Orthopedic Emergencies:

Compartment Syndrome
Acute **Joint** Dislocation

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Select an area to comment on

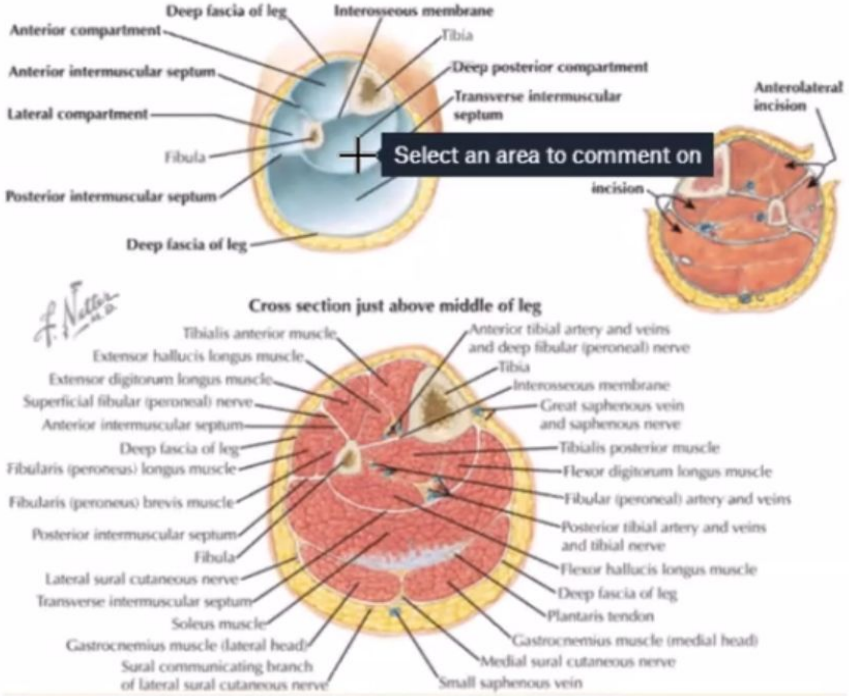
Compartment syndrome

Objectives

- To explain the pathophysiology of CS
- To Identify patients at risk of developing CS
- To be able to diagnose and initially manage patients with CS
- To be able to describe the possible complications of CS

Definition

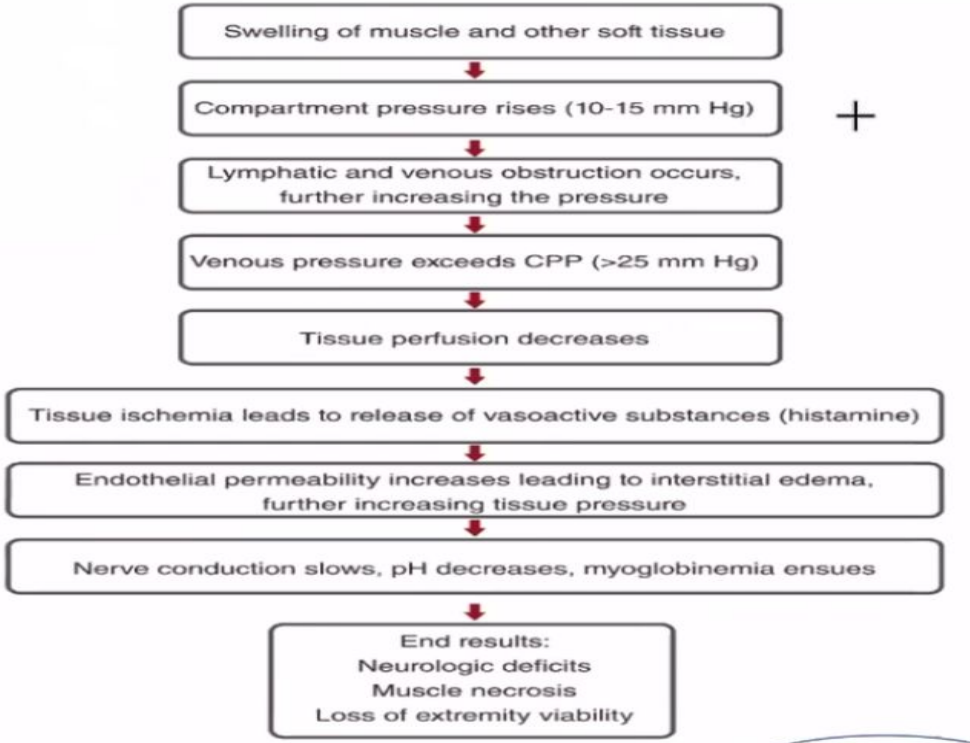
- Orthopedic emergency
- Intercompartmental pressure exceeds prefusion pressure
- It can develop wherever a compartment is present
- Artery> arteriole> capillary bed (diffusion/exchange)> venule> vein



Definition

"Acute compartment syndrome is a potentially devastating condition in which the pressure within an osseofascial compartment rises to a level that decreases the perfusion gradient across tissue capillary beds, leading to cellular anoxia, muscle ischemia, and death"

Pathophysiology



Pathophysiology

Select an area to comment on

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

Etiologies: Increase the Compartment Volume

- Close soft tissue injury/ crush injury
- Close fracture
- Open fracture
- Hemorrhage:
- Vascular injury
- Coagulopathy (anticoagulation therapy)
- Increased capillary permeability after burns (especially circumferential)
- Infusions or high-pressure injections (eg, regional blocks, paint guns)
- Reperfusion after prolonged periods of ischemia

Etiologies: Reduction in Volume of Tissue Compartments

- Tight circumferential dressings (eg, can occur with cotton cast padding alone)
- Cast or splint
- Prolonged limb compression, as in Trendelenburg and lateral decubitus or from alcohol or drug abuse
- Risk factors (general):
  - Head injury
  - Decreased conciseness (Late diagnosis)
  - Hypotension

Etiologies: Orthopedics conditions

Underlying Condition	% of Cases
Tibial diaphyseal fracture	36
Soft tissue injury	23.2
Distal radius fracture	9.8
Crush syndrome	7.9
Diaphyseal fracture forearm	7.9
Femoral diaphyseal fracture	3.0
Tibial plateau fracture	3.0
Hand fracture(s)	2.5
Tibial pilon fractures	2.5
Foot fracture(s)	1.8

Diagnosis: Early

Select an area to comment on

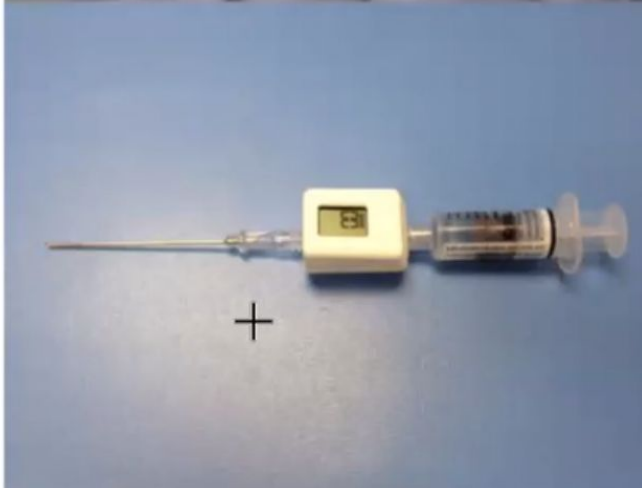
- Pain!!!
- Pain increase with stretching the involved compartment
- Presence of risk factor
- High index of suspicion

Diagnosis: Late

- Paresthesia
- Paralysis
- Pallor
- Severely high pressure:
  - Pulselessness (RARE!)

Diagnosis

- Tight, woody compartment
- Tender compartment
- Measurement:
  - Rarely necessary
  - Must be done at area of highest expected pressure
  - May give false low result



Management

- Prevention
  - Maintain normal blood pressure
  - Remove any constricting bandage
  - Keep limb elevated
  - Regular close monitoring
  - Avoid nerve blocks, sedation and strong analgesia to obtain patients feed back

Management

- 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)

Fasciotomy

- 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

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

Fasciotomy

Select an area to comment on

- 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

Fasciotomy

- It is a prophylactic procedure
- Does not reverse injury to permanently damaged tissue

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so better to have a low threshold!

Complications

- Myonecrosis --> myoglobinuria-->myoglobinuria--> kidney tubular damage
- Loss of function of the involved compartment:
  - Flexion contracture
  - Paralysis
  - Loss of sensation

Complications

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

Acute joint dislocation

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Objectives

Select an area to comment on

- 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

Definition

- Dislocation:
  - Total loss of contact between the articular surfaces of the joint
- Subluxation:
  - partial loss of contact between the articular surfaces of the joint

Definition

- 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

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

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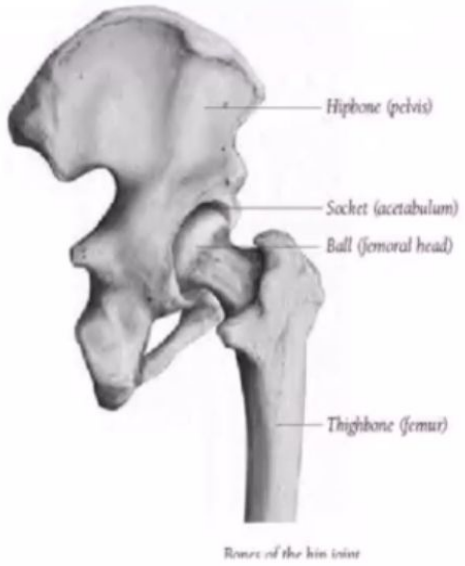
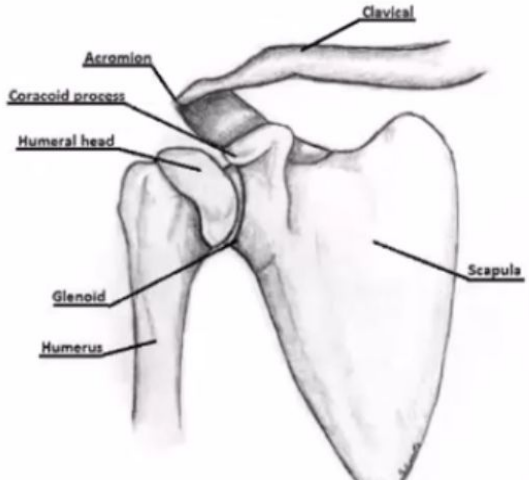


Bones of the hip joint



Pathophysiology

- 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.

Pathophysiology

- 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 victors that may lead to a dislocation
- A joint might dislocate in different directions

At risk groups

Select an area to comment on

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

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

Select an area to comment on

Diagnosis

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

Diagnosis

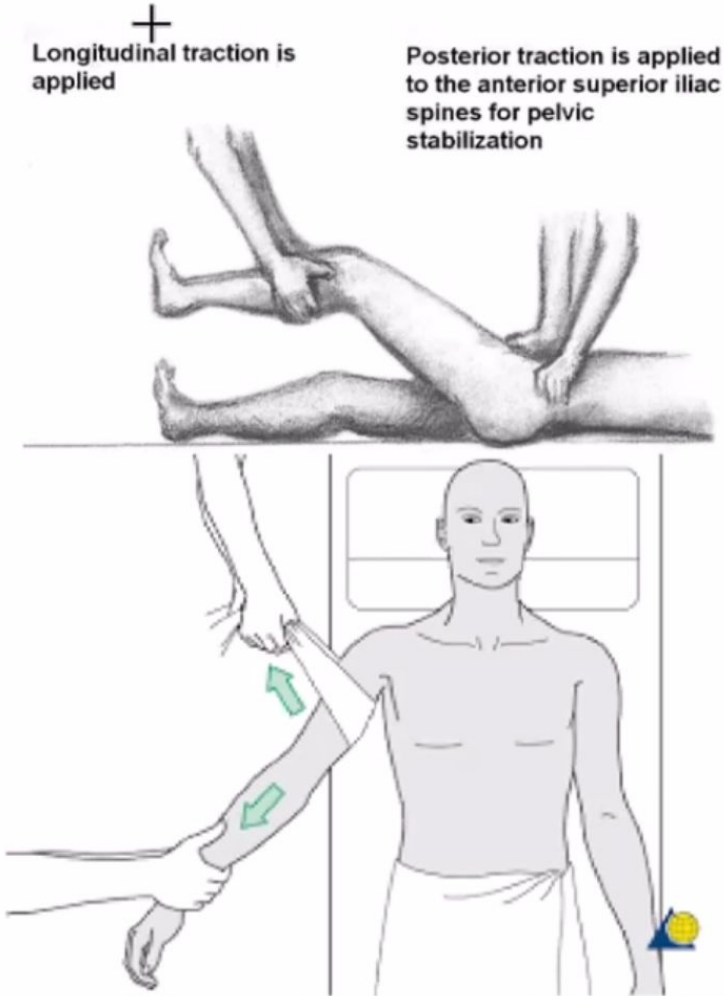
- X-rays:
  - Should be done urgently without delay if dislocation is suspected
  - Two perpendicular views of the involved joint
  - Occasionally, special views are required such as the axillary view for shoulder dislocation
  - X-rays to the joint above and below

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
- Protect the joint
- Rehabilitation
- Follow for late complications

Management principles: Reduction

- Monitor vitals
- IV analgesia (opioid)
- 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



Management principles: Reduction

- 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

Management principles: Reduction

- 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

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

Late complications

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

Acute hip joint dislocation

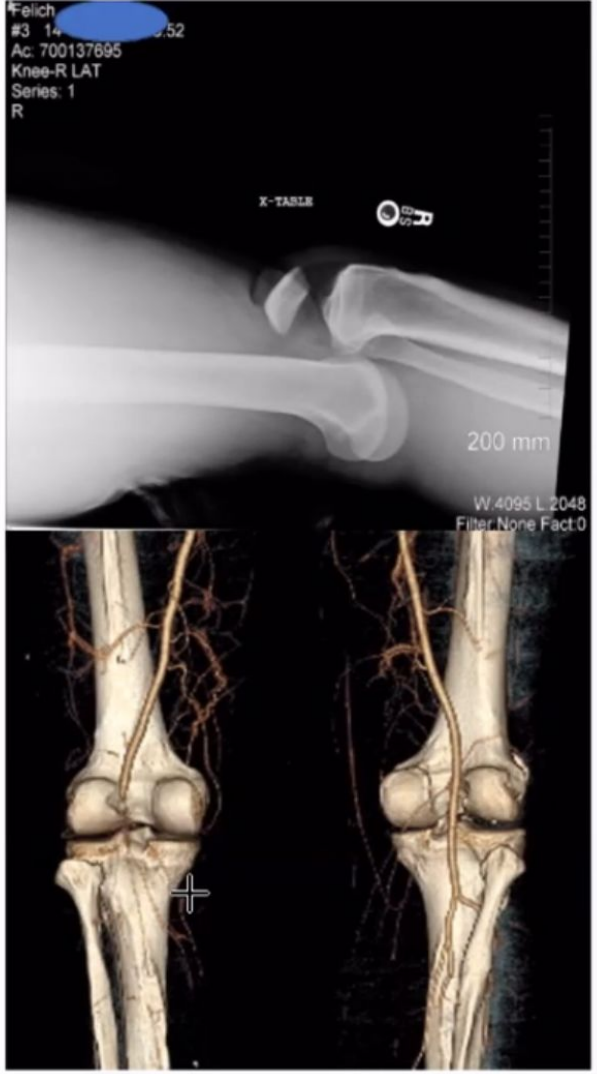
- Posterior dislocation is commonest
- Major trauma with hip flexed (dashboard injury)
- Sciatic nerve injury common
- High incidence of late avascular necrosis
- An orthopedic emergency!!+

Acute should joint dislocation

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

Acute knee joint dislocation

- Three or more ligaments
- Severe (high energy) trauma
- May be associated with popliteal artery injury---- Limb threatening
- Very serious
- 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



Take home messages

- High index of suspension is needed to make diagnosis of compartment syndrome
- Pain is the most sensitive symptom/sign for compartment syndrome
- Early intervention can save limb suffered from compartment syndrome
- Joint dislocation is an emergency
- Prompt reduction should be performed
- Check neurovascular status pre and post reduction