Lecture 4

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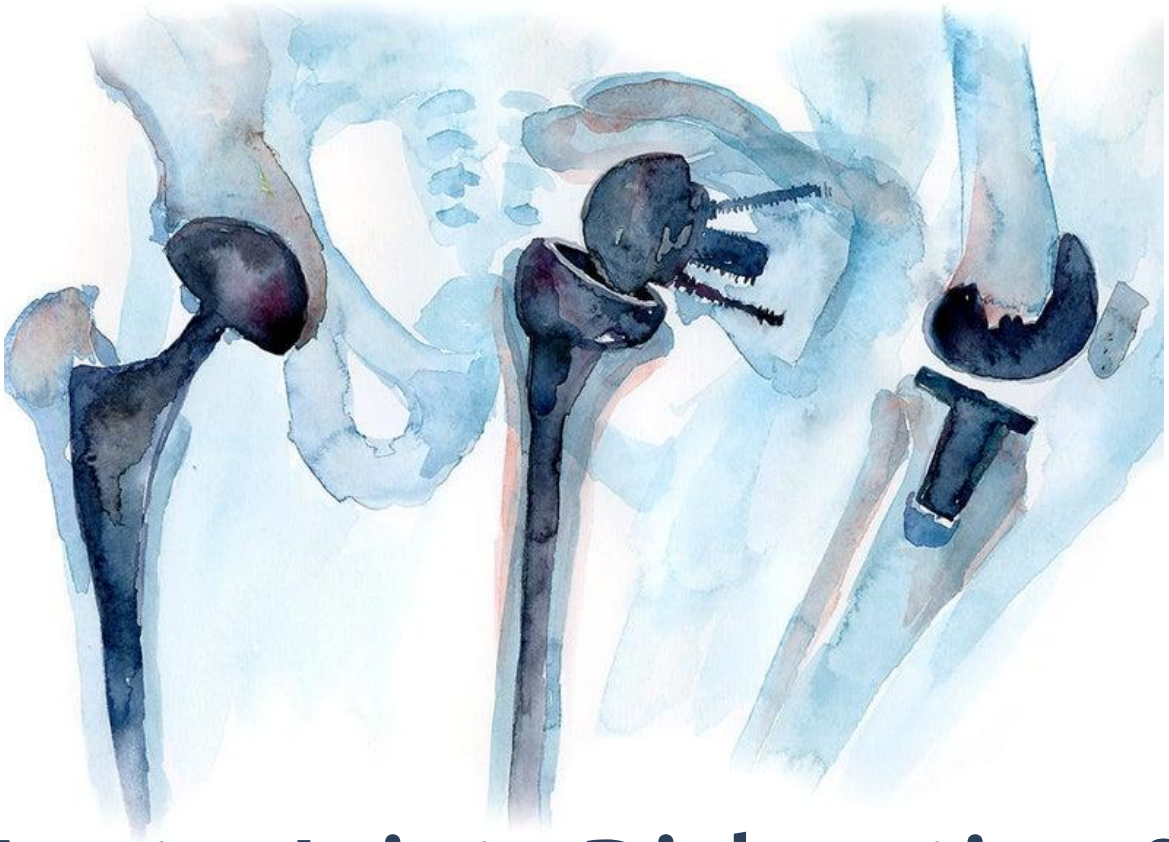

Acute Joints Dislocation & Compartment Syndrome

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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
- 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.

Color Index:

Original text | Doctor's notes | Text book
Important | Golden notes | Extra

Acute Compartment Syndrome:

Definition

- "Is a potentially devastating condition in which the pressure within an osteofascial compartment rises to a level that decreases the perfusion gradient across tissue capillary beds, leading to cellular anoxia, muscle ischemia, and death".
- Can be either due to increased compartment content or decreased space.
- Compartment syndrome is considered an **orthopedic emergency!** In which Intracompartmental pressure exceeds perfusion pressure resulting in muscles and nerves ischemia . It can develop wherever a compartment is present. [1]

Pressure Gradient

- Arteries > arteriole > capillary bed (diffusion/exchange) > venule > vein

Pathophysiology

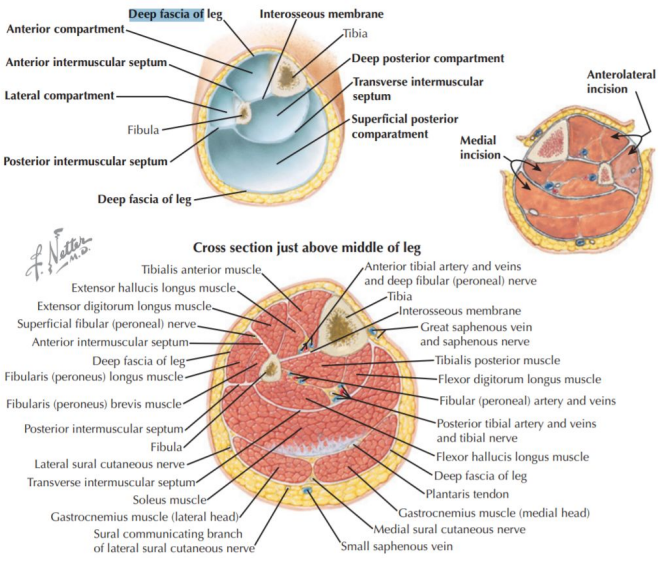
Threshold pressure: (Absolute measurement). Variation between people limits the use of it

- It's CS if the Intercompartmental pressure exceeds 30 mm Hg (rigid). Because this pressure is enough to close the capillary bed perfusion pressure.

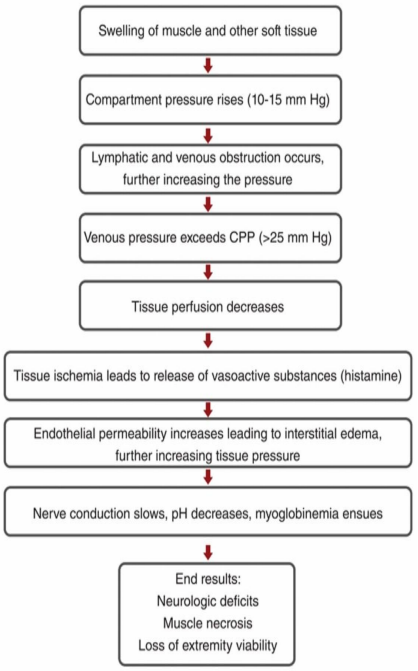
Relative measurement:

Δ = **DBP - Intercompartment = <30 (if less than 30 it is CS)**

- Less than 30 mm Hg difference between compartment pressure and preoperative diastolic pressure = it is more relative to perfusion = (clinically relevant)
- For example if a patient's BP was 100/60 and his intracompartmental pressure (IMP) was 25 mmHg. This patient doesn't have CS because (60-25=35) which means that the compartmental pressure didn't exceed the perfusion pressure (no ischemia)



Blue area enclosed by fascia layer contains muscle, nerve & blood supply. Each group is called a compartment



1- It typically occurs following a traumatic event, most commonly a fracture. Also, could happen due to burns or a cast. Very unlikely to have an absent artery pulse because it's unlikely for compartment pressure to be > artery pressure. However, when it reaches the level of perfusion pressure the compartment cascade will begin.

Acute Compartment Syndrome:

Etiology

Increased compartmental volume (internal expanding forces)

- Close soft tissue injury/ crush injury. Local hematoma inside
- Close fracture. Internal medullary artery bleeding
- Open fracture. [1]
- Hemorrhage. From medulla
- Vascular injury. Like laceration
- Coagulopathy (anticoagulation therapy).
- Increased capillary permeability after burns (especially circumferential).
- Infusions or high-pressure injections (eg, regional blocks, paint guns). Radiology intervention/ extravasation
- Reperfusion after prolonged ischemia. [2] (most ischemia → fasciotomy)

Reduced compartmental volume (external compressing forces)

- Tight circumferential dressings (artificial) (eg, can occur with cotton cast padding alone)
- Cast or splint (artificial)
- Prolonged limb compression as in Trendelenburg, lateral decubitus, alcohol or drug abuse [3]

General Risk Factors

- **Young patient coming with a tibial diaphyseal fracture**
- Head injury. (Late diagnosis)
- Decreased consciousness (Late diagnosis)
  - Mainly because of the loss of communication between the patient and doctor.
- Hypotension
  - Due to decreased perfusion pressure which decreases the relative threshold for CS.

Orthopedic Conditions

Why tibial fractures are no. 1?

- Scientifically, it's proven by evidence.
- Logically, the tibia is a large bone placed in a small compartment

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

1- It is a common mistake that people make thinking that an open fracture helps in releasing the pressure. In fact, usually the hole is small and isn't enough to overcome the pressure caused by the internal bleeding. The blood also can close the hole by acting like a valve. Moreover, the hole is usually in one compartment and we have more than one (4 in case of the tibia).
2- Damage to the basement membrane can cause leakage of intravascular fluid into the interstitium increasing the intracompartmental volume. The cut off in ischemia is usually 6 hours until the cellular death of the structures (vessels, nerves…)
3- It happens more in western countries by getting drunk and not moving for a long time (>24 hrs). This can compress one side of the leg causing a compartment syndrome on the other side.

Acute Compartment Syndrome:

Diagnosis

- **It's a clinical diagnosis!** (No X-ray, US, MRI or CT)
- You need to keep a high index of suspicion to perform immediate surgery and save the patient's limb.

Signs and Symptoms

Early	Late
★ Very severe pain not responding to analgesics - Out of proportion to the injury - Patient cries from the pain - Increase need of analgesics - **This is the most sensitive (first Sx)** • Pain with passive stretching of the muscles in the compartment - Dorsiflexion → posterior compart. - Plantarflexion → anterior compart. • Pain might be worse with elevation. • Patient will not initiate motion on their own. • Presence of risk factor. • Tense swelling • Tight (woody compartment) - **Most reliable** clinical sign - Calf muscle would be hard and woody (normally soft and fleshy) • Measurement of the IMP is high	• 4Ps: **P**aralysis, **P**aresthesia, **P**allor and **P**ulselessness. - Pulselessness is RARE - Only severely high compartment pressure causes it because the pressure need to exceed the arterial pressure to occlude it. (almost never) - Sign of severity - • Tender compartment. - Movement of anterior or posterior muscles of leg elicits severe pain.

Pediatrics

- 3 As: (Increasing Analgesic requirement, Anxiety, Agitation)

IMP (Intramuscular pressure)

- We insert a device in the compartment that injects fluid and collect it and provide us with the reading.
- Rarely necessary and might give a false low result if not inserted at the area of the highest expected pressure
- We can use it as a relative measure if the patient is unconscious for example and cannot communicate

Issues:

- Not reliable (if injected in muscle → v. high reading)
- High false positive rate (perform unnecessary procedures)

Acute Compartment Syndrome:

Management

Initial (Underdeveloped CS)

- Maintain normal blood pressure.
- Remove any constricting bandage
- Keep limb elevated. (but not too much at heart level)
- Regular close monitoring (15-30 minute intervals).
- Avoid nerve blocks, sedation and strong analgesia to obtain patients feedback
  - Anything that can block pain response.

Late (Fully Developed CS)

- Remove any constricting bandage (the first and immediate thing)
- Maintain normal blood pressure.
- Keep limb at heart level.
- Diuresis to avoid kidney tubular injury if late.
  - Diuresis isn't for CS it's to protect the kidney from myoglobinuria
- Urgent surgical decompression (Fasciotomy).

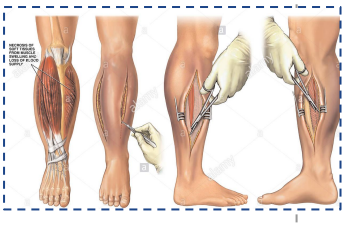
Summary

1. Split the cast and dressing down to the skin.
2. Elevate the leg (to the level of the heart)
3. Ice to decrease the swelling
4. Feel the compartments, if not tight you observe the patient every 2 hrs
5. If compartments are tight, take patient to OR for emergency fasciotomy

Fasciotomy

- It is a prophylactic procedure [1] done by releasing the compartment fascia to allow swollen muscles to expand which will decrease IMP and prevent further damage.
- This procedure doesn't reverse the damage and should be done as soon as possible.

Indications:



- > 6hrs of ischemia (e.g. arterial embolism)
- Significant tissue injury
- Worsening clinical picture
- Fully developed CS
- Absolute compart p >30 mmHg or relative pressure (DP-IMP) <30 mmHg

Technique:

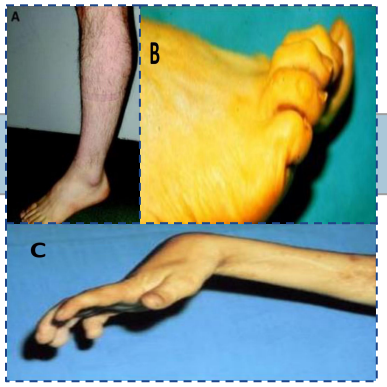
- Debridement of all necrotic tissue [2]
- Second and third look surgeries are often required
- Closure is usually done after the swelling subsides
- Skin grafting is often required

1- It is a prophylactic procedure intended to save what's left of the viable tissue. So if someone came with a >24 hrs missed CS there'll be no benefit for the fasciotomy.
2- Leave the skin open for 48 hrs for debridement then check before closing the skin incision

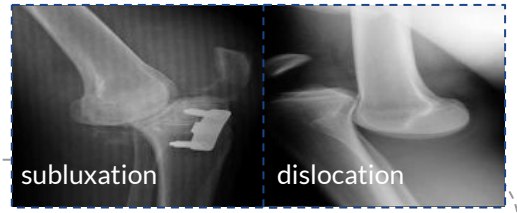
Acute Compartment Syndrome:

Complications

Complications of Compartment Syndrome
1- Myonecrosis
Myonecrosis → myoglobenemia → myoglobinuria → AKI (tubular damage) • We can measure creatinine kinase (CK) to check for rhabdomyolysis
2- Loss of Function
1. Flexion contracture 2. Paralysis (nerve damage) 3. Loss of sensation and chronic pain
3- Leg Complications
Anterior Compartment: ➔ Drop foot (pic A) Deep Posterior Compartment: ➔ Clawed toes (pic B) ➔ Loss of sensation in the sole
4- Forearm Complications:
• Volar compartment → Volkmann contracture (pic C) [1]



Acute Joint Dislocation:



Definitions

- **Dislocation** is the **total** loss of contact between the articular surfaces of the joint.
- **Subluxation** is the **partial** loss of contact between the articular surfaces of the joint.

Description:

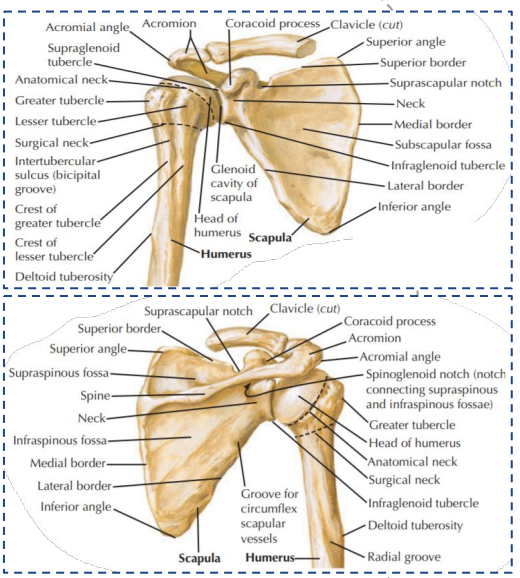
- We usually describe the dislocation by stating the location of the distal segment.
  For example:
  - ➔ Anterior shoulder dislocation means that the humerus is displaced anteriorly.
  - ➔ Posterior hip dislocation means that the femur is displaced posteriorly.

1- Permanent flexion contracture due to shortening of forearm muscles ("claw-like deformity" of the hand, fingers, and wrist) usually caused by ischemia due to compartment syndrome

Acute Joint Dislocation:

Shoulder Anatomy

- The shoulder joint is a round on flat joint.
- The more movement needed by a joint the less bony stability must be there and more dependence on the muscles and soft tissue.



Joint Stability:

- Bony stability:
  - ➔ Shape of the joint (ball and socket vs. round on flat)
- Soft tissue:
  - ➔ Dynamic stabilizers → tendons and muscles [1]
  - ➔ Static stabilizers → ligaments ± Meniscus/labrum [2]
- **Complex synergy → functional and stable joint**

Pathophysiology

- It takes higher energy to dislocate a joint with bony stability (ex: hip) than a joint with mainly soft tissue stability (ex: shoulder) like weak ligaments.
- Connective tissue disorders may lead to **increased joint instability** due to abnormal soft tissue stabilizers. [3]
- Dislocation of a major joint should lead to considering other joints. [4]
- When a joint is subjected to sufficient force in certain directions it might sustain a fracture (in stable joint usually like hip joint), a dislocation (with torn ligament) or a fracture dislocation.
- Different joints have different force vectors that may lead to a dislocation.
- A joint might dislocate in different directions; in acute dislocation mainly is in one direction.

Groups at Risk

- Major trauma victims especially unconscious patient.
- Athletes and sport enthusiasts.
- Connective tissue disorder patient; due to increased joint instability in result of abnormal soft tissue stabilizers and increased soft tissue laxity.

1- The body move the joint by contracting the muscles and these muscle cause compressive force to hold the joint in place.
2- One which is holding the joint in the place regardless of the movement status of joint (mainly ligaments) e.g. acute knee dislocation happens b/c there is injury in the ligament of knee that stabilize the knee joint, shoulder dislocation rely mainly on soft tissue called labrum which is a kind of cartilage that surrounds the periphery of the glenoid, if torn the join is no further stable.
3- Ehlers-Danlos Syndrome has high tendency to have dislocation at lower threshold of energy
4-If an energy is sufficient to dislocate a joint you should suspect other injuries including muscle/ neurovascular.

Acute Joint Dislocation:

Diagnosis

- Hx of a traumatic event
  - Hx of major trauma or high risk position
- Pain and inability to utilize the limb
- Visible deformities (squaring of shoulders) such as:
  - ➔ Shortening
  - ➔ Malalignment
  - ➔ Malrotation

Squaring of shoulders (shoulder dislocation)

Xray: in the field reduce first, in the hospital images → reduce

- Should be done **urgently** without delay if dislocation is suspected.
- Two **perpendicular** views of the involved joint (one view is misleading)
- Special views might be required such as axillary view for the shoulder.
- X-rays to the joint above and below.

Internal rotation, shortening of the leg & posterior hip dislocation.

❗ Always check for other injuries (distracting injury). Pain can hide things
❗ Always check for distal neurovascular status. **BEFORE AND AFTER**
❗ Always check for compartment syndrome.

Management

Management Principles	
1	Must rule out other injuries.
2	Pain relief (consent for reduction/conscious sedation (no intubation)
3	Urgent reduction
4	Check stability and safety zone
5	Check neurovascular status after reduction (even before) **MEDICOLEGAL**
6	X-ray after reduction to confirm reduction [1,2]
7	Protect the joint (by immobilization and stabilizing for 2-3 wks)
8	Rehabilitation (physiotherapy)
9	Follow for late complications

1- If the patient is in hospital setting already then it's better to do Xray before reduction for documentation if available.
2- Meanwhile, if patient is in the scene of injury then came to hospital then it's better to reduce right away because the muscle are softer at that time and it's easier to reduce.

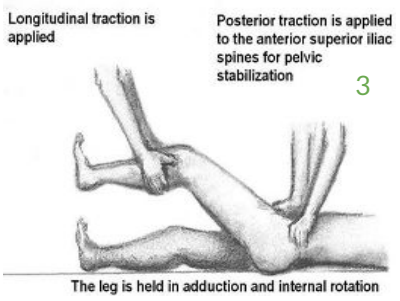
Acute Joint Dislocation:

Reduction Technique

- During reduction, follow the following steps:

1	Monitor the vital signs
2	IV analgesia (opioids)
3	IV sedation (to relax the muscles)
4	Gradual traction to distract the joint
5	Realignment and rotation to reduce the joint based on the dislocation direction
6	A palpable clunk will be felt
7	Check ROM and stability of the joint
8	Once the joint is reduced recheck the NV status: - Intact before but not after → urgent management is needed - Absent before but present after → check again later to confirm

- If irreducible or partial reduction
  - ➔ Perform an urgent closed reduction under general anesthesia or open reduction.
  - ➔ Usually caused by insufficient muscle relaxation or soft tissue entrapment.



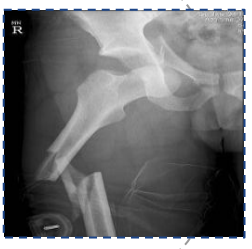
Complications

Early	Late
• Heterotopic ossification • Neurological injury - Reversible or irreversible • Vascular injury • Compartment syndrome • Osteochondral fracture/ injury	• Stiffness • Heterotopic ossification • Chronic instability • Avascular necrosis - Common in femur head • Osteoarthritis

1- If the patient is in hospital setting already then it's better to do Xray before reduction for documentation if available.
2- Meanwhile, if patient is in the scene of injury then came to hospital then it's better to reduce right away because the muscle are softer at that time and it's easier to reduce.
3- Stabilize → traction of leg → .hip flexion → countertraction of pelvis → wait for a 'Clunk' → joint is reduced.
4- Has many techniques one of them is dislodging by using body weight of patient and pull the arm along the joint then use a folded sheet by a helper to pull shoulder.

Acute Joint Dislocation:

Special Considerations



- ! A fracture dislocation is usually reduced in an open fashion in the operating room.
- ! You must confirm concentric reduction on x-ray, otherwise an open reduction should be performed.
- ! Make sure that the neurovascular status is documented before & after.

Examples of Joint Dislocation	
Example	Description
Hip dislocation 	• **Posterior** dislocation is commonest. • Major trauma with hip flexed(dashboard injury in RTAs). • Sciatic nerve injury is common; check extension/flexion of big toe • Loss of foot dorsiflexion • High incidence of late avascular necrosis 10% • **An orthopedic emergency!** • Low recurrence rate • Immobilized by knee immobilization
Shoulder dislocation 	• Common. • Anterior dislocation is more common. • Patients presents with pain and limited range of motion after shoulder injury. • Patients with seizures prone to posterior dislocation. • May cause chronic instability (damaged labrum) • Can result in axillary nerve injury and wasting in deltoid muscle and numbness over its area. • Young patient with dislocation = Higher rate of recurrence • Immobilized by a normal sling • Image is showing **anterior shoulder dislocation** (humerus is anterior)
Knee dislocation 	• **Very serious emergency**. (could be either anterior or posterior) • Usually with **severe** (high energy) trauma. • Three or more ligaments are teared [1] • Associated with popliteal artery injury (50%) (limb threatening) and peroneal nerve injury. (foot drop) • Needs accurate **vascular assessment**. (popliteal artery) • May be associated with fracture/ compartment syndrome. • Most require surgery either early or late or both. • Prognosis is not great • Image is showing **anterior knee dislocation** (tibia is anterior)

1- have medial and lateral collateral ligament and, anterior and posterior cruciate ligaments these main ligaments hold the knee plus meniscus.

Extra:

Compartment Syndrome

- increased interstitial pressure in an anatomical compartment (forearm, calf) where muscle and tissue are bounded by fascia and bone (fibro-osseous compartment), with little room for expansion
- interstitial pressure exceeds capillary perfusion pressure, leading to irreversible muscle necrosis (in 4-6 h) and eventually nerve necrosi

Etiology

- intracompartmental
  - fracture (particularly tibial shaft or paediatric supracondylar and forearm fractures)
  - reperfusion injury, crush injury, or ischemia
- extracompartmental: constrictive dressing (circumferential cast), poor position during surgery, circumferential burn

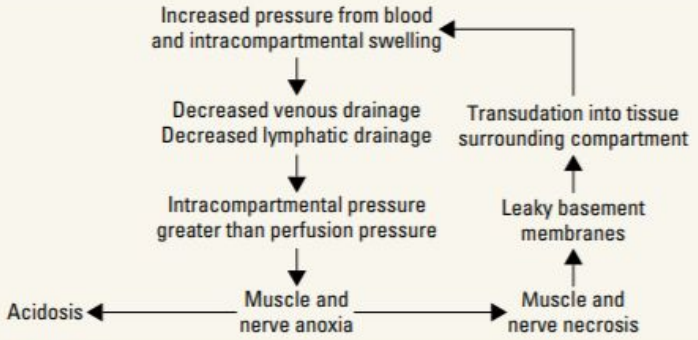


Figure 8. Pathogenesis of compartment syndrome

Most important sign is increased pain with passive stretch. Most important symptom is pain out of proportion to injury

Clinical Features

- pain out of proportion to injury (typically first and most significant symptom)
- pain with active contraction of compartment
- pain with passive stretch (most sensitive sign)
- swollen, tense compartment
- suspicious history

- **5 Ps:** late sign – do not wait for these to develop to make the diagnosis!

5 Ps of Compartment Syndrome
Pain: out of proportion for injury and not relieved by analgesics
- Increased pain with passive stretch of compartment muscles

Pallor: late finding
Paresthesia
Paralysis: late finding
Pulselessness: late finding

Investigations

- compartment syndrome is a clinical diagnosis; investigations usually not necessary
- in children or unconscious patients where clinical exam is unreliable, compartment pressure monitoring with catheter (normal = 0 mmHg; elevated ≥30 mmHg or [dBP – measured pressure] ≤30 mmHg)

Treatment

- non-operative
  - remove constrictive dressings (casts, splints), elevate limb to the level of the heart
- operative
  - urgent fasciotomy
  - 48-72 h postoperative: necrotic tissue debridement + wound closure
  - may require delayed closure and/or skin grafting

Plain Film Findings of Osteomyelitis
- Soft tissue swelling
- Lytic bone destruction*
- Periosteal reaction (formation of new bone, especially in response to #)*

*Generally not seen on plain films until 10-12 d after onset of infection

Complications

- Volkmann's ischemic contracture: ischemic necrosis of muscle; followed by secondary fibrosis; and finally calcification - especially following supracondylar fracture of humerus
- rhabdomyolysis, renal failure secondary to myoglobinuria

Extra:

Shoulder

Shoulder Dislocation

- complete loss of continuity between the two articular surfaces of the glenohumeral joint; may be anterior or posterior

Investigations
- anterior dislocation x-rays: AP, trans-scapular, and axillary views of the shoulder
- posterior dislocation x-rays: AP, trans-scapular, and axillary views of the shoulder; or CT scan

Table 8. Anterior and Posterior Shoulder Dislocation

	Anterior Shoulder Dislocation (>90%)	Posterior Shoulder Dislocation (5%)
MECHANISM		
	Abducted externally rotated/hyperextended arm Blow to posterior shoulder Involuntary, usually traumatic; voluntary, atraumatic	Adducted, internally rotated, flexed arm FOOSH 3 Es (epileptic seizure, EtOH, electrocution) Blow to anterior shoulder
CLINICAL FEATURES		
Symptoms	Pain, arm slightly abducted and externally rotated with inability to internally rotate	Pain, arm is held in adduction and internal rotation; external rotation is blocked
Shoulder Exam	**"Squared off" shoulder** **Positive apprehension test**: patient looks apprehensive with gentle shoulder abduction and external rotation to 90° as humeral head is pushed anteriorly and recreates feeling of anterior dislocation **Positive relocation test**: a posteriorly directed force applied during the apprehension test relieves apprehension since anterior subluxation is prevented **Positive sulcus sign**: presence of subacromial indentation with distal traction on humerus indicates inferior shoulder instability	**Anterior shoulder flattening**, prominent coracoid, palpable mass posterior to shoulder **Positive posterior apprehension ("jerk") test**: with patient supine, flex elbow 90° and adduct, internally rotate the arm while applying a posterior force to the shoulder; patient will "jerk" back with the sensation of subluxation Note: the posterior apprehension test is used to test for recurrent posterior instability, NOT for acute injury
Neurovascular Exam Including	**Axillary nerve:** sensory patch over deltoid and deltoid contraction **Musculocutaneous nerve:** sensory patch on lateral forearm and biceps contraction	Full neurovascular exam as per anterior shoulder dislocation
RADIOGRAPHIC FINDINGS		
Axillary View	Humeral head is anterior	Humeral head is posterior
Trans-scapular 'Y' View	Humeral head is anterior to the centre of the "Mercedes-Benz" sign	Humeral head is posterior to centre of "Mercedes-Benz" sign
AP View	Sub-coracoid lie of the humeral head is most common	Partial vacancy of glenoid fossa (vacant glenoid sign) and >6 mm space between anterior glenoid rim and humeral head (positive rim sign), humeral head may resemble a lightbulb due to internal rotation (lightbulb sign)
Hill-Sachs and Bony Bankart Lesions	**± Hill-Sachs lesion:** compression fracture of posterior humeral head due to forceful impaction of an anteriorly dislocated humeral head against the glenoid rim **± Bony Bankart lesion:** avulsion of the anterior glenoid labrum (with attached bone fragments) from the glenoid rim	**± Reverse Hill-Sachs lesion** (75% of cases): divot in anterior humeral head **± Reverse bony Bankart lesion**: avulsion of the posterior glenoid labrum from the bony glenoid rim
TREATMENT		
	Closed reduction with IV sedation and muscle relaxation **Traction-countertraction**: assistant stabilizes torso with a folded sheet wrapped across the chest while the surgeon applies gentle steady traction **Stimson:** while patient lies prone with arm hanging over table edge, hang a 5 lb weight on wrist for 15-20 min **Hippocratic method**: place heel into patient's axilla and apply traction to arm **Cunningham's method**: gentle longitudinal support and traction of the arm at the patient's side, massage/relaxation of deltoid, trapezius, and biceps to allow atraumatic shoulder reduction. low-risk, low pain; if not successful try above methods Obtain post-reduction x-rays Check post-reduction NVS Sling x 3 wk (avoid abduction and external rotation), followed by shoulder rehabilitation (dynamic stabilizer strengthening)	Closed reduction with sedation and muscle relaxation Inferior traction on a flexed elbow with pressure on the back of the humeral head Obtain post-reduction x-rays Check post-reduction NVS Sling in abduction and external rotation x 3 wk, followed by shoulder rehabilitation (dynamic stabilizer strengthening)

Posterior Shoulder Dislocation
Up to 60-80% are missed on initial presentation due to poor physical exam and radiographs

There are 4 Joints in the Shoulder
Glenohumeral, AC, sternoclavicular (SC), scapulothoracic

Shoulder passive ROM: abduction – 180°, adduction – 45°, flexion – 180°, extension – 45°, int. rotation – level of T4, ext. rotation – 40-45°

Factors Causing Shoulder Instability
- Shallow glenoid
- Loose capsule
- Ligamentous laxity

Frequency of Dislocations
- Anterior shoulder > Posterior shoulder
- Posterior hip > Anterior hip

The glenohumeral joint is the most commonly dislocated joint in the body since stability is sacrificed for motion

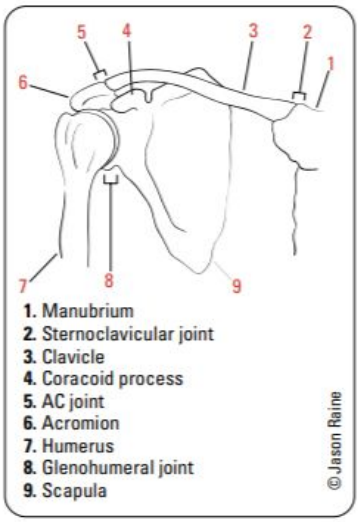


Figure 9. Shoulder joints

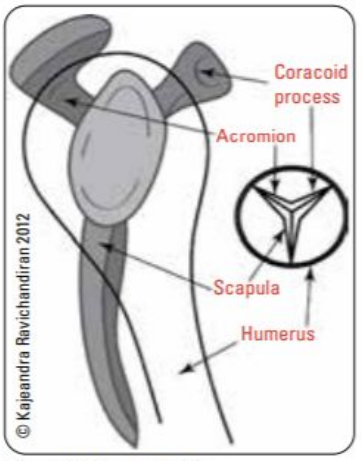


Figure 10. Mercedes-Benz

Extra:

Prognosis
- recurrence rate depends on age of first dislocation
- <20 yr = 65-95%; 20-40 yr = 60-70%; >40 yr = 2-4%

Specific Complications
- recurrent dislocation (most common complication)
- unreduced dislocation
- shoulder stiffness
- rotator cuff or capsular or labral tear (Bankart/SLAP lesion)
- injury to axillary nerve/artery, brachial plexus

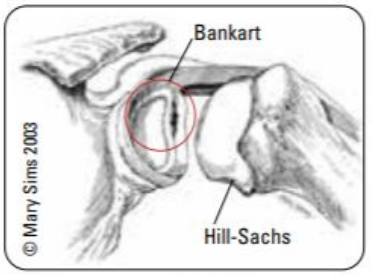


Figure 11. Posterior view of anterior dislocation causing Hill-Sachs and Bankart lesions

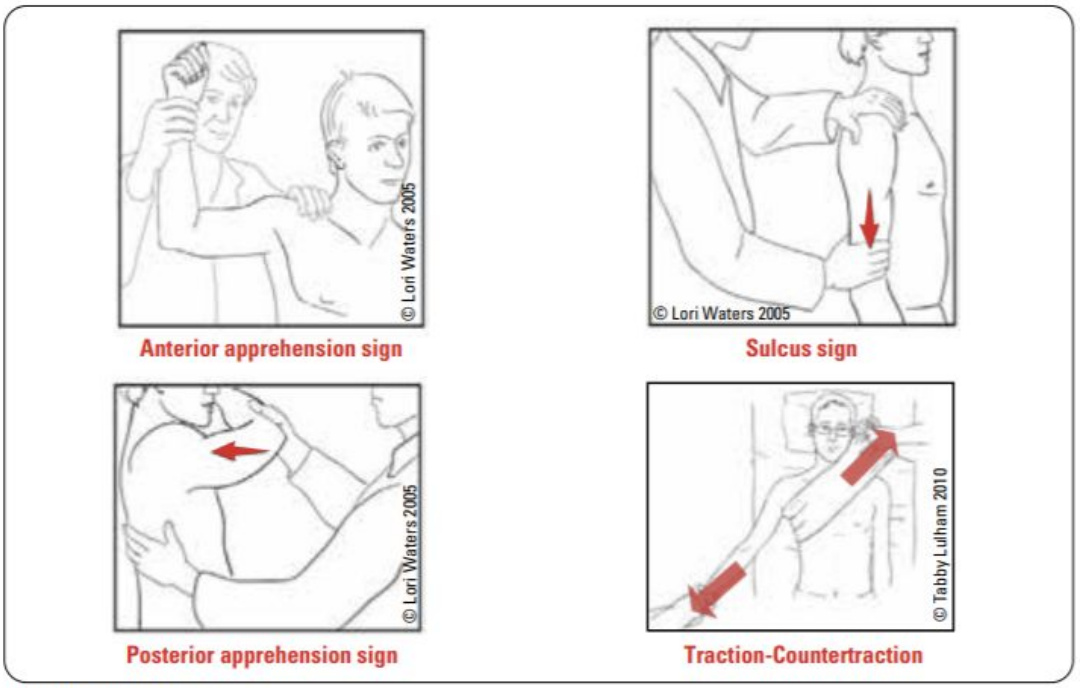


Figure 12. Shoulder maneuvers

Hip

Hip Dislocation

- full trauma survey (see Emergency Medicine, *Patient Assessment/Management*, ER2)
- examine for neurovascular injury prior to open or closed reduction
- high index of suspicion for associated injuries
- reduce hip dislocations within 6 h to decrease risk of AVN of the femoral head
- hip precautions (no extreme hip flexion, adduction, internal or external rotation) for 6 wk post-reduction
- see *Hip Dislocation Post-Total Hip Arthroplasty*, OR31

Up to 50% of patients with hip dislocations suffer fractures elsewhere at the time of injury

ANTERIOR HIP DISLOCATION
- mechanism: posteriorly directed axial loading of the femur with hip widely abducted and externally rotated
- classified into inferior (flexion, abduction, external rotation) and superior (extension and external rotation)
- clinical features: shortened, abducted, externally rotated limb
- treatment
  - closed reduction under conscious sedation/GA
  - post-reduction CT to assess joint congruity

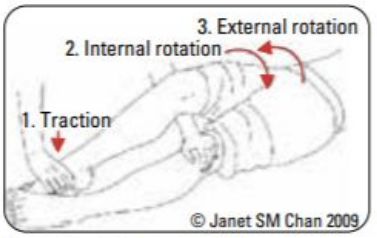


Figure 34. Rochester method

Extra:

POSTERIOR HIP DISLOCATION
- most frequent type of hip dislocation (90%)
- mechanism: severe axial load to knee with hip flexed and adducted
  - e.g. knee into dashboard in MVC
- clinical features: shortened, adducted, internally rotated limb
- treatment
  - closed reduction under conscious sedation/GA only if no associated femoral neck fracture or ipsilateral displacement
  - ORIF if unstable, intra-articular fragments, or significant displacement
  - post-reduction CT to assess joint congruity and fractures

COMPLICATIONS FOR ALL HIP DISLOCATIONS
- post-traumatic OA
- AVN of femoral head
- associated fractures e.g. femoral head, neck, or shaft
- sciatic nerve palsy in 25% (10% permanent)
- HO
- thromboembolism – DVT/PE

Dislocated Knee

Mechanism
- high energy trauma more common (i.e. MVC) or low energy (sport related, obesity)
- by definition, caused by tears of multiple ligaments

Clinical Features
- knee instability
- effusion
- pain
- ischemic limb

Classification
- Kennedy classification (based on direction of tibial displacement) classified by relation of tibia with respect to femur
  - anterior, posterior, lateral, medial, rotary
- Schenck classification (based on pattern of ligamentous injury)

Schenck Classification
Type 1: Single ligament injury (ACL or PCL)
Type 2: Injury to ACL and PCL
Type 3: Injury to ACL, PCL and either MCL or LCL
Type 4: Injury to ACL, PCL, MCL, LCL
Type 5: Multiligamentous injury with periarticular fracture

Investigations
- x-ray: AP and lateral
  - associated radiographic findings may include extensor mechanism injury, tibial plateau fracture dislocations, proximal fibular fractures, and/or avulsion of fibular head
- assessment of NVS:
  - ABI (abnormal if <0.9)
  - arteriogram or CT angiogram if abnormal vascular exam (such as abnormal pedal pulses)
  - detailed neurologic assessment, paying close attention to the peroneal nerve

Treatment
- urgent closed reduction
  - can be complicated by interposed soft tissue (posterolateral variant)
- assessment and management of neurovascular injuries
- emergent operative repair if vascular injury, open fracture or dislocation, irreducible dislocation, or compartment syndrome
- ligament reconstruction to restore knee stability is typically performed in a staged fashion
- comprehensive physiotherapy

Specific Complications
- high incidence of associated injuries (tibia/fibula fracture, extensor mechanism injury)
- popliteal artery tear
- peroneal nerve injury
- capsular tear
- chronic: instability, stiffness, post-traumatic arthritis

Quiz

MCQ

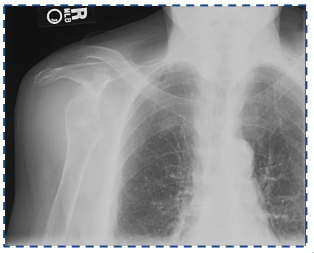
Q1: A 35-year-old male sustains a closed tibial shaft fracture after falling from 12 feet. Which of the following measurements would be concerning for an evolving compartment syndrome?

A. Preoperative anterior compartment measurement of 25, with preoperative DP of 60
B. Intraoperative anterior compartment measurement of 25, with intraoperative DP of 54
C. Intraoperative anterior compartment measurement of 29, with preoperative DP 58
D. Intraoperative anterior compartment measurement of 28, with intraoperative DP of 72

Q2: During a dual incision fasciotomy of the leg, the soleus is elevated from the tibia to allow access to which of the following compartments?

A. Superficial Posterior
B. Deep Posterior
C. Lateral
D. Anterior

Q3: An 80-year-old woman presents to the emergency room with right shoulder pain and immobility. She fell down the steps outside her house and landed on her right side two hours prior to presentation. On exam, her right arm is abducted and externally rotated. She has decreased sensation to touch over the lateral aspect of her right shoulder. What is your diagnosis?



A. Anterior shoulder dislocation
B. Posterior shoulder dislocation
C. Impingement syndrome
D. Adhesive capsulitis

SAQs

A 23-year-old patient presents to the emergency department after a motor vehicle accident. The patient was an unrestrained driver involved in a head-on collision. The patient is heavily intoxicated on what he claims is only alcohol. An initial trauma assessment is performed, and is notable for significant bruising of the right forearm. The patient is in the trauma bay, and complains of severe pain in his right forearm. A physical exam is performed and is notable for pallor, decreased sensation, and cool temperature of the skin of the right forearm. Pain is elicited upon passive movement of the right forearm and digits. A thready radial pulse is palpable. A FAST exam is performed, and is negative for signs of internal bleeding. The patient's temperature is 99.5°F (37.5°C), pulse is 100/min, blood pressure is 110/70 mmHg, respirations are 12/min, and oxygen saturation is 98% on room air. Radiography of the right forearm is ordered. The patient is still heavily intoxicated.

1. What is your diagnosis?
   Compartment syndrome
2. How would you manage such patient?
   Page 5

Answers

Q1	Q2	Q3
C	B	A

THANK YOU

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