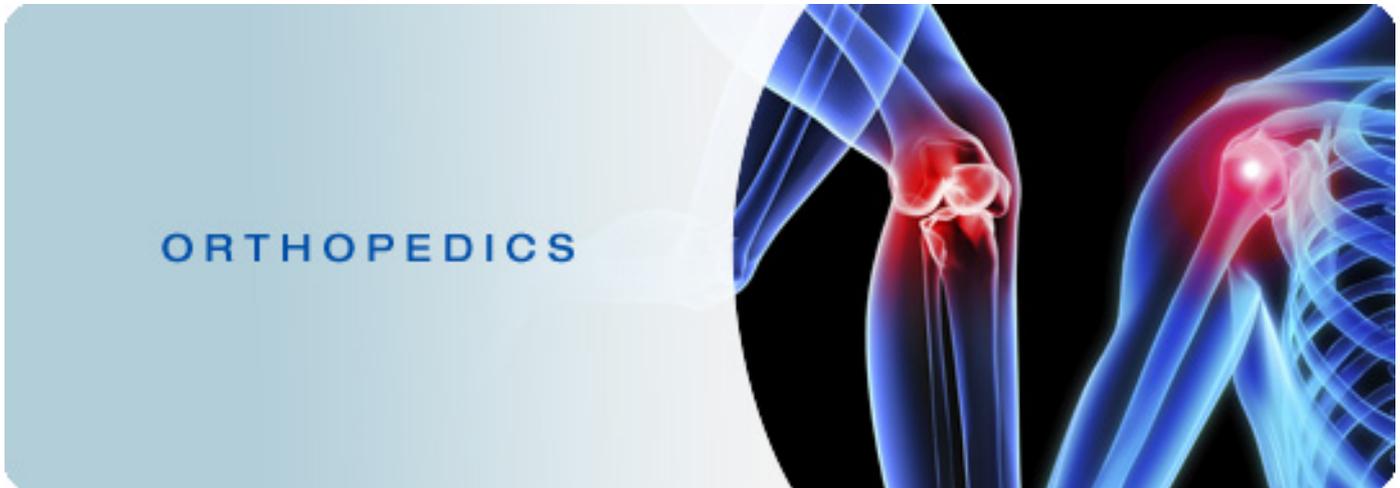


Isn't it funny how someone can say "I believe in Allah " but still follow the Satan who by the way also, " believes " in Allah...

430 ORTHOPEDICS TEAM



Lecture: Compartment Syndrome/Acute Joint Dislocation.

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Team Leader:

Ayedah Al-Ruhaimi

-The slides were provided by the doctor.

-429 team group A-1.

-Important notes in **Red**.

-Copied slides in **Black**.

-Doctor's notes in **green**.

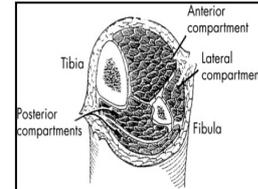
Compartment Syndrome/Acute Joint Dislocation

- **Objectives:**

1. To explain the pathophysiology of CS
2. To Identify patients at risk of developing CS
3. To be able to diagnose and initially manage patients with CS
4. To be able to describe the possible complications of CS

- **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**

1. Elevated tissue pressure
2. Absence of diffusion at the capillary bed
3. Cell damage and swelling
4. Further increase in tissue pressure
5. Lack of oxygenation
6. Vicious circle

- **Threshold pressure: (IMP)**

1. 30 mm Hg (rigid), (Intracompartment pressure)
2. Less than 30 mm Hg difference between compartment pressure and diastolic pressure (clinically relevant)

Note: patient with hypotension they will have high compartment pressure and more to get compartment syndrome.

- **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** : most common factor.

✓ **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):**

1. Head injury → decreased consciousness!
2. Decreased conciseness → late diagnosis
3. Hypotension

✓ **Note** : Unconscious patients can't alert you when they feel pain (due to compartment syndrome). So, check their compartment pressure every hour.

• **Diagnosis:**



• **Early: >> all about pain**

- **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: (IMP)**

- Paresthesia
- Paralysis
- Pallor

• **Severely high pressure:**

- Pulselessness (RARE!)

Note: this happened when the compartment pressure is equal to the systolic pressure.

- **Tight, woody compartment**
- **Tender compartment**



- **Measurement:**

- Rarely necessary
- Must be done at area of highest expected pressure
- May give false low result

- **Management: (IMP)**

- **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



- **Fasciotomy: (IMP)**

- 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: (IMP)**

- 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: (IMP)**

1. Myonecrosis>Myoglobinemia>Myoglobinuria>Kidney tubular damage
2. Loss of function of the involved compartment:
 - Flexion contracture
 - Paralysis
 - Loss of sensation

✓ **Note:**

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.

3. Leg:

- **Anterior compartment:**

- Drop foot

- **Deep posterior compartment:**

- Clowed toes
- Loss of sensation in the sole

4. Forearm:

- Volar compartment
- Volkman contracture

✓ **Notes:**

Volkman'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"

• **Objectives:**

1. To describe mechanisms of joint stability
2. To be able diagnose patients with a possible acute joint dislocation
3. to be able to describe general principles of managing a patient with a dislocated joint
4. to describe possible complications of joint dislocations in general and in major joints such as the shoulder, hip and knee

• **Joint stability:**

1. **Bony stability**

- Shape of the joint (ball and socket vs. round on flat)



2. Soft Tissue:
 - Dynamic stabilizer: Tendons/Muscles
 - Static stabilizer: Ligaments ± meniscus/labrum
 3. Complex synergy leading to a FUNCTIONAL and STABLE joint
 4. It takes higher energy to dislocate a joint with bony stability than a joint with mainly soft tissue stability
 5. Connective tissue disorders may lead to increased joint instability due to abnormal soft tissue stabilizers.
 6. Dislocation of a major joint should lead to considering other injuries.
- ✓ **Notes:**
- Shoulder is round on flat (the glenoid surface persay 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:**
 - **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:**

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

- **Management principles: (Very IMP)**

- Must rule out other injuries
- Pain relief
- Urgent reduction
- Check stability and safety zone
- Check neurovascular status after reduction
- **X-rays after reduction**
- Protect the joint
- Rehabilitation
- Follow for late complications

- ✓ **Notes :**

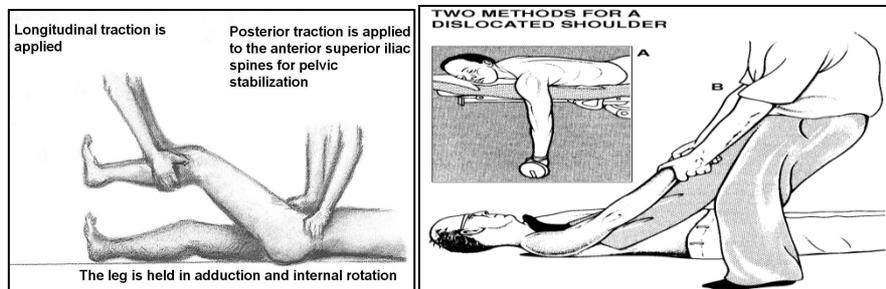
- **Safety zone:** The range of motion with stability (no danger of dislocation) For example, 10 degrees flexion and 20 degrees extension. If the patient goes beyond that, the joint will get unstable and might be dislocated.
- **Neurovascular status** should be checked before and after the reduction.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



• **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: (IMP)**

- Heterotopic ossification
- Neurological injury (reversible or irreversible)
- Vascular injury
- Compartment syndrome
- Osteochondral fracture/injury

- **Note:** Heterotopic Ossification=Myositis Ossificans

- **Late complications: (IMP)**

- Stiffness
- Heterotopic ossification
- Chronic instability
- Avascular necrosis
- Osteoarthritis

- **Note:** Avascular Necrosis in hip dislocation mostly.

- **Special considerations:**

- **Hip joint: IMP**

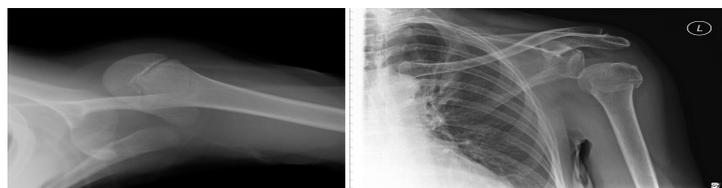
- Posterior dislocation is commonest
- Major trauma with hip flexed (dashboard injury)
- Sciatic nerve injury common
- High incidence of late avascular necrosis
- An orthopedic emergency!!

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



- **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: (IMP)**

- 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:**

1. Popliteal artery is attached to the posterior of the tibia → anterior dislocation of the tibia will stretch the artery → Intimal injury or rupture.

2. when there is a dislocation of knee we do ABI to rule out the injury of Popliteal artery>> when the ABI is abnormal (less than 9) we do angiogram to confirm the diagnosis.(IMP)

