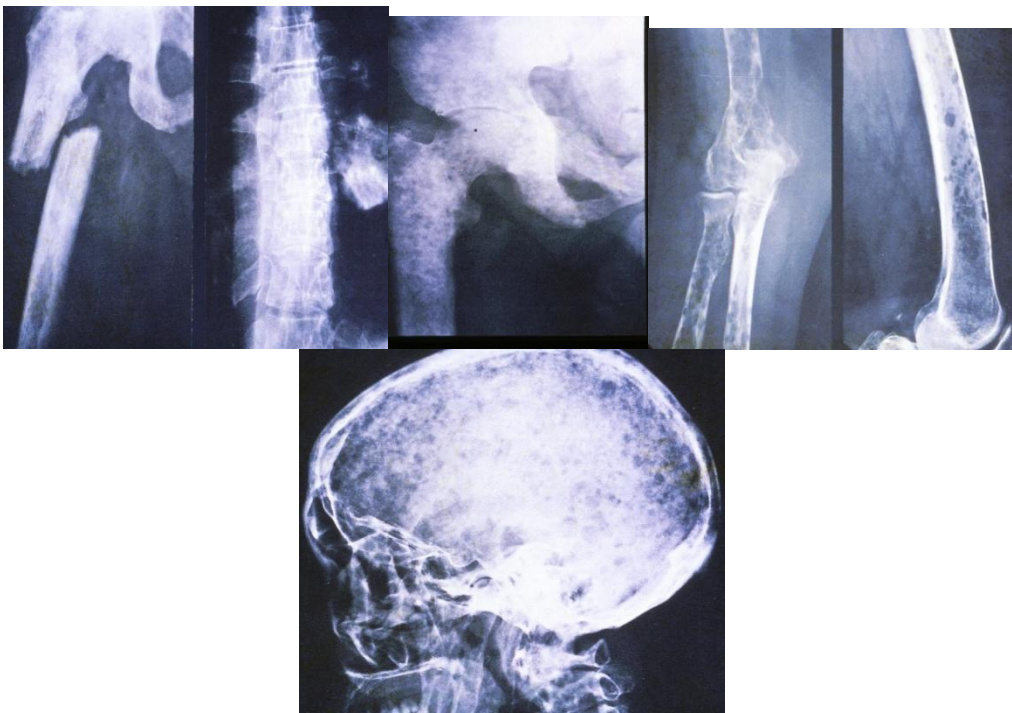
- Central bones (axial skeleton): skull, ribs, pelvic girdle. & spine.
- It may be solitary, multiple (commonest) or generalized osteoporosis (myelomatosis: multiple myeloma + only generalized osteoporosis).

■ Presentation :

- Pt ill (decreased immunity)
- Sclerotic (no more elasticity) so more prone to fractures
- In skull there will be pepper (lytic) & salt (sclerotic)... {if sclerotic → un flexible → easy to fracture) mottled appearance}.
- P.t came with bone ach (backache) + osteopenia.
- More common in periphery than center
- The only one definitive to diagnose it, is Bone marrow aspiration. "Biopsy".

■ Treatment

- Bone marrow transplant
 - Success rate is 30%
 - Cost million \$
 - Radiotherapy.
 - Chemotherapy.
 - The rule of orthopedic surgeon is only when you have pathological fracture → do internal fixation.
- } all 3 done by oncologist.



4- Metastatic lesions

- Tumor outside the bone. The most common tumors are: prostate, thyroid, breast, lung and kidney.
- More than 45 in age, F>M.
- More common than primary tumors in later adult life.
- Affect SAME SITE which affected by multiple myeloma.
- Take biopsy to know where is the primary
- If there is fracture do curettage first then fixation.

■ Presentation :

- Patient present & primary tumor is known & the patient is treating from it.
- May present with secondary metastasis. So, we have to search for the primary and try to treat it.
- Usually metastasis occurs in the highly vascular bones e.g. vertebral body, ribs, pelvis, upper end of femur, and humerus.

■ Radiological feature :

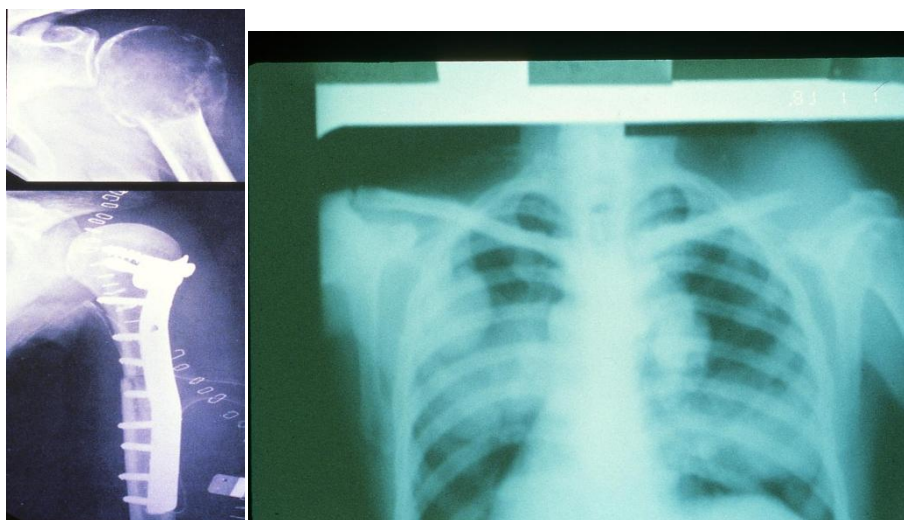
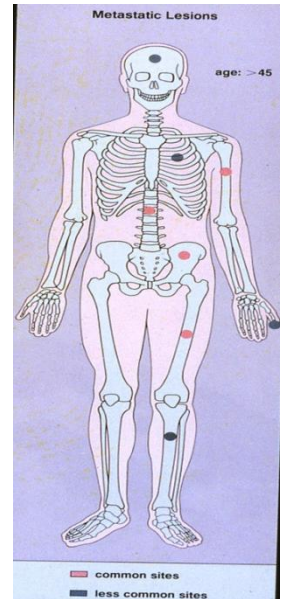
- It may be solitary or multiple (common) or just osteoporosis (called carcinomatosis).
- It differs from multiple myeloma because it may present with lytic or sclerotic lesion while the M.M only present with lytic lesion.
- If the primary tumor is from the **prostate** → the lesion will be **sclerotic**.
- If the primary tumor is from the **breast** → the lesion will be **lytic**.

■ Investigation :

- Same as Multiple myeloma
- X-ray shows decreased bone density (bone eaten away) with thinning of the cortex. Resembles bone cysts but the age group directs the diagnosis.
- Metastasis usually of the lung → sarcoma
- CT- scan of the chest performed for definite diagnosis.

■ TREATMENT :

- Same as Multiple myeloma



Some IMP Notes From 427

All bone tumors all metaphyseal except:

- 1- Osteoid osteoma: metaphyseal + diaphyseal.
- 2- Enchondroma: metaphyseal + diaphysis.
- 3- Chondroblastoma + giant cell tumor: epiphysis.
- 4- Ewing's sarcoma: diaphyseal tumor.

Most of the tumor occurring in children or growing age (>25) except:

- 1- Osteoid osteoma: 10-35.
- 2- Osteoblastoma: 10-35.
- 3- Osteochondroma: 10-35.
- 4- Enchondroma: 15-40.
- 5- Giant cell tumor: 20-40.
- 6- Multiple myeloma & metastasis: old age >50.

Most of the tumor occurs more common in male except:

- Giant cell tumor: F>M.
- MULTIPLE myeloma +metastasis: f >m
- Simple bone cyst +ABC+ enchondroma: F=M.

Benign tumor that may transfer to malignant:

- 1- Osteoblastoma.
- 2- Osteochondroma.
- 3- Giant cell tumor.
- 4- Chondromatosis.

- Metastatic tumor more common than primary tumor.
- Most common primary benign tumor: osteochondroma.
- Most common primary malignant tumor: multiple myeloma then osteosarcoma.

Important tumors (study them very well)

- 1- Simple cyst.
- 2- Know the difference between osteblastoma& osteoid osteoma.
- 3- Enchondroma&condroblastoma : على الطاير
- 4- Osteosarcoma: أهم شي
- 5- Ewing sarcoma: pay attention to its presentation.
- 6- Multiple myeloma: pay attention about it investigation.

Orthopedic investigations

◆ Radiological

- Non invasive
- Simple
- Almost needed
- Quick answer
- Types:
 - X-rays
 - CT Scan
 - MRI
 - Bone scan

❖ X-rays

- Whole bone
- Two views
- Two joints
- Two occasions (in pediatric cases)

✓ Notes :

- AP & Lateral: Angulation is not clear in lateral
- In pediatric: for example a fracture near the growth plate area, not obvious initially. However, on a second occasion (for example a week has passed and the patient is still on pain), there will be a callus formation indicating a fracture in the formerly thought normal-looking area.

❖ CT Scan

- Some times
- Some cases which is
 - Complicated
 - pelvic fracture
 - Intra articular
 - Others
 - Advanced
 - Tumors
 - infection

❖ MRI

- For soft tissue
- No radiation
- Cases
 - Ligament injury
 - Tumors
 - infection

❖ Bone scan

- Screening for skeletal lesion
- Some cases
 - Tumor
 - infection
- **Note:** Does not diagnose, just locate the abnormality. Diagnosis is by MRI & CT.

◆ **Non Radiological**

- Blood
- Biopsy
- Aspiration
- Arthroscopy
- **Note:** Biopsy is for bone, while aspiration is for joint.

❖ **Blood**

- CBC
 - HB
 - WBC
 - Nutrophils
- ESR
- CRP
- Blood culture

❖ **Biopsy**

- Why?
 - Tumor
 - Infection
- How?
 - Orthopedic surgeon supervision and decision
 - Complete aseptic technique
 - Pre op planning
- **Note:** The biopsy is done in the same area planned for near-future operative incision.

❖ **Aspiration**

- From joint
- Why?
 - Infection
 - Malignancy
- How?
 - Aseptic technique
 - Orthopedic supervision
 - In ER or OR?

✓ **Notes:**

- Joint fluid:
 - Normal: transparent/clear + viscous (for example, raw egg whites)
 - Full of puss → indication for surgery
 - Turbid: check for the type of infection + WBCs...
- Hip joint aspiration must be done in OR

❖ **Arthroscopy**

- To the joints
- Visualizing the joint from inside
- Diagnostic vs. therapeutic

OSTEO-ARTHROSIS

- Osteoarthritis (OA) is non-inflammatory degenerative disorder of synovial joints, affecting the articular cartilage.
- The changes in the synovium in OA are secondary to articular cartilage lesions, in contrast to Rheumatoid Arthritis, where the primary lesion is in the synovium).
- Rheumatoid Arthritis starts first with an inflammation in the synovium.

OA has two types:

1) **Primary OA:** → like congenital defect in the cartilage.

- **Idiopathic**
- Usually hereditary problem
- **Usually bilateral and commonly seen in old ages.** More common in the upper limbs (Generalized osteoarthritis)

2) **Secondary OA:**

Local or systemic causes are present. E.g. trauma, infection, congenital disorders, bleeding disorders, Wt. load, etc.

Note:

- Secondary OA is more common in our community than western countries, and more common in females due to obesity and lack of activity (sedentary lifestyle).
- Presentation tends to be at an earlier age in females.
- OA of hip or knee is often secondary OA.
- Obesity is considered to be a cause of secondary OA.
- It is usually a mono-arthritis, but in the knee it may be bilateral.
- Upper limbs are less likely to be affected than lower limbs due to less stress.

Predisposing Factors:

1. **Increased load** e.g. Obesity (N.B. the hips & knees takes 3.5 times the body weight each, with each step). In jogging and squatting the cartilage take a high stress.
2. **Trauma** e.g. Intra-articular fracture, ligament injury, etc.
3. **Congenital Disorders** e.g. Developmental Dysplasia of the Hip.
4. **Infections** e.g. *Septic Arthritis*.
5. **Inflammation** e.g. *Rheumatoid Arthritis*.
6. **Necrosis** e.g. *Perthes' disease*, steroid injured, and Avascular Necrosis.
7. **Hematological Disorders** e.g. *Hemophilia* (due to recurrent *Hemarthrosis*) & *Sickle Cell disease* (most commonly in the hip & shoulder due to arteriolar occlusion).
8. **Metabolic disorders** e.g. crystal deposition diseases {such as **Gout** → usually affects small joints (hand & feet joints). **pseudogout** (calcium pyrophosphate deposition) usually affects large joints (knee)}
9. **Endocrine disorders** e.g. *Diabetes Mellitus* & *Acromegaly*.
 - **Diabetes Mellitus → Neuropathic OA is a rapidly progressive degeneration in a joint which lacks proprioceptive & protective pain sensations → the joint will heal by itself, unorganized healing → leading to completely unorganized destroyed painless joint "Charcot's Joint" → severe osteoarthritis**

Charcot joint: progressive degeneration of a weight bearing joint, a process marked by bone destruction, bone resorption, and eventually deformity.

- 10. Neuropathy**, Examples in the lower limb include: DM, *Syphilis* & *Tabes Dorsalis*; while in the upper limb it is usually due to *Syringomyelia*.
- 11. Occupation that commonly predispose to trauma in manual workers.** Indirect cause of osteoarthritis.
- 12. Hereditary factors** e.g. *Multiple Skeletal Dysplasia* & Primary Generalized OA.

Note:

- **Primary Generalized OA has two types: nodal & non-nodal**
- **Nodal affects small joints of the hands → heberden's and bouchard's nodes.**

Epidemiology:

- Common in Saudi Arabia especially in the knees (most common site **in our community**) → valgus deformity (60% of the weight is on the medial side of the knee)
- In western countries, the hip is most commonly affected. 90% of individuals over 40 years have degeneration of weight bearing joints (though asymptomatic and more common in males, however after the age of 50 → females are more commonly affected)
- In KSA, females are the most commonly affected in all age groups and at a younger age.
- Normal degeneration due to age usually starts in the 30's and is affected by exercise and activity, usually starts in the lumbar spine called "**orthoscopic finding**".

Common Affected Joints:

1. **Knee** Medial compartment of the knee (patella-femoral joint) is more prone to undergo degeneration than the lateral aspect.
2. **Hip**
3. **Cervical & Lumbar spine.**
4. **Small joints of the hand and feet.**

Note:

- **Shoulder OA is not commonly seen except in case of secondary OA, especially due to *Rheumatoid Arthritis* & *Sickle Cell* disease.**
- **Gout affects small joints while psuedogout affects larger joints. (psuedogout shows 3 joint lines in x-ray images due to calcium pyrophosphate deposition).**

PATHOLOGY**Cellular Changes:**

- **Water content of cartilage normally is 80-85%, the rest being matrix. This in turn helps for distribution of forces on the joints.**
- 1. The first initiating event is possibly fatigue fracture of the collagen fiber network in the cartilage matrix (N.B. The collagen matrix consists of collagen fibers embedded in a firm, hydrated gel of proteoglycans & structural glycoproteins).
- 2. Swelling and softening of the cartilage follows. (Due to increased water content → thinning of synovial joint → reduced shock absorber).
- 3. Then, gradual depletion of proteoglycans in the matrix happens.
- 4. Proteoglycan depletion results in abnormal distribution of body weight over articular cartilage, leading to chondrocyte damage.

Group A1

5. Proteolytic enzymes are released from damaged chondrocyts resulting in more destruction of collagen fibers. (Not the primary factor of OA).
6. Fibrillation on weight bearing surfaces of the cartilage ensues.

Long story short:

- Disturbed balance of matrix and water in the cartilage → water content decreases → results in decrease in proteoglycans → loss of ability of recoiling → cartilage becomes softer → loss of distribution of forces → more stress (force) on a single point in the joint → secondary inflammation.

- **Subchondral Cyst formation.** Synovial fluid will be pumped into sub-chondral bone through fissures in the articular cartilage “cyst formation” especially in areas of greater stress.
- **Subchondral Bone Sclerosis.**

Note: Fissuring occurs in cartilage. sclerosis occurs in bone.

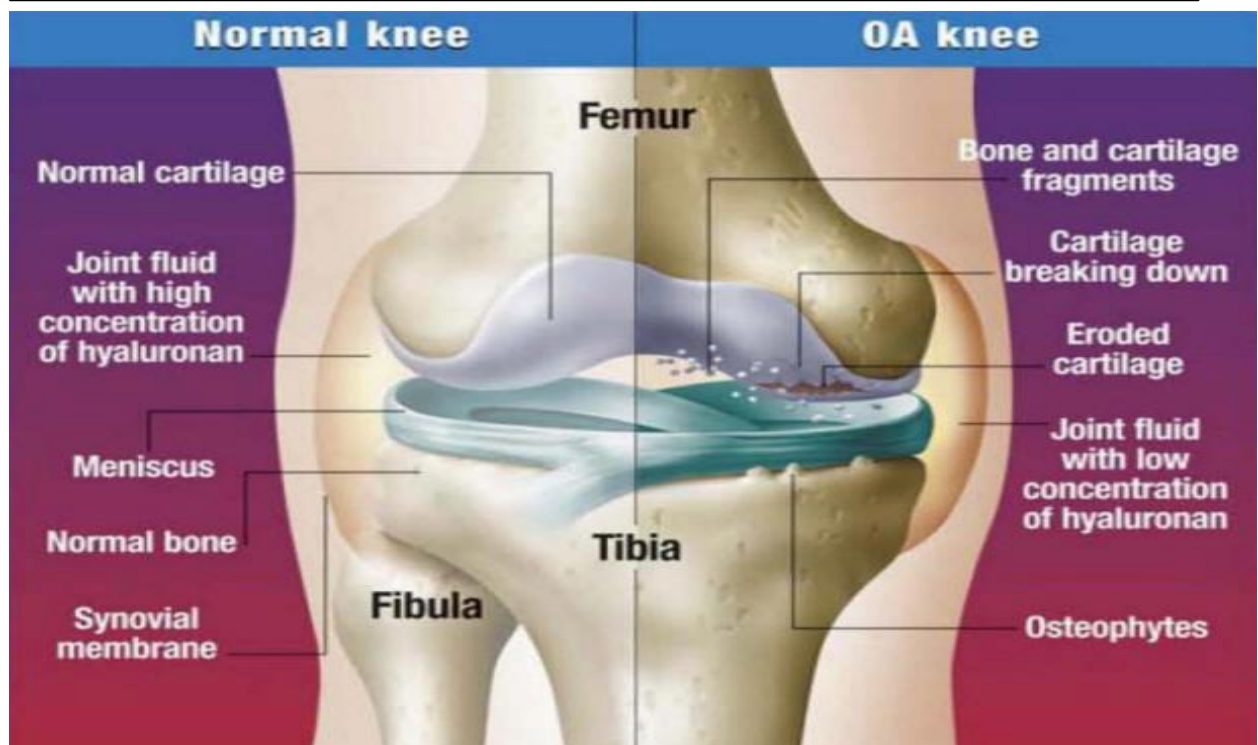
- **Osteophyte Formation at the periphery of the joint.**

Sequence of events:

- 1- Flaking and fibrillation of cartilage.
- 2- Cartilage erosion and decreased joint space.
- 3- Peripheral areas of unstressed cartilage ossify and forms osteophytes.
- 4- Synovial and capsular thickening.
- 5- Progressive weakening of sub-chondral bone leading to bone collapse & deformity.
- 6- Distortion of the ligaments may happen → mal-alignment and subluxation of the joint.

Remember In the knee, the most common deformity “in *Osteoathrosis*” is **Varus** due to ligament laxity.

- Lateral Thrust → Is a clinical presentation of the patient with OA.



CLINICAL FEATURES

Symptoms:

1) Pain:

- It is the main presenting symptom. (MCQ)
- It is also the main indication for surgery.(MCQ)→ **The indications for surgery: (MCQ)**
 1. Pain (90%)
 2. Sub-laxation
 3. Severe bone erosion
- Nature: it is aggravated by activity and relieved by rest early in disease.
- Relation of pain to stairs, praying & sitting.

2) Stiffness:

- At early stage, stiffness will be in the morning & after prolonged rest because of stasis & congestion around the joint capsule. Later on, stiffness will be more severe & may become continuous.

3) Deformity:

- Fixed flexion deformity.
- Varus or valgus in the knee (the usual deformity is varus; if it is valgus, you have to think about associated Rheumatoid Arthritis, or history lateral meniscal injury).

4) Instability: “giving away”

- E.g. instability of the knee due to degeneration and rupture of the anterior cruciate ligament, or quadriceps weakness.

Stages of symptoms of osteoarthritis:

- 1) Morning stiffness
- 2) Pain on activity
- 3) Pain at rest
- 4) Pain at night

Signs:

- 1) **Swelling** (due to effusion, synovial & capsular thickening and/or Osteophytes). Effusion in the suprapatellar pouch.
- 2) **Painful movement.**
- 3) **Decreased range of movement** (active & passive). (OA of patella-femoral joints results in decreased mobility of patella)
- 4) **Locking sign**, in movement (inability to continue extension or flexion)
- 5) **Crepitus** (due to rough articular surfaces).
- 6) **Instability.**
- 7) **Deformity.**
- 8) **Painful mcmurray’s test.(knee OA)**
- 9) **Nodules. (heberdens and bouchards nodes in the hand (OA of hand)**
- 10) **Positive Trendelenburg’s test (hip OA)**



INVESTIGATIONS

X-Ray:

- AP & Lateral standing views are needed especially in case of hip or knee OA.
- Skyline (or Axial) view should be obtained in knee OA to show patello-femoral joint. (important in knee imaging to look at osteophytes and joint space, and subluxed patella)
- All three views must be obtained.
- X-ray features of OA:
 - 1) Narrowing of joint space.
 - 2) Subchondral sclerosis.
 - 3) Bone cysts.
 - 4) Osteophytes.
 - 5) Mal-alignment (e.g. Varus deformity).
 - 6) At the end stage:
 - Subluxation.
 - Bone erosion.
 - Loose bodies.
 - Tilting of the patella.
 - 7) Evidence of primary cause in secondary OA may be present e.g. old fracture, Rheumatoid Arthritis, etc.

- X-ray is imaging of choice.
- Synovial fluid rarely taken for analysis (proteins, glucose, cell count)
- Complete blood count usually normal

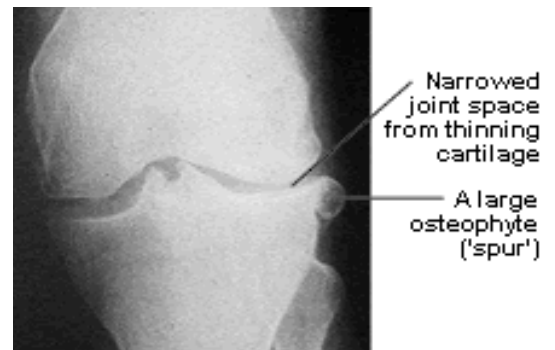


Figure 4. X-ray of the knee joint showing osteoarthritic changes (front view of left leg)



Figure 1

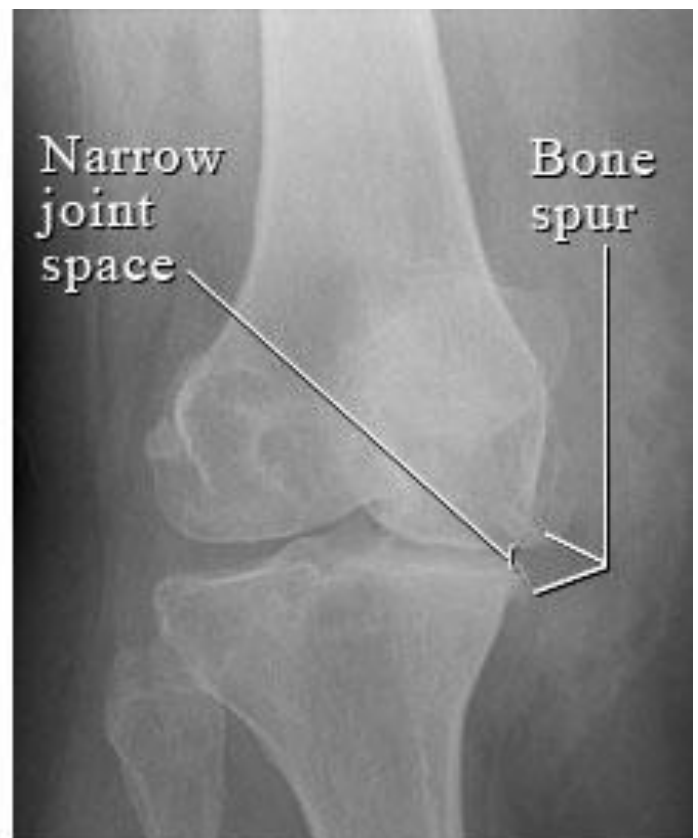


Figure 2

TREATMENT

Available measures of treatment:

A) Conservative treatment.

B) Surgical treatment:

- 1- Arthroscopic debridement.
- 2- Osteotomy.
- 3- Arthrodesis.
- 4- Arthroplasty.

Aims of treatment:

- 1- Relieve pain.
- 2- Increase range of movement.
- 3- Reduce load.

A) CONSERVATIVE TREATMENT

- **Weight reduction** in obese patients.
- **Load reduction** especially in obese patients: can be achieved by using walking stick [external support. Used by the opposite hand to the affected leg (strengthen the muscle)]
- **Physiotherapy** → **the most effective conservative** (including muscle & range of movement exercises & modify the activities) this is aimed at:
 - 1) Strengthening the muscles around the joint to take off some load from the affected joint, therefore decreasing the pain and slowing the progression of the disease.
 - 2) Increasing the range of movement of the diseased joint.
- **Medications:**
 - Systemic drugs: at first, *Paracetamol* is used as an analgesic; if not effective **NSAIDs** can be used.
 - Local injections:
 - 1- Hyaluronic acid injections:
 - Major constituent of synovial fluid and serves as a lubricant & shock absorber. It changes the environment around synovial cells → causes' natural secretion of synovial fluid.
 - Effective in patients with mild to moderate X-ray changes (no bone erosion, subluxation nor many osteophytes).
 - A course of 3 injections are given
 - Adverse effects include:
 - 1- Hypersensitivity especially if derived from birds.
 - 2- Local reaction at the injection site.
 - 2- Steroid injections:
 - Always try to avoid them except in case of very acute exacerbation of pain
 - Adverse effects: accelerate progression of disease → osteonecrosis of the joint.

IMP:

Scenario: A schoolteacher came to the ER complaining of right knee pain. She weighs 85 kg and she's 160 cm tall. Knee pain is aggravated by walking and relieved by rest. The knee is in Varus deformity. Management:

- Weight loss → 10-15 kg.
- Physiotherapy → Quadriceps (Vastus Medialis Obliquus) strengthening.
- Pain control with mild anti-analgesics. Start with paracetamol
- Modification of activity: guide to help her in work and go up the stairs.
- ❖ If anti analgesic is not improving the pain and the x-ray shows joint space narrowing (severe osteoarthritic changes), administer NSAIDS for short period (2-3 months) + modify activity + use cane → **corticosteroid injection** would be efficient if cartilage is **severely and acutely degenerated**. Hyaluronic acid is given nowadays in a course of 3 injections.

B)SURGICAL TREATMENT

1. Arthroscopic Debridement: “join lavage”

- Consists of washing the joint, diluting the proteolytic enzymes, removing osteophytes & shaving irregular surfaces.
- Used in moderate OA (bone is not exposed yet).
- Used for temporary treatment in Knee OA.

2. Osteotomy:

- To realign the deformed joint (e.g. varus/valgus in the knee (**10° valgus instead of 7° valgus**), abduction/adduction in the hip) in order to decrease pain & slow the progress of the disease by:
 - Redistribution of body weight to less damaged parts of the joint.
 - Vascular decompression of subchondral bone.
- **Used mainly in:**Hip&Knee

- **Indications:**

- 1- Very narrow joint space but not complete loss of the space, many osteophytes and/or severe night pain.
- 2- Failed arthroscopic debridement.

- **Conditions:**

- ✓ Young (< 55 years).
- ✓ Thin to reduce the post-surgical complications such as bone collapse, in addition to the problems of prolonged rehabilitations).
- ✓ Active.
- ✓ Joint must be Mobile.
- ✓ Joint must be Stable.
- ✓ Minimally deformed joint.

Note: There must be overcorrection of the deformity in order to decrease the load on the damaged part of the articular cartilage. For example, the knee is normally in slight physiological valgus (about 7°) and therefore about 60% of the weight is on the medial side of the knee, while 40% is on the lateral side. In case of 10°varus deformity of the knee, the amount of correction should be 10° + 7° + 3°. “Overcorrection” = 20° (now, 40% of the weight will be on the damaged medial side & 60% on the lateral side)

3. Arthrodesis: for **youngers as they’re more active**, because total replacement will fail in such a patient.

- **It is surgical fusion of a joint aimed at:**
 - Conversion of painful stiff joint to painless stiff joint.
 - Stabilizing a joint in a functional position.
 - Performed on axial and peripheral joints.
 - Good prognosis
 - Distributes force on distal and contralateral joints.
 - 15 years after surgery patient will present with recurrent osteoarthritis of a joint distal to the previously affected (arthrodesis) joint due to the stress exerted on it.
 - Hip arthrodesis is performed in chronic hip infection typically Tuberculosis because Arthroplasty could not be done.

- **Indications:**

- Infection (part of treatment of joint infection is stabilization)
- Neuropathic
- Stiff painful joint (sickle cell disease)
- Paralytic joints. (knee: quadriceps paralysis e.g. poliomyelitis)
- Failed total joint replacement
- Flail joint

- **Contraindications:**

- Bilateral osteoarthritis
- Ipsilateral osteoarthritis
- Sickle cell anemia.

- **Disadvantages:** It transfers the load to the most distal joint leading to secondary OA of that joint.

4. Arthroplasty:

- **There are 3 types:**

- Excisional arthroplasty. → Used as a mode of treatment of small joint of the hand and foot & in large joint “hip & knee” if there’s infection.
- Partial replacement.
- Total replacement.

A) Excisional arthroplasty: → It gives a good range of motion.

- Means removing part of a joint to create a gap at which movement can occur. It is aimed at allowing painless movement at the expense of stability (pseudoarthrosis).
- Results in a freely mobile pseudojoint. (IMP)

- **Used in:**

- 1st Carpo-Metacarpal Joint (CMJ).
- Metatarso-Phalangeal Joint (MTPJ).
- Post infection in the hip “Girdlestone’s Arthroplasty” & the knee.

- **Indications:**

- 1- Severely stiff & painful joint especially in hand & foot. Like RA
- 2- Post infection in the hip & knee. “selected”

B) Partial replacement “Hemiarthroplasty”: → In general, not for inflammatory, nor infection

- Means replacing part of the joint (either one articular surface as in the hip, or one joint compartment as in the knee).

- **Used in:**

- Hip fractures
- Shoulder
- Knee.
- Subcapital fracture of the femur neck.

Group A1○ **Indications:**

- 1- Necrosis.
- 2- Trauma.
- 3- Degeneration.
- 4- Inflammation (only for the shoulder; because total replacement of the shoulder easily ends with loosening).
- 5- Shoulder and hip traumatic injuries (grade 4)
- 6- Rheumatoid Arthritis of the Shoulder

○ **Contraindications:**

- 1- Infection.
- 2- Rheumatoid Arthritis (except the shoulder “non-weight bearing”) (MCQ)
- 3- Young patients (especially in the weight bearing hips & knees; because the prostheses need to be changed)

Note: acetabulum & glenoid should be in good condition before considering hemiarthroplasty in the hip or shoulder. Similarly, one compartment should be normal in the knee joint. Therefore, hemiarthroplasty cannot be used in case of hip OA, because both joint surfaces are affected, also should not be used in the knee if both compartments are affected. (MCQ)

C) Total replacement:

- Means replacing both surfaces of a joint. It is aimed at realigning the joint in order to decrease pain & increase movement.

○ **Used in:**

- Hip & Knee (most common joints).
- Shoulder (not advisable; see above).
- Elbow.
- Ankle.

○ **Indications:**

- 1- Severe Pain.
- 2- Stiffness.
- 3- Deformity (with pain & stiffness).
- 4- Old patients (> 50 years).
- 5- Obese

○ **Contraindications:**

- 1- Infection (**Acute T.B.**)
- 2- Neuropathic OA (see above).
- 3- Loss of extensor mechanism. (**Paralytic**)
- 4- Relative contraindications (i.e. you have to look for other options before considering total replacement):
 - a) Young patients (see above).
 - b) Active & athletic patients.

Note:

Consider goals of the patient (occupation/lifestyle)
Loosening, mal-alignment & bone erosion are the end stage to be reached by all prostheses
Exclude infection in any case of loosening of the prosthesis.
The patient should not overstress the prosthesis by participating in contact sports or other stressful activities.

Imp (Surgical Interventions)

Scenario1: Patient with total varus deformity, osteophyte formation, subchondral sclerosis in the joint, overweight, >50 years, night pain, not responding to anti-analgesics and corticosteroid injections came for treatment → DO surgery!!

Corrective Osteotomy: to realign a joint, useful mainly in the knee to correct varus or valgus deformity

- Main aim is to divert the weight to the lateral compartment of the knee. (Conditions: mobile knee, <60 years, stable, and minimally deformed)

Scenario 2: 70 year old female patient presenting with big toe pain, restricted motion of toe. X-ray shows osteophyte formation and subchondral sclerosis. She has no deformity of the foot, yet, clear presentation of Osteoarthritis. What to do?

Arthrodesis: elimination of the joint by fusion. Particularly hands and feet.

Scenario 3: 65 year old obese patient presenting with severe pain in the knee which prevents him from sleeping at night, severe stiffness and a joint deformity. What to do?

Total arthroplasty:

- Used for extremely painful and stiff joints with severe deformities in an obese with many other complications. Total arthroplasty is considered. → **causes limitation of movement.**

Metabolic Bone Disorders

◆ Introduction:

❖ Orthopedic Surgeons and Bone:

- Orthopedic surgeons have to deal with all types of bone : healthy or diseased; and that's why they have to know about bone metabolism
- Bones in the body protect vital organs
- Bones give support to muscles and tendons
- Bone may become weak in certain conditions

❖ Bone is a living structure:

- There is a continuous activity in bone during all stages of life
- There is continuous bone resorption and bone
- Formation as well as remodeling
- That means bone is not only for protection and support but its contents play an important part in blood homeostasis
- Many factors are involved in this process

❖ Bone Metabolism:

- Bone metabolism is controlled by many factors:
 - Calcium
 - Phosphorus
 - Parathyroid gland
 - Thyroid gland
 - Estrogen
 - Glucocorticoid hormones
 - Intestinal absorption
 - Renal excretion
 - Diet
 - Vitamin D
 - Sun exposure

❖ Bone Structure

- Bone is formed by
 - Bone matrix : which consists of
 - 40% organic : collagen type1 (responsible for tensile strength)
 - 60% Minerals : mainly Calcium hydroxyapatite, Phosphorus, and traces of other minerals like zinc
- Cells in bone : osteoblasts, osteoclasts, osteocytes

❖ Plasma levels:

- Calcium : 2.2-2.6 mmol/l
- Phosphorus : 0.9-1.3 mmol/l
- Both absorbed by intestine and secreted by kidney in urine
- Alkaline phosphatase : 30-180 units/l
- Is elevated in bone increased activity like during growth or in metabolic bone disease or destruction
- Vitamin D level : 70-75 nmol/l

❖ **Parathyroid Hormone (PTH)**

- Production levels are related to serum calcium levels:
- It increases calcium levels in the blood by
 - increasing its release from bone
 - increase absorption from the intestine
 - increase reabsorption from the kidney (also increase secretion of phosphorus)

❖ **Hyperparathyroidism:**

- Primary : Adenoma of the gland
- Secondary : as a result of low calcium
- Tertiary : as a result of prolonged or sustained stimulation = hyperactive nodule or hyperplasia

❖ **Calcitonin :**

- Is secreted by C cells of thyroid gland
- Its secretion is regulated by serum calcium
- Its action is to cause inhibition of bone resorption and increasing calcium excretion by this it causes lowering of serum calcium

❖ **Bone Strength:**

- Bone strength is affected by mechanical stress which means exercise and weight bearing
- Bone strength gets reduced with menopause and advancing age
- Reduced bone density on X rays is called Osteopenia
- Osteopenia is also a term used to describe a degree of reduced bone density, which if advanced becomes Osteoporosis

❖ **Bone Density:**

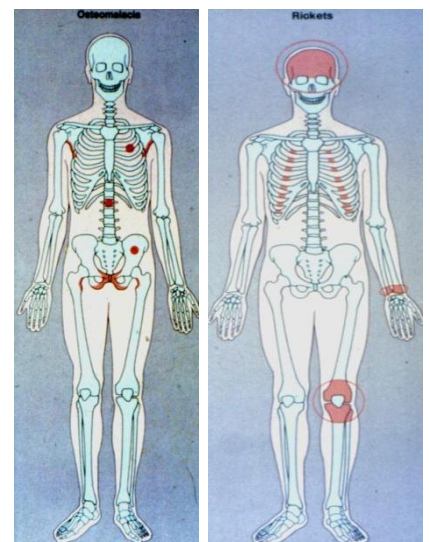
- Bone density is diagnosed at current time by a test done at radiology department called : DEXA scan
- DEXA is (Dual Energy X ray Absorbtiometry)
- Increased bone density does not always mean increased bone strength, as sometimes what is called Brittle bone which is a dense bone is not a strong bone but fragile bone which may break easily

❖ **Rickets & Osteomalacia:**

- ❖ Different expressions of the same disease.
- ❖ Inadequate mineralization. (normal matrix deficiend)
- ❖ **Rickets** : Areas of endochondral growth [*Growth Plate*]
- ❖ **Osteomalacia** : All skeleton is incompletely calcified [*the most is Spine*]

❖ **Causes:**

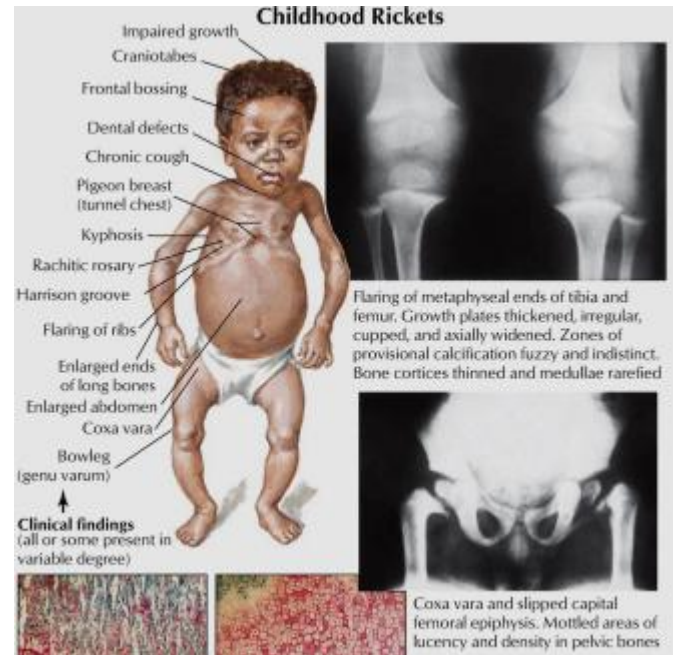
- Calcium deficiency
- Hypophosphataemia
- Defect in Vitamin D metabolism:
 - Nutritional [*especially breast-feeding baby*]
 - Underexposure to sunlight
 - Intestinal malabsorption
 - Liver & kidney diseases



◆ Symptoms & Signs

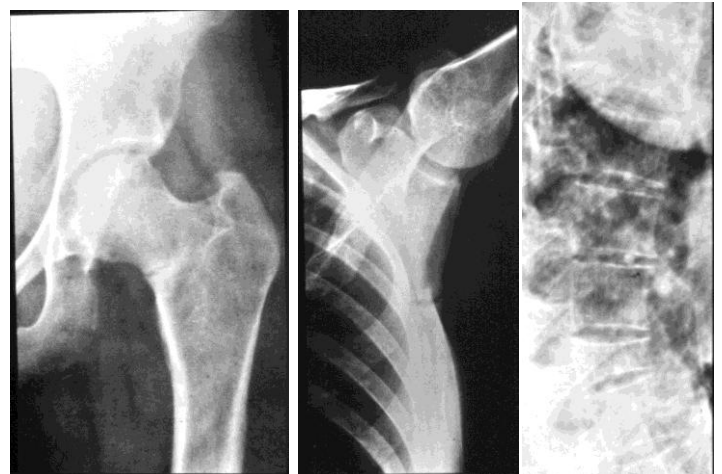
◆ Rickets

- Child is restless, babies cry without obvious reason
- Failure to thrive
- Muscle weakness
- In severe cases with very low calcium: tetany or convulsions
- Joint thickening especially around wrists and knees
- Deformity of limbs, mostly Genu varum or Genu Valgum
- Pigeon chest ,
- Rickety rosary ((thickening of all costochondral joint)),
- craniotabes



◆ Osteomalacia

- Bone pain, mainly backache
- Muscle weakness
- Reduced bone density
- Vertebral changes : Bi-concave vertebra, vertebral collapse , kyphosis
- Stress fractures : Loosers zones in scapula, ribs ,pelvis, proximal femur
- Deformities & stress fractures (pathological)



◆ Biochemistry:

- *Hypocalcaemia, Hypocalcuria*
- *High alkaline phosphatase*

◆ X-rays

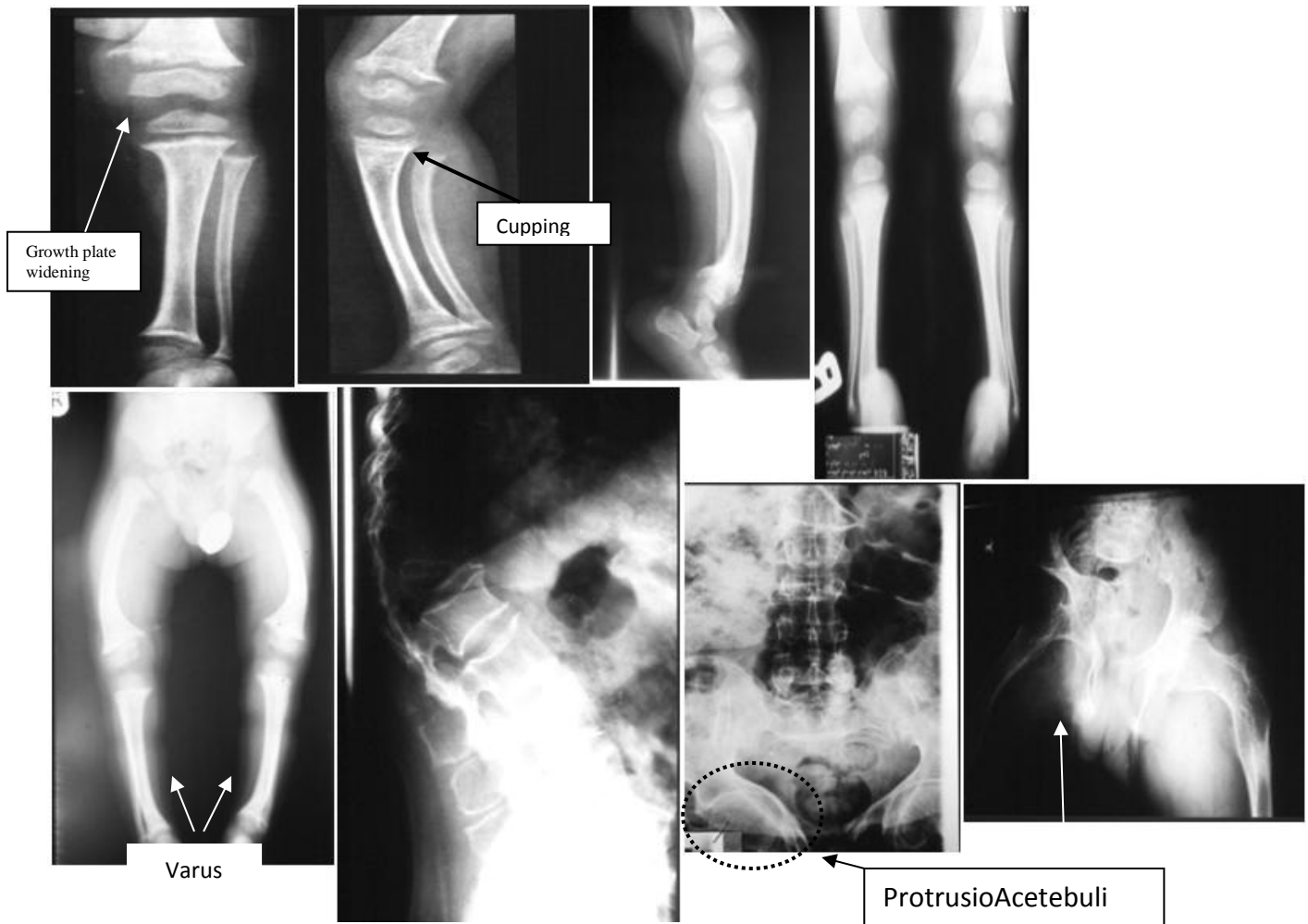
◆ Rickets

- Growth plate widening & thickening
- Metaphyseal cupping to accumulate the growth plate widening.
- Long bone deformities [2y.o. : *varus* / 4y.o. : *Valgus*]

◆ Osteomalacia

- Looser zone , biconcave vertebra , protrusioacetabuli
- Spontaneous fractures. {stress fracture}

- ◆ Signs of secondary hyperparathyroidism: due to prolonged hypocalcemia.

Group A1➤ **Treatment**

- ▣ ***Rickets***
 1. controlled Vitamin D
 2. sun exposure
 3. correct residual deformities
- ▣ ***Osteomalacia:***
 1. Vit. D + Ca
 2. fracture management
 3. correct deformity if needed

◆ **Osteoporosis**

- Mineralisation is not affected
- Decrease bone mass (amount of bone per unit volume) {deficient matrix}
- Mainly post-menopausal and age related

❖ **Primary Osteoporosis :****1- Post menopausal Osteoporosis:**

- Due to rapid decline in estrogen level
- This results in increased osteoclastic activity
- Normal bone loss usually 0.3% per year
- Post menopausal bone loss 3% per year

Group A1- **Risk Factors in Post-menopausal Osteoporosis:**

- Race
- Hereditary
- Body build
- Early menopause
- Smoking/ alcohol intake/ drug abuse
- ? Calcium intake

2- Senile Osteoporosis:

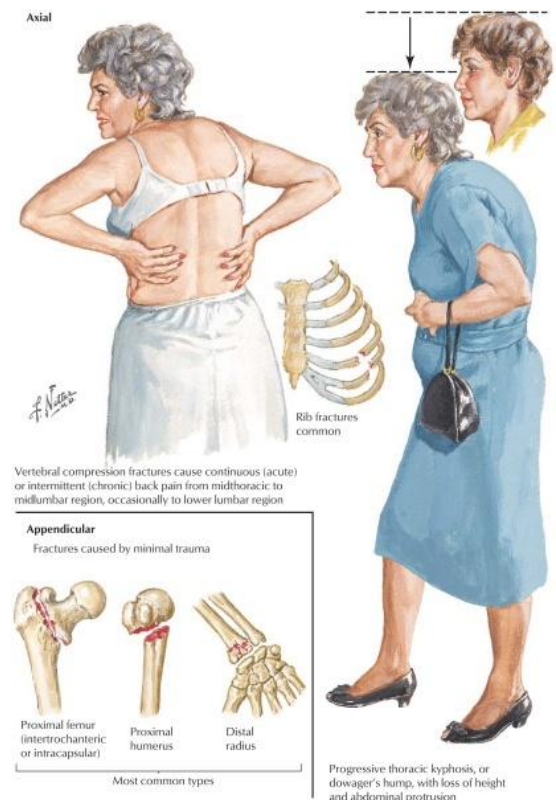
- Usually by 7th to 8th decades there is steady loss of at least 0.5% per year
- It is part of physiological manifestation of aging
- Risk factors in Senile Osteoporosis :
 - Male menopause
 - Dietary : less calcium and vitamin D and protein
 - Muscle weakness
 - Reduced activity

● **Clinical Features of Osteoporosis:**

- Osteoporosis is a Silent disease
- Osteoporosis is Serious due to possible complications :mainly fractures
- Osteoporosis does not cause pain usually
- Osteoporosis causes gradual increase in dorsal kyphosis
- Osteoporosis leads to loss of height
- Osteoporosis is not osteoarthritis; but the two conditions may co-exist

● **Osteoporotic Fractures:**

- They are Pathological fractures
- Most common is osteoporotic compression fracture (OVC #s)
- Vertebral micro fractures occur unnoticed (dull ache)
- Most serious is hip fractures
- Also common is wrist fractures (Colles fracture)

❖ **Secondary Osteoporosis**

- Drug induced : steroids, alcohol, smoking, phenytoin, heparin
- Hyperparathyroidism, hyperthyroidism, Cushing's syndrome, gonadal disorders, malabsorption, mal nutrition
- Chronic diseases : RA, renal failure, tuberculosis
- Malignancy : multiple myeloma, leukemia, metastasis

❖ **Disuse Osteoporosis**

- Occurs locally adjacent to immobilised bone or joint
- May be generalised in in bed ridden patients
- Awareness of and attempts for prevention are helpful

❖ **Prevention of Osteoporosis**

- Prevention of osteoporosis should start from childhood
- Healthy diet, adequate sunshine, regular exercise, avoidance of smoking or alcohol, caution in steroid use
- At some time in the past there was a recommendation of HRT (Hormone replacement Therapy) for post menopausal women ? And men; but now this is discontinued

◆ **Management of Osteoporosis**❖ **Drug Therapy:**

- Estrogen has a definite therapeutic effect and was used extensively as HRT but cannot be recommended now due to serious possible side effects
- Adequate intake of calcium and vitamin D is mandatory
- Drugs which inhibit osteoclast activities : e.g. Bisphosphonates like sodium alendronate FOSAMAX , BONVIVA
- Drugs which enhance osteoblast activities : bone stimulating agents like PROTELOS, FORTEO

❖ **Exercise:**

- Resistive exercises
- Weight bearing exercises
- Exercise should be intelligent to avoid injury which may lead to fracture

❖ **Management of Fractures**

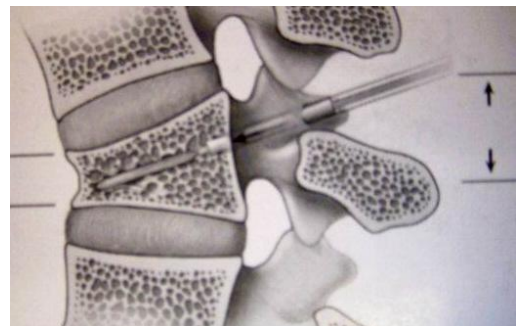
- Use of load shearing implants in fracture internal fixation instead of plating

◆ **Management of OVC Fractures:**

- Pain relief
- Prevention of further fractures
- Prevention of instability
- Vertebroplasty
- Kyphoplasty

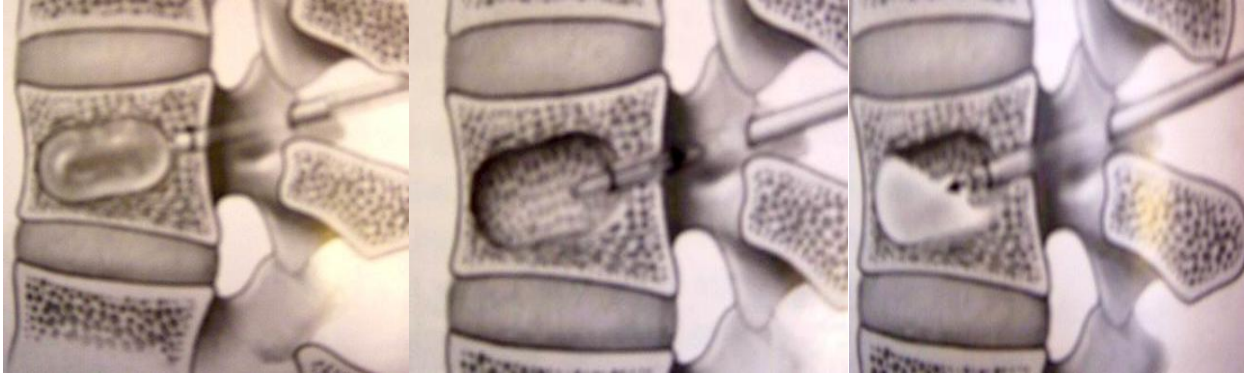
❖ **Vertebroplasty:**

- Is the injection of bone cement into the collapsed vertebra
- The injection is done under X ray control (image intensifier) by experienced orthopedist or interventional radiologist
- It results in immediate pain relief
- It helps to prevent further OVF
- Possible complication is leakage of cement into spinal canal (nerve injury) or venous blood (cement PE)



❖ **Kyphoplasty**

- Is the injection of bone cement into the collapsed vertebra AFTER inflating a balloon in it to correct collapse and make a void (empty space) into which cement is injected
- It is possible that some correction of kyphosis is achieved
- It is safer because cement is injected into a safe void

❖ **Hyperparathyroidism:**

- Excessive PTH secretion : primary, secondary or tertiary
- Leads to increased bone resorption , sub periosteal erosions, osteitis manifested by fibrous replacement of bone
- Significant feature is hypercalcemia
- In severe cases : osteitisfibrosacystica and formation of Brown tumours

❖ **Radiological changes:**

- Generalised decrease in bone density
- Sub-periosteal bone resorption (scalloping of metacarpals and phalanges)
- Brown tumours
- Chondrocalcinosis (wrist, knee, shoulder)

❖ **Management:** "By management of the cause"

- Primary hyperparathyroidism due to neoplasm(adenoma or carcinoma) by excision
- Secondary hyperparathyroidism by correcting the cause of hypocalcaemia
- Tertiary hyperparathyroidism by excision of hyperactive (autonomous) nodule
- Extreme care should be applied after surgery to avoid hypocalcaemia due hungry bones syndrome

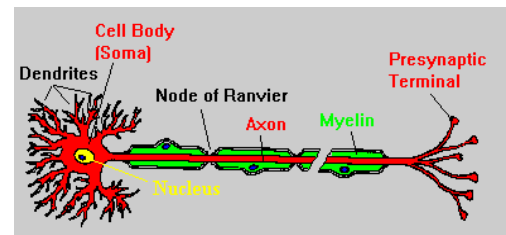
Peripheral nerve injury

◆ What is peripheral nerve?

- It is a nerve which connects between CNS & periphery, with EXCLUSION of cranial nerves.
- It is composed of: cell body, axon & nerve end.
- If the *Cell Body* is Motor: it is located in anterior Horn cell in spinal cord (motor end plate).
- If axon is sensory: it is located in posterior Horn cell.
- Always mixed (contain both sensory & motor fibers) No pure sensory or motor.
- It has the capability of regeneration unlike of CNS.
- Rehabilitation is very important in peripheral nerve injury.

◆ Definition of nerve injury:

- It is Partial OR Complete interruption of normal physiology of the nerves (nerve conduction is affected).



◆ Types:

1-Neuropraxia:

- E.g.: when you set for long time you feel numbness.
- Commonest & easiest in recovery
- Reversible failure propagation of electrical impulses across the affected nerve segment.
- No anatomical change of the nerve structure (anatomy is intact).
- Duration: usually: seconds – minutes.
Rare: hours - days.

e.g.:

- Saturday night palsy: alcoholics → radial nerve palsy
- Honeymooner's syndrome.
- Wheel chair bound persons.

2-Axontemesis:

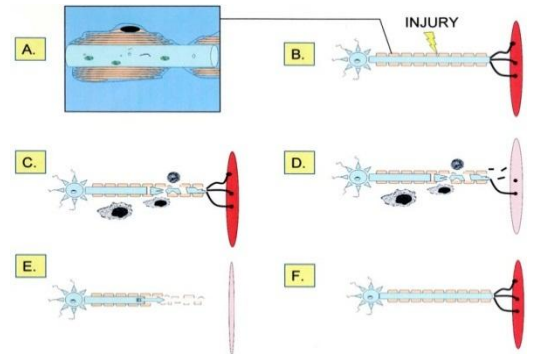
- Complete absence of sensory & motor activity of that nerve
- Associated with accident & trauma:
 - ◆ Fracture of humeral shaft → radial nerve injury
 - ◆ Fracture of medial epicondyle → ulnar nerve injury.
 - ◆ Fracture of proximal fibula → peroneal nerve injury.
 - ◆ Fracture of acetabulum & posterior dislocation of femoral head → sciatic nerve injury.
- No sensation or motion (loss of nerve function).
- Axon + myelin sheath are damaged (histological changes).
- The cell body loses its continuity with nerve.
- Endo, epi, perineum are intact (fascia is intact).
- Anatomy is intact.
- There is Wallerian degeneration.
- Good prognosis.

3- Neurotmesis:

- Anatomical damaged in the nerve (nerve ends are not in continuity) → complete disturbance of activity of that nerve + loss of supporting tissues.
- There is wallerian degeneration.
- Prognosis is poor & worst without surgical repair.

Wallerian degeneration:

- It is a process of proximal part regeneration & distal part degeneration of the nerve regarding to the damage site.
 - Length of regeneration: **1mm/day**. e.g.: if the length of sciatic nerve injury is 50cm → it needs 500 days to recover.
 - During the period of regeneration, if the distal part is not stimulated from outside → lead to atrophy of motor end plate & loss its function. So, you have to stimulate motor end plate by rehab to prevent degeneration of it (**it is not reversible**).
 - If the anatomy is intact (axontmesis) → no need to repair.
 - If the anatomy is disturbed (neurotmesis) → you have to repair. Then wait for regeneration.
- N.B:** if the tunnel is not in continuity that is mean there is no stimulus for regeneration which may cause neuroma (group of N. tissue which doesn't have any function).

**Rehabilitation:**

- Pain control by simple analgesia.
- Nerve & muscle stimulation.
- Dynamic splints to avoid stiffness. (We have to prevent pressure sores).
- Nearby joints range of motion by doing passive movement to prevent muscle stiffness.
- It takes months-years (long time) to recover.

Remember:

- Pressure sores develops due to the pressure of splint in case of complete loss of sensation of the splinted limb.
- You can prevent pressure sores by padding the splint with cotton between splint & limb.

◆ Etiology:**■ Acute:**

- Fractures (the commonest) → axontmesis.
- Wrong position (Saturday night syndrome, handicap) {neuropraxia}.
- Surgery. {neurotmesis}
- Electrical burn (the worst) because it damages everything.

■ Chronic:

- Tight N. passage (e.g.: carpal tunnel syndrome, tarsal tunnel syndrome).
- Tumors which compress the nerve.

◆ Presentation: Pain

- History of trauma.
- Loss of sensation.
- Loss of motion
- Loss of power.
- Loss of reflexes.

Group A1

- Muscle wasting.
- Contractures (deformity).
- Tropic changes: loss of normal well-being of limb due to disuse (shiny skin, hair disturbance.....).

Diagnosis: Confirmed by:

- X-ray: in trauma.
- EMG: study of muscle electrical activity.
- NCS (neural conduction study): study of activity of electricity in the N. itself.
- MRI. (Like in brachial plexus injury so, we use it in special cases).

◆ **Erb's palsy:**

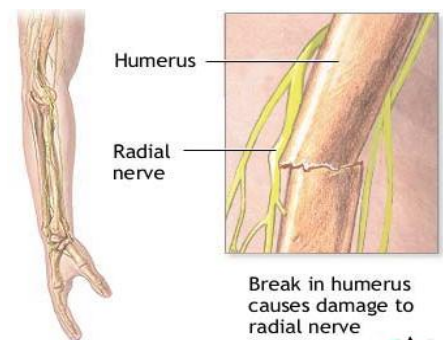
- Birth injury (difficult labor e.g.: shoulder dystocia & breech presentation).
- Traction often on N. roots C5-C6 but may occur on C4-C7-C8.
- Stretch or rupture or avulsion ← the worst.
- Upper limb in extension + internal rotation ← waiter phenomena.
- Mother notices no motion in the affected limb.
- 90% good recovery.
- Remember: rehab. Is important.
- Role of surgery after 3 months of life: explore & repair.
- **Fracture of clavicle does not cause Erb,s palsy.**

◆ **Carpal Tunnel Syndrome:**

- Median N. entrapment due to thickening of flexor retinaculum.
- **Presentation:**
 - Pain, numbness, worse at night & wakes pt. from sleep.
 - Weakness + burning sensation: ↑with bending the wrist forward.
 - It affects:
 - lateral 3½ fingers
 - Thenar area is wasting.
- Female > male: ↑ with pregnancy & hypothyroidism → no explanation.
- ↑in manual workers.
- **Diagnosis:**
 - Clinical.
 - Needs NCS to confirm the diagnosis.
- **Rx:**
 - Conservative (not helpful).
 - No role of medical Rx.
 - Surgical (main procedure for this condition) just open the flexor retinaculum.
 - Immediate recovery post-operatively.

◆ **Radial nerve injury:**

- The common cause: humeral shaft fracture at the junction between middle & lower third.



Group A1

- **Presentation:**
 - Wrist drop (cannot extend).
 - Loss of sensation in snuff box area (numbness).
- Rarely disturbed anatomically.
- **Rx:**
 - Conservative (dynamic splint).
 - Do NCS, if no improvement within 3 months → surgical intervention.



N.B: dynamic splint= splint with joint movement **but** static splint= splint with no joint movement.

◆ Ulnar N. injury:

- Associated with elbow injury + tight compartment.
- Usually in children with supracondylar fracture.
- **Presentation:**
 - Numbness in medial 1½ fingers.
 - Hypothener muscle wasting.
 - In late stage: CLAW hand (extension of MCP +flexion of IPJ) due to loss of lumbrical & interosseous action.
- **Rx:** as in radial nerve.

◆ Sciatic nerve injury: (no loss of hip flexion + Knee Extension)

- With trauma or posterior dislocation of the hip + distal injury to its branches (posterior Tibial + common peroneal).
- **Presentation:**
 - Loss of sensation & motion below the knee level.
 - Loss of all activities (flexion, extension ...) below the knee level.
 - Extension of the knee is not lost.
- Long period of recovery.

◆ Peroneal nerve injury:

- **Presentation:**
 - foot drop → no heel strike= inability to extend the foot.
 - Loss of sensation.
 - Leg weakness.
- **Causes:**
 - Direct injury **is rare**.
 - Tight splint without proper cotton padding.
 - Skeletal traction.
- **Rx:** -skeletal traction.
 - Dynamic splint.

◆ Quiz:

- Axon degeneration occurs from mild compression injury. X
- The prognosis for Neuropraxia is poor. X
- Axonotmesis is generally caused from separation of the cell body from the neuron. X
- Wallerian Degeneration typically does not occur in Neuropraxic injury. ✓
- Surgical reconstruction is necessary in Neurotmesis. ✓
- Wallerian Degeneration does not occur in Neurotmesis. X
- A ligamentous structure can cause Neuropraxia. ✓