[Color index : Important | Notes | Extra] Editing file link

Acute Joint Dislocation and Compartment Syndrome

Objectives:

★ At the end of this course, students should be able to demonstrate **knowledge**, able to **diagnosis**, and initially **manage** a patient with an **acute compartment syndrome & acute joint dislocation**. This requires the ability to identify, characterize and differentiate through patient inquiry, examination and limited investigation, and outline management of **acute compartment syndrome & acute joint dislocation.**

★ Review Pathophysiology of Acute Compartment Syndrome.

★ Review Current Diagnosis and Treatment.
(Risk Factors, Clinical Findings, Management, Complications).

★ To **describe mechanisms** of joint stability.

★ To be able **diagnose** patients with a possible acute joint dislocation.

★ To be able to **describe general principles of managing** a patient with a dislocated joint.

★ To describe possible **complications** of joint dislocations in general and in major joints such as the **shoulder, hip and knee**.

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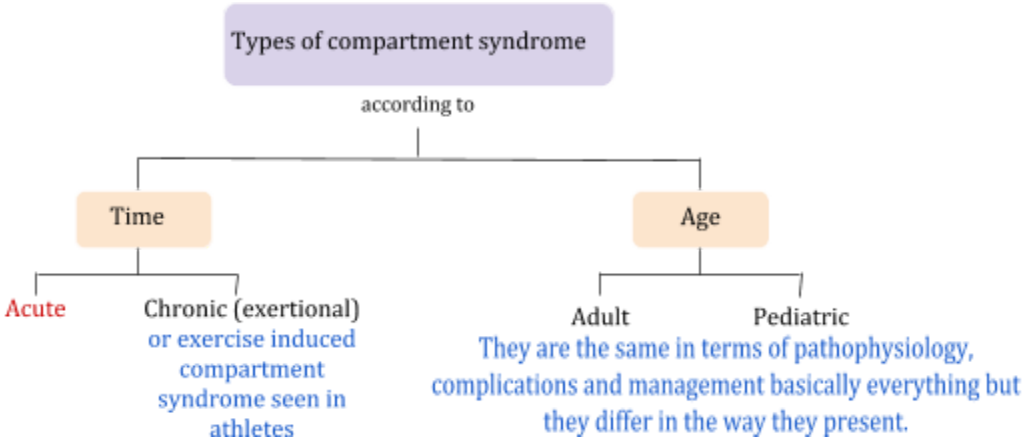
References: 435 Lectures And Notes

Acute Compartment Syndrome

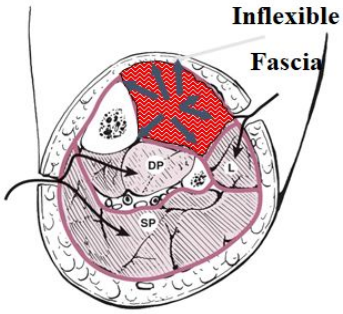


Acute compartment syndrome

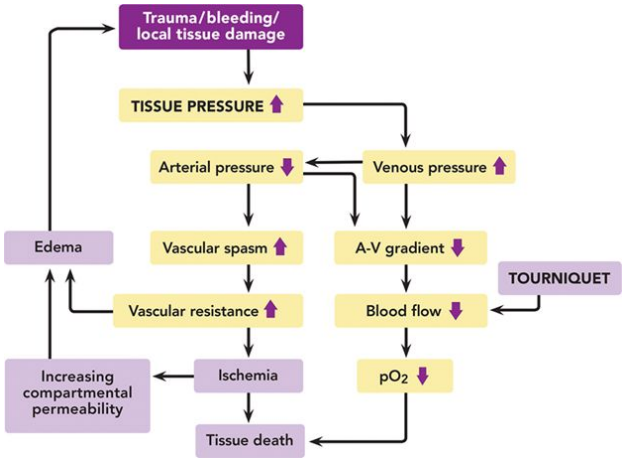
Occurs when the tissue pressure within a closed muscle compartment **exceeds** the perfusion pressure and results in muscle and nerve ischemia. It typically occurs subsequent to a traumatic event, most commonly a **fracture**.

1- Pathophysiology

★ One of the leg compartment (pic). Every compartment is separated from other compartments and is made up of group of muscles surrounded by fascia.



★ Inflexible compartment → Increased intracompartmental pressure → Reduced perfusion pressure → Ischemia and compartment syndrome.



Compartment syndrome is due to a vicious circle

1- Autoregulatory mechanisms may compensate:

★ Decrease in peripheral vascular resistance.
★ Increased extraction of oxygen.

2- As system becomes overwhelmed:

★ Critical closing pressure is reached.
★ Oxygen perfusion of muscles and nerves decreases. because of the high pressure inside compartment!

3- Cell death initiates a "vicious cycle":

Refer to complex chains of events that reinforce themselves through a feedback loop.

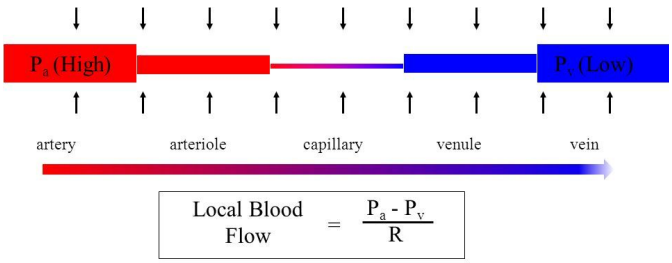
★ increase capillary permeability.
★ increased muscle swelling.

- The end result of the compartment syndrome is ischemia. When there is ischemia and necrosis the cell will swell and thus resulting in an increase in the intra-compartment pressure

Vascular Consequences of Elevated Intra-compartment Pressure:
A-V Gradient Theory

In compartment syndrome there is increase in vascular resistance, increase in venous pressure and decreased arterial pressure. All of these will lead to decreased blood flow.

The local blood flow equal the **difference** between arterial pressure (Pa) and venous pressure (Pv) **divided** by the vascular resistance.



$$\text{Local Blood Flow} = \frac{P_a - P_v}{R}$$

Matsen, 1980

2-Etiology of acute compartment syndrome

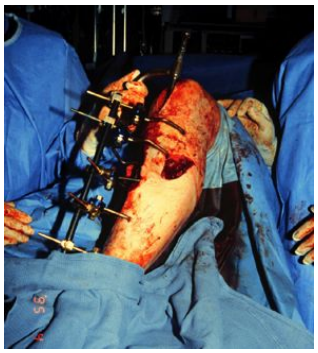
- Decreased Volume (external) → Tight casts / dressings
- Increased Volume (Internal)
  - Hemorrhage in to a compartment (most common)
    - Fracture (most common): Tibia shaft, Supracondylar
    - Bleeding Disorder
  - Swelling from traumatized tissue: Crush syndrome, Soft tissue injury
    - (AKA traumatic rhabdomyolysis or Bywaters' **syndrome**) is a medical condition characterized by major shock and renal failure after a crushing injury to skeletal muscle.
  - Increased fluid: Burns\ Injection
  - Arterial injury
    - Post-ischemic swelling
    - Reperfusion injury:
      - •Ischemia causes damage to cellular basement membrane that results in edema
      - •With reestablishment of flow, fluid leaks into the compartment increasing the pressure.

In reperfusion injury, there is acute cut of blood supply to the tissue following thrombosis or embolus. If it's followed by resumption of blood supply the fluid will leak out of cells into the compartment (ischemia will cause swelling of the cell initially, followed by leakage of fluid out into the compartment after reestablishment of blood flow) and this will cause increase in the intra-compartment pressure causing compartment syndrome. Therefore, any patient with acute artery embolism or acute artery injury with reestablishment of blood flow after **6 hours** of ischemia, we do **prophylactic fasciotomy** because we know if we don't do fasciotomy the patient will develop compartment syndrome.

The most common of acute compartment syndrome is **increase in volume from inside** and the most common cause is hemorrhage secondary to trauma like **fracture** or a minor trauma in a patient with a bleeding disorder (hemophilia) .

Fracture Treatment Increases Intramuscular Pressure (IMP):

Splinting/casting, Manipulation, Traction, Spanning External Fixator, Nailing. Fracture treatment increase the risk of compartment syndrome, and therefore you have to follow the patient after surgery



Incidence of Acute Compartment Syndrome (ACS):

A 10% Calcaneal fractures

B 18% Schatzker VI plateau fractures[1] Tibial plateau fracture

C Supracondylar fracture

D 48% Segmental tibia fractures Segmental fracture = high energy trauma = more risk for having compartment syndrome

53% Medial knee fx/dislocations / 41% foot crush injuries / 2-10% tibial fractures
You have to carefully examine the patient and do serial examination to rule out compartment syndrome

[1] **Schatzker classification** system is one method of classifying tibial plateau fractures.

3- Clinical Diagnosis of Acute Compartment Syndrome

First, Signs and Symptoms	
Adult	Pediatric
Traditionally based on **clinical assessment** of the **5P's**: ★ **P**aresthesia (burning or prickling sensation) ★ **P**aresis (muscle weakness/partial paralysis) ★ **P**ain on stretch ★ **P**ink Color ★ **P**ulse present might be absent but usually present. Physical signs: Pain with passive stretch of muscles in the affected compartment (early finding)/ Firm and tense compartment with a firm "wood-like" feeling If soft unlikely to be compartment syndrome / Pallor from vascular insufficiency (uncommon) / Reduced two-point discrimination or vibration sense. **Muscle weakness (onset within approximately two to four hours of ACS) but, Paralysis (late finding).** Pulses- perfusion- sensation- motors all are considered as late signs	**5P's** are not reliable in children so we use **3A's:** ★ Increasing **A**nalgesic requirement ★ **A**nxiety ★ **A**gitation

Difficult Diagnosis:

Classic signs of the **5P's ARE NOT RELIABLE:**

- ★ These are signs of an **ESTABLISHED** compartment syndrome where **ischemic injury has already taken place.**
- ★ These signs **may be present in the absence of compartment syndrome.**
- ★ Palpable pulses are usually present in acute compartment syndromes **unless an arterial injury occurs.**
- ★ Sensory changes-paresthesias and paralysis **do not occur until ischemia has been present for about 1 hour or more.** Paralysis develops after 8 hours of ischemia = to late

Pain ! This is the most sensitive symptom however this is not 100% accurate because everyone who has injury or fracture will have pain

- ★ The most important symptom of an **impending** compartment syndrome is **PAIN DISPROPORTIONATE TO THAT EXPECTED FOR THE INJURY** patient keeps crying from pain, asking for more analgesia and **PAIN WITH PASSIVE STRETCH.** with acute compartment syndrome the muscle is ischemic and thus very sensitive to stretching, whenever you stretch the ischemic muscle it will cause severe pain. Let's say we have compartment syndrome in the flexor compartment of the forearm, how do we do passive stretching of the muscles? By **extension** of the wrist
- ★ Pain may be **worse with elevation**. tissue perfusion depends on diastolic blood pressure and if we raise the limb above the heart level, the arteriolar pressure will decrease leading to **decrease in the blood flow** and worsening of compartment syndrome. (you shouldn't elevate the limb above the heart level if you suspect compartment syndrome in a patient)
- ★ Patient will not initiate motion on own.

- ★ Be careful with **coexisting nerve injury.** if the patient has spinal cord injury, sedated or on strong analgesia he won't feel the pain "useless". Also in cases of distracting injury (has two injuries but complaining of one only "the stronger one") compartment syndrome could be missed. eg. femur and wrist fractures at the same time, patient complains only of pain in the thigh.
- ★ In **severe trauma** or when the patient is **unconscious** pain may, however, be **difficult to assess**.
- ★ Pain is also subjective and can be nonspecific.

Pain out of proportion to the injury 'and' pain with passive stretching of the muscles in the compartment' are the earliest (sensitive), most reliable indicators of Acute Compartment Syndrome.

Clinical findings vs Timing !

Impending/ Early ACS	Late ACS
Pain out proportion to injury Pain with passive stretch of muscles in the affected compartment Paresthesia	Pulseless Paralysis Paresthesia /sensation loss (complete loss) One of the earliest signs of established compartment syndrome (takes 1 hour): loss of 2 point discrimination

Who is at high risk?

- ★ Inability to accurately obtain history and physical exam (Head trauma, Drug/ETOH intake and Pediatric)
- ★ Multiply injured patients with **hypotension** and hypoxia will worsen the compartment syndrome because it will decrease the arterial pressure → Compartment syndrome can occur at lower absolute pressure **so be aware of polytrauma patients.**
- ★ **High energy fracture** (severe contamination, joint extension intra-articular fracture, segmental injuries, widely displaced fracture, bilateral fracture, floating knee fracture femur and tibia , open fracture). open fracture is a fracture communicating with the skin, previously thought it wasn't associated with compartment syndrome as the compartment has opened, however this **not true.**
- ★ The presence of an **open fracture does NOT rule out the presence of a compartment syndrome.**
- ★ **Impaired sensorium** (Alcohol, Drug, Decrease GCS (Glasgow Coma Score), Unconscious, Chemically unconscious, Neurologic deficit, Cognitively challenged, Intubated patients)
- ★ Post operative patients on analgesia that may mask the development of pain (PCA Patient-Controlled Analgesia, Spinal or epidural, Regional block patient will not feel the pain 18 hours after surgery)

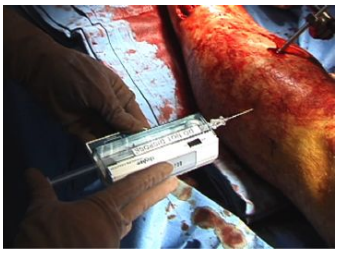
Problems with Physical Diagnosis :

Literature meta-analysis found that **clinical findings have poor sensitivity.**

- ★ Sensitivity of 13-19%
- ★ Positive predictive value of 11-15%.
- ★ Specificity = 97% (3% incidence of C.S. Compartment Syndrome in patients without clinical findings)

High index of clinical suspicion is the most important

4-Investigations for Acute Compartment Syndrome

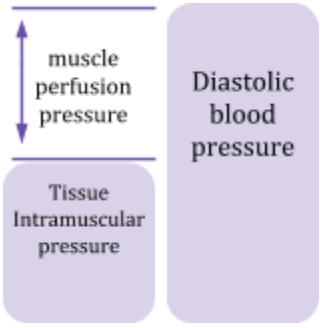


Intramuscular Pressure (IMP) Measurement:

If you are not sure but suspecting compartment syndrome, the only way to confirm the diagnosis is by measuring the intra-compartment pressure

★ Measurement of compartment pressures can be a useful adjunct to clinical assessment of the patient[2].

★ Needed for comatose or otherwise non-evaluable patient:
Anesthesia / Head Injury / Sedated / Intoxicated / Pediatric patients



Intramuscular Pressure (IMP) and Diastolic Blood Pressure (DBP):

★ Development of a compartment syndrome depends **not** only on intramuscular pressure but also depends on diastolic blood pressure; **DBP - IMP should be greater than 30 mmHg to maintain normal perfusion. (Discussed in details below).**

Perfusion Pressure (ΔP) Vs Intramuscular Pressure (IMP):

★ Currently, the "differential pressure" is considered the most reliable indicator of compartment syndrome and most reliable indicator of when fasciotomy is not necessary:

- ★ if MAP- IMP < 45 mmHg (MAP= Mean Arterial Pressure) → compartment syndrome
- ★ if DBP - IMP < 30 mmHg (AKA Delta pressure) → compartment syndrome
- ★ if absolute IMP > 30 mmHg → compartment syndrome previously used : May leads to **unnecessary** fasciotomies or **Failure** to perform **needed** fasciotomies![3]

The patient can have intra-compartment pressure of less than 30 mmHg but still have compartment syndrome. How? if the diastolic pressure is low.

Muscle Ischemia	Nerve Ischemia
Less than **4** hours - **reversible** damage. More than **8** hours - **irreversible** changes. **4-8** hours - **variable**. Myoglobinuria **after 4 hours.** Renal failure. Check CK levels. to check for renal failure. Maintain a high urinary output by aggressive hydration – Alkalinize the urine.	**1** hour - **normal conduction**. **1-4** hours - **neuropraxic** (temporary loss of motor and sensory function due to blockage of nerve conduction) damage **reversible**. **8** hours - **axonotmesis** (injury causing severe damage to the axons) and **irreversible** change. If established time of ischemia is more than 8 hours it's not a good idea to perform fasciotomy because of high risk of complications.

[2] The Stryker pressure measurement device or similar device is kept in many operating rooms for this purpose. The needle is inserted into the compartment in question, a gentle flush with 0.1 to 0.2 cc of saline clears the measurement chamber, and a reading is obtained.

[3] Explanation: the three bullet points are three different ways used to evaluate the intracompartmental pressure, the first two are more reliable than the third (Absolute IMP > 30 mmHg) because of the risk mentioned.

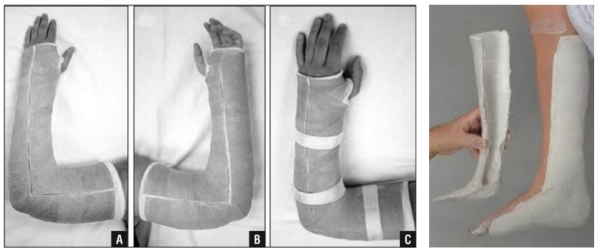
EXTRA! NOT MENTIONED NEITHER BY THE DOCTOR NOR THE SLIDES!!:
Neuropraxia vs. Axonotmesis.. and Neurotmesis

Neuropraxia: Despite the nerve fibers being intact (the sheath and axon aren't cut), it results in nerves transmissions being completely blocked. Neuropraxia is often caused when nerves are stretched in dislocation or fractures, or it may arise when there has been prolonged pressure on a nerve or a blunt injury. Patients suffering from neuropraxia tend to recover spontaneously within a few months, perhaps even after several hours.

Axonotmesis: when the endoneurium, epineurium, perineurium, and Schwann cells remain intact, but the myelin sheath and axons are damaged.That's why this type of nerve injury tends to be caused by a more severe contusion or crush compared to other nerve injuries, like neuropraxia.

Neurotmesis: occurs when the sheath and axons are completely or partially severed (cut) – hence why it's the severest nerve injury you can suffer from.

5- Management of Acute Compartment Syndrome

Treatment of impending Acute Compartment Syndrome or High risk patients: imp.
1- Immediately assess the patient. Personally!! not by a phone call
2- Identification and **removal of external compressive forces**, and releasing casts or dressings down to the skin: without removing the cast because you'd lose the fracture stability if cast removed. a. Bi-valving the cast and loosening circumferential dressings. (pictures) b. Leg compartment: keep the ankle in neutral to 30 degree plantar flexion. c. Forearm compartment: avoid deep elbow flexion. keep the elbow extended 
3- The limb **should not be elevated above the heart** level (kept at the level of the heart) so as not to decrease arterial flow any further.
4- **Serial physical examination.**
5-Maintain normal BP as **hypotension may decrease perfusion further** and compound any existing tissue injury.
6- Early assessment of **metabolic acidosis** and **myoglobinaemia** is mandatory **to avoid potential renal failure.**

Impeding ACS is the most **common presentation**.

Treatment of Acute Compartment Syndrome: Emergent Fasciotomy!

Indications:

- ★ **Clinical presentation** consistent with compartment syndrome.
- ★ Compartment pressures within (30 and less than) 30 mmHg of diastolic blood pressure (delta p).
- ★ **6 -8** hours of **total ischemia time.**

Contraindications:

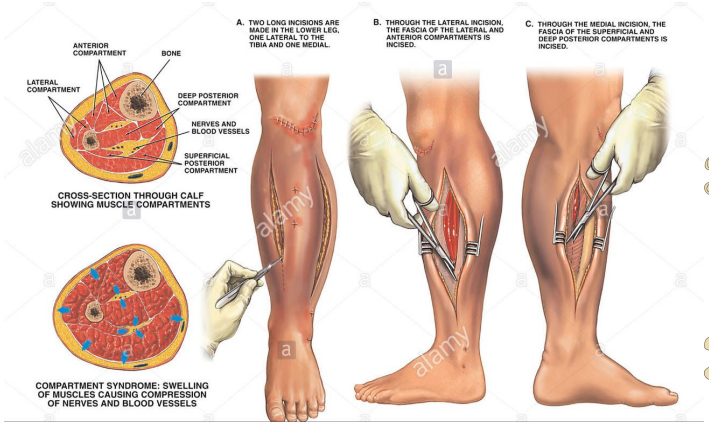
- ★ Missed compartment syndrome (high complications). more than 8 hours.

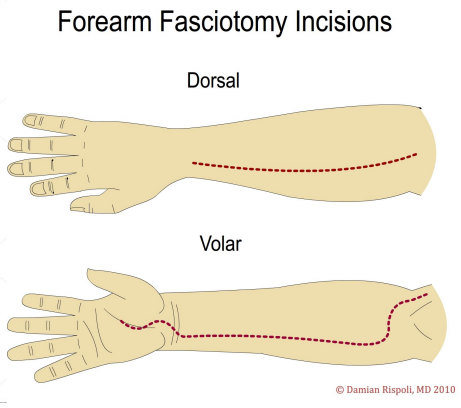
Technique of Fasciotomy:

- ★ **Longitudinal** skin **incision** that extends the **entire length** of the compartment.
- ★ **Release of fascia** of involved muscle.
- ★ **Skin left open: Closure** of skin is usually achieved **after swelling has subsided. Skin grafting** is often required.
- ★ **Second and third look surgeries are often required.**

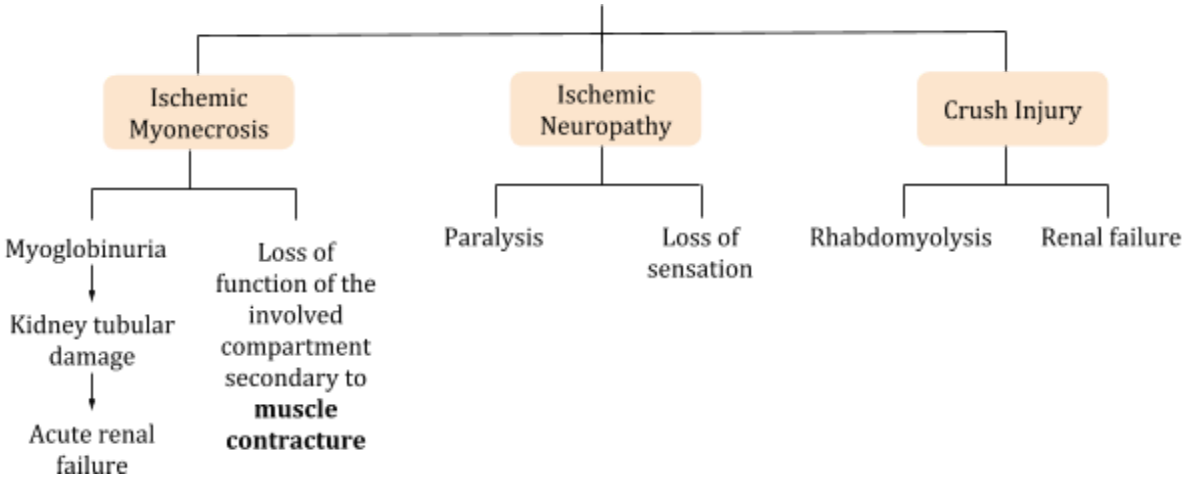
Complications of Fasciotomy: it's not a benign procedure

- ★ Muscle weakness. permanent
- ★ Chronic venous insufficiency.
- ★ Tethered scars.
- ★ Impaired sensation.
- ★ Ulceration.
- ★ Costs.





6- Consequences of Acute Compartment Syndrome



Delay in Diagnosis/ Treatment is the cause of a poor outcome

Acute Joint Dislocation

Joint stability:

1. **Bony stability**: Shape of the joint (ball and socket vs round on flat)
2. **Soft Tissue stability**:
   - ★ **Dynamic** stabilizer: Tendons/Muscles
   - ★ **Static** stabilizer: Ligaments ± meniscus/labrum

Complex synergy leading to a **FUNCTIONAL and STABLE joint**.

Hip joint depends more on the bony stability (deep socket). The _ joint is **shoulder joint** (very shallow joint not deep), depends mainly on ligaments.

Dislocation vs Subluxation:	
 Dislocation: a complete disruption of the joint.	 Subluxation: a partial dislocation.

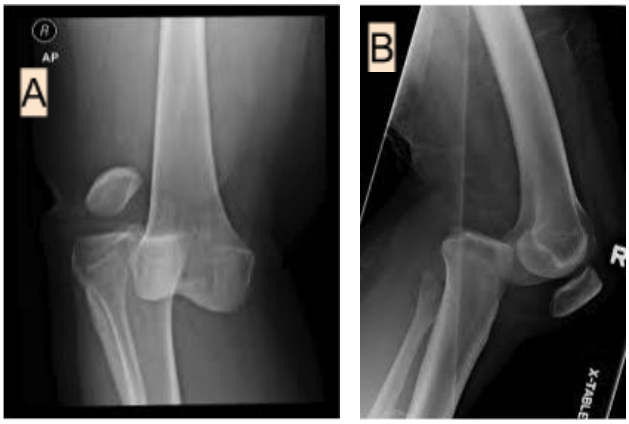
- ★ It takes **higher energy** to dislocate a joint with **bony stability** than a joint with mainly soft tissue stability.
- ★ **Connective tissue disorders** may lead to increased joint instability due to abnormal soft tissue stabilizers.
- ★ Dislocation of a major joint should lead to considering **other injuries.** You should look for other associated injury (neurovascular injury/peri-articular fracture).
- ★ When a joint is subjected to **sufficient force** in **certain directions** it might sustain a **fracture** (in very stable joint usually, like hip joint → fracture in the acetabulum)**, a dislocation** with torn ligaments **or a fracture dislocation.**
- ★ Different joints have **different force victors** that may lead to a dislocation.
- ★ A joint might dislocate in **different directions.** Usually in one direction
- ★ A joint dislocation is described by stating the location of the **distal segment** in relation to proximal. You have to have 2 views (AP- lateral)
- ★ **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.

Acute joint dislocation means very high energy trauma , or sometimes happens with low energy trauma like in the shoulder dislocation. Be aware also of the people who have ligament laxity or connective tissue disorders (ehlers danlos syndrome) they might have spontaneous voluntary dislocation. Shoulder dislocation and joint laxity are more common in female.

What do you see in those two X-rays? Posterior-Lateral dislocation

Anteroposterior view (AP): Tibia (distal) dislocated toward the fibula (lateral) in relation to the femur (proximal). (A)

Lateral view: Tibia (distal) dislocated backward (posterior) in relation to the femur (proximal). (B)



High risk group:

- ★ Major trauma victims.
- ★ Athletes and sport enthusiasts.
- ★ Connective tissue disorder patients.

Diagnosis of Acute Joint Dislocation:

1- Signs and Symptoms:

- ★ 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.
- ★ Neurovascular compromise .
- ★ **Should check** for other injuries (distracting injury).
- ★ **Should always check** the distal neurovascular status.
- ★ **Should check** for compartment syndrome.

Deformity is according to the joint: **Posterior dislocation of the hip:** hip would be flexed, externally rotated and adducted. **Anterior shoulder dislocation:** loss of deltoid contour (empty), shoulder slightly abducted and slightly externally rotated.

2-Investigations:

X-rays:

- ★ Should be done **urgently** without delay if dislocation is suspected. because if patient has **fracture dislocation** there is NO WAY you can reduce it.
- ★ **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**.
- ★ Patients with recurrent dislocation we don't do x-ray, we immediately do reduction.

Management of Acute Joint Dislocation: (as GP or ER physician)
1. Activate ATLS if high energy trauma or associated with other injuries.
2. Analgesia ++
3. Quick clinical/NV (neurovascular) assessment. And compartment assessment.
4. Urgent **2 view** x-rays.
5. Urgent reduction. After confirming dislocation and excluding fracture.
6. Check stability and safety zone. some joints once hey are reduced become stable and some of them with minor movement will dislocate again
7. Re-check neurovascular status after reduction.
8. Examine the compartment to R/O CS.
9. **Post reduction 2 view X-rays.** you have to make sure that the joint is reduced immediately without any complications
10. Immobilize the joint.
11. Consult Orthopaedics.

Principles of Joint Reduction:

1. ++ Analgesia (opioid)
2. +/- IV sedation (to relax the muscles) → Need cardiorespiratory **monitoring**. Ready for intubation at any time because of sedation.
3. Need assistant for help.
4. **Gradual traction + countertraction in the line of deformity to distract the joint.** Reduction without traction result in fracture.
5. **Realignment** and **rotation** to reduce the joint based on **direction** of dislocation.
6. Check ROM (Range Of Motion) and stability of the joint.
7. Re-check the NV (neurovascular) status.
8. **Confirm** the reduction by **2 view x-rays**.
9. Immobilize the joint in **the most stable position.**

Don't attempt to reduce a fracture dislocation in ER, instead consult the Orthopedic! because patient will need urgent open reduction in OR!

Failed reduction in ER:

Causes:

- ★ Inadequate analgesia/Sedation.
- ★ Entrapped soft tissue within the joint.
- ★ Associated fracture.
- ★ Wrong technique.
- ★ Associated with significant soft tissue injury for static and dynamic stabilizers.

Action:

- ★ Urgently **consult** Orthopaedic surgeon.
- ★ Patient will need Urgent closed reduction under general anesthesia and possible open reduction if closed reduction fails.

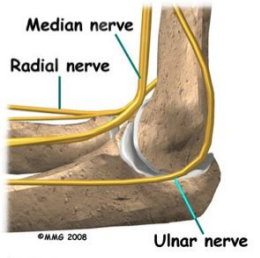
Fracture-Dislocation:

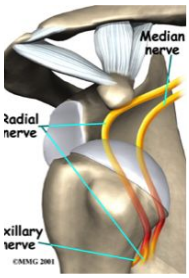
A fracture dislocation is usually reduced in an open fashion in the operating room. Fractured femur, dislocated hip and fracture in the acetabulum, needs open reduction.

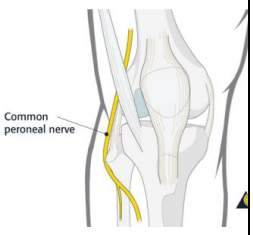
Sequelae(Complications) of Acute Dislocation:

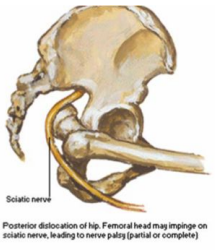
Early	Late
★ Nerve injury. ★ Chondral (cartilage) injury. ★ Osteochondral fracture. ★ Periarticular fracture. ★ Vascular injury. ★ Ligaments tear. ★ Compartment syndrome.	★ Recurrent dislocation. ★ Instability. ★ Stiffness. ★ Avascular necrosis. ★ Post-traumatic arthritis. ★ Heterotopic ossification .

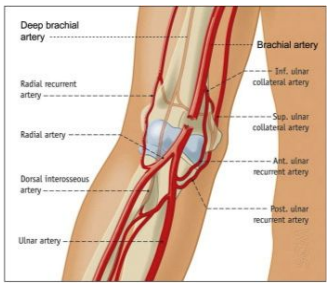
Nerve Injury	Vascular Injury
★ Shoulder dislocation → axillary nerve ★ Elbow → any nerve can be injured ★ Knee dislocation → common peroneal nerve (drop foot) ★ Hip dislocation → sciatic nerve (usually the peroneal part is affected resulting in drop foot, if both parts all the foot is affected)	Knee dislocation is associated with high potential of popliteal artery injury. How to assess vascular? Presence or absence of pulse don't rule out vascular injury. The most important is ABI "ankle brachial index" if less than 0.9 there is vascular injury. We also check the capillary refill- temperature- color



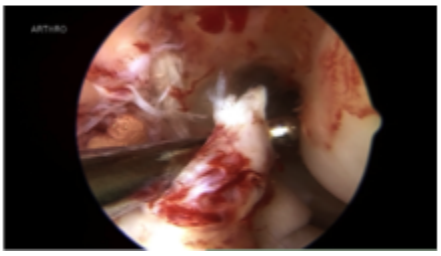


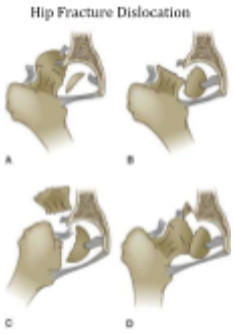




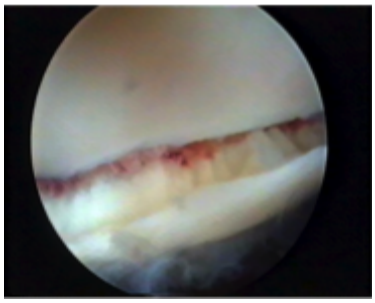


ACL and PCL Tear
anterior and posterior cruciate ligament

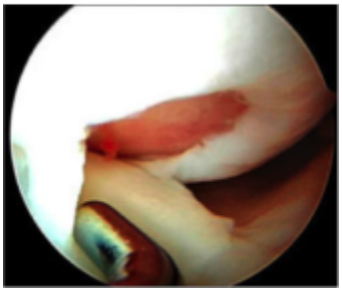




Osteochondral fracture



Chondral Injury



Sequelae of missed (chronic) dislocated joint:

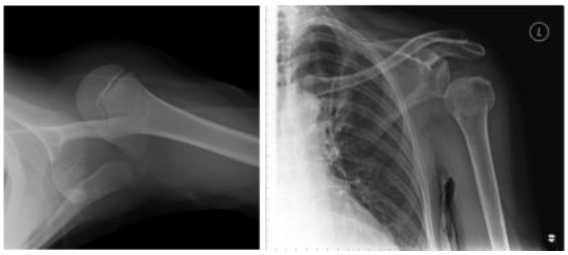
★ Irreversible (permanent) nerve palsy.
★ Chondrolysis.
★ AVN. Avascular Necrosis
★ Loss of joint function.
★ Stiff joint.
★ Inability to do closed reduction.
★ Post-traumatic arthritis.
★ Poor outcome even after successful open reduction

Usually seen in the posterior dislocation of shoulder because in the X-ray the dislocation is not obvious if we didn't take 3 views. Common in epileptic patients. 97% of shoulder dislocation is anterior

Hip Dislocation

- ★ **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



- ★ **Commonest large joint dislocation.**
- ★ **Anterior** dislocation is more common.
- ★ Patients with **seizures** prone to **posterio**r 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 associated with **peroneal nerve** injury.
- ★ May be associated with fracture/ compartment syndrome.
- ★ Most require surgery either early or late or both.

Knee dislocation needs urgent reduction and it's highly associated with vascular injury so you need to do **ABI.**

-The End-

Notes from Dr. Bin Nasser about the compartment syndrome:

هل ال 5p's تنطبق في الكومبارتمنت سندروم؟ طيب مين الوحيد الي ما ينطبق عالكومبارتمنت سندروم كرايتيريا؟ البلسلسنس pulselessness

In the compartment syndrome there is pulse

90%of the times pulselessness doesn't happen in compartment syndrome : if someone developed compartment syndrome today and ignored it. after a week- month, how will his limb looks like? Actually in compartment syndrome the necrosis will be just inside the compartment so the blood supply to the skin won't be affected *the artery enters the compartment and its branches will come out from the compartment 100% intake bc the blood will enter the compartment but there won't be any exchange* so the skin appearance will be **normal.** but for the nerves since it will be damaged inside the compartment he'll **loss his sensation in the skin**

studies show that the pts. who underwent faciatomy of an open fracture after 48 hrs : 100% of them either died or developed severe infection that requires imputation *bc u have like a culture agar which will be fibrous *tissue with time so if we open the area they will develop very severe infection within 24 hrs

Below are three tables summarizing the three compartments the doctor mentioned we should know.
(Extra)

Leg Compartments			
Compartment	Muscles	Nerves	Movement
Anterior compartment	★ Tibialis anterior ★ Extensor hallucis longus ★ Extensor digitorum longus ★ Fibularis tertius	Deep fibular nerve	Dorsiflexion of foot and ankle
Lateral compartment	★ Fibularis longus ★ Fibularis brevis	Superficial fibular nerve	Plantarflexion and eversion of foot
Superficial posterior compartment	★ Gastrocnemius ★ Soleus ★ Plantaris	Tibial nerve	Plantarflexion of foot and ankle
Deep posterior compartment	★ Popliteus ★ Flexor digitorum longus ★ Flexor hallucis longus ★ Tibialis posterior	Tibial nerve	Plantarflexion and inversion of foot

Thigh Compartments			
Compartment	Muscles	Nerves	Movement
Anterior compartment	★ Quadriceps (Vastus medialis, Vastus intermedius, Vastus lateralis and Rectus femoris) ★ Sartorious	Femoral nerve	Quadriceps: all extend the leg at knee joint and Rectus femoris has additional movement it flex the thigh at the hip joint. Sartorious flexes the thigh and leg at the hip and knee joints.
Posterior compartment	★ Hamstrings (Biceps femoris, Semitendinosus, Semimembranosus)	Sciatic nerve	All flex leg at knee joint and extend thigh at hip joint, but additionally: Biceps femoris laterally rotate thigh and leg at hip and knee joints. Semitendinosus and Semimembranosus medially rotate thigh and leg at hip and knee joints.
Adductor (medial) compartment	★ Gracilis ★ Adductor longus ★ Adductor magnus	Obturator nerve	All the three adduct thigh at hip joint but additionally: Gracilis: flexes leg at knee joint Adductors: medially rotate the thigh at hip joint.

Forearm Compartments			
Compartment	Muscles	Nerves	Movement
Anterior (flexor) compartment	Three layers: ★ Superficial (Flexor carpi ulnaris, Palmaris longus, Flexor carpi radialis, Pronator teres) ★ Intermediate (Flexor digitorum superficialis) ★ Deep (Flexor digitorum profundus, Flexor pollicis longus, Pronator quadratus)	All muscles innervated by median nerve, except flexor carpi ulnaris muscle and medial half of flexor digitorum profundus innervated by ulnar nerve.	**Superficial:** ★ Flexors carpi ulnaris and radialis: flex and adduct the wrist joint. ★ Palmaris longus: flex the wrist joint ★ Pronator teres: pronation. **Intermediate:** Flexes proximal interphalangeal joints of index, middle, ring and little finger. **Deep:** ★ Flexor digitorum profundus: flexes distal interphalangeal joints of index, middle, ring and little finger. ★ Flexor pollicis longus: flexes interphalangeal joint of the thumb. ★ Pronator quadratus: pronation.
Posterior compartment	★ Superficial (Extensor carpi radialis longus and brevis, Extensor digitorum, Extensor digiti minimi, Extensor carpi ulnaris) ★ Deep (Supinator, Abductor pollicis longus, Extensor pollicis brevis, Extensor pollicis longus, Extensor indicis)	Radial nerve	**Superficial:** ★ Extensor carpi radialis longus and brevis: extend an abduct wrist. ★ Extensor digitorum: Extend index, middle, ring and little finger. ★ Extensor digiti minimi: extend little finger. ★ Extensor carpi ulnaris: extend and adduct wrist. **Deep:** ★ Supinator: supination. ★ Abductor pollicis longus: abduct carpometacarpal joint of thumb. ★ Extensor pollicis brevis: extends metacarpophalangeal joint of thumb. ★ Abductor pollicis longus: extends interphalangeal joint of thumb. ★ Extensor indicis: extend index.

MCQs

1) Young girl came with tibia-fibular fracture with increasing pain and increase analgesics requirement. What is the best sign of diagnosing compartment syndrome?

A) Pain out of propotion.
B) Pale skin
C) Pulseless
D) Loss of sensation.

Ans: A

2) 22 years universal student hit in posterior shoulder come to the ER complaining of shoulder pain and limited range of motion what is the diagnosis (pic shoulder dislocation)?

A) Anterior shoulder dislocation.
B) Rotator cuff tear
C) Frozen shoulder.

Ans: A

3) Patient with epilepsy developed staticus epileptics and during the attack he fall and had bilateral posterior shoulder dislocation in ED they managed his fracture and had splint, 4 hours later nurse noticed decrease urine output and urine turned to dark brown, he had high creatinine level, which level support the diagnosis?

A) Creatinine kinase.
B) Hemoglobin.
C) Haptoglobin.
D) Urea.

Ans: A

4) 22-year-old came to the ER after a direct hit to his shoulder during a volleyball match his shoulder was abducted and his arms are flexed he mentioned that it has happened 4 times during this year -An x-ray was provided of shoulder dislocation What is the most likely diagnosis:

A) adhesive capsulitis.
B) shoulder dislocation.

Ans: most likely B

5) Young male presented to the ER after falling on his outstretched hand.What is the most likely diagnosis:

A) Shoulder dislocation.
B) Clavicle fracture.
C) Glenoid fracture.
D) Sternoclavicular joint dislocation

Ansr: A

6) Which nerve is the most likely to be injured in anterior shoulder dislocation?

A) Axillary.
B) Ulnar.
C) Median.
D) Anterior interosseous.

The Ans:A

7) Which of the following is most likely to be found in compartment syndrome?

A) IMP 29 DBP 50
B) IMP 30 DBP 65
C) IMP 29 DBP 70
D) IMP 30 DBP 75

The Ans:A