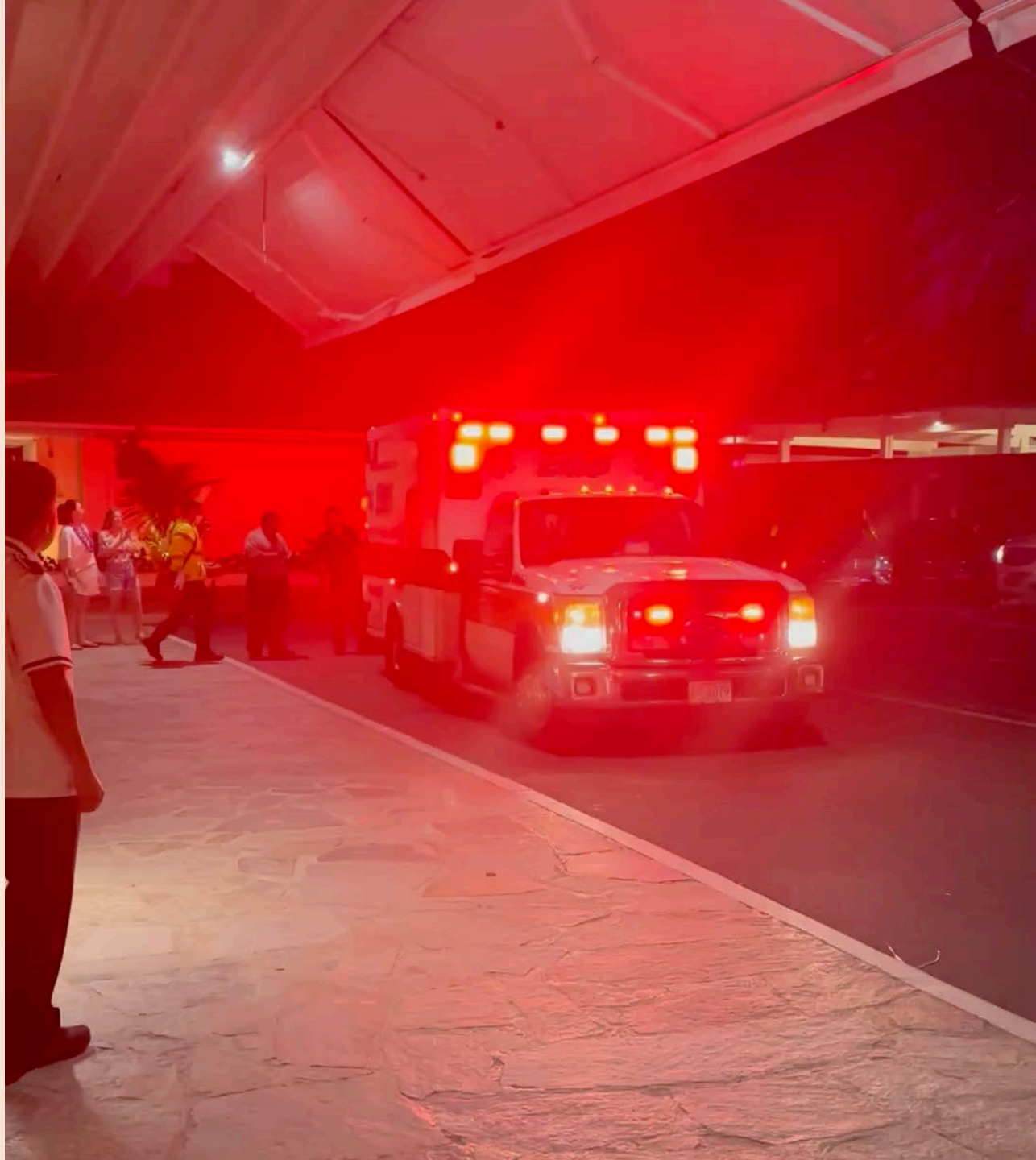
Last Night



Orthopedic Critical Care Without an Orthopedist

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San Francisco General Hospital and Trauma Center

Double Blind Study

Outline

- Compartment Syndrome
- Open Fractures
- Dislocations
- Septic Joints

Compartment Syndrome

- Trauma
- Vascular injury
- Reperfusion
- Casts/splints
- Anticoagulation
- Infusions
- Positional injuries
  - Found down

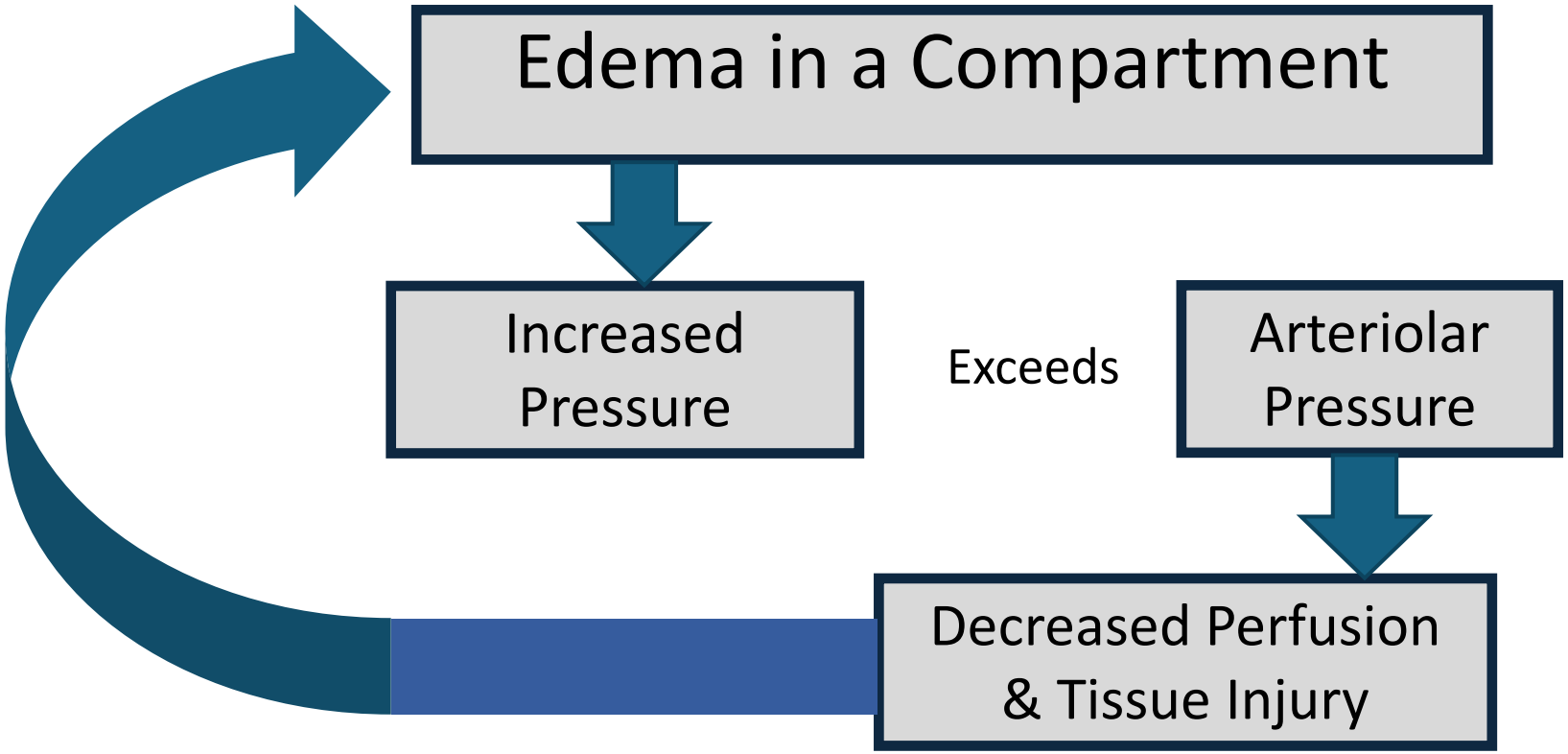
Diagnosis and treatment of acute extremity compartment syndrome

Arvind G von Keudell, Michael J Weaver, Paul T Appleton, Donald S Bae, George S M Dyer, Marilyn Heng, Jesse B Jupiter, Mark S Vrahas

	Proportion of cases (%)
Fracture	
Tibial diaphyseal fracture	36%
Distal radius fracture	10%
Diaphyseal forearm fracture	8%
Femoral diaphyseal fracture	3%
Tibial plateau fracture	3%
Soft tissue	
Soft-tissue injury	23%
Crush syndrome	8%
Other	9%

Table: **Incidence of fractures and other disorders associated with acute extremity compartment syndrome**

Pathophysiology



Compartment Syndrome Exam: The 5 (or 6) P's

- Subjective
  - Pain
- Objective
  - Paresthesias
  - Paralysis
  - Pallor
  - Poikilothermia
  - Pulselessness

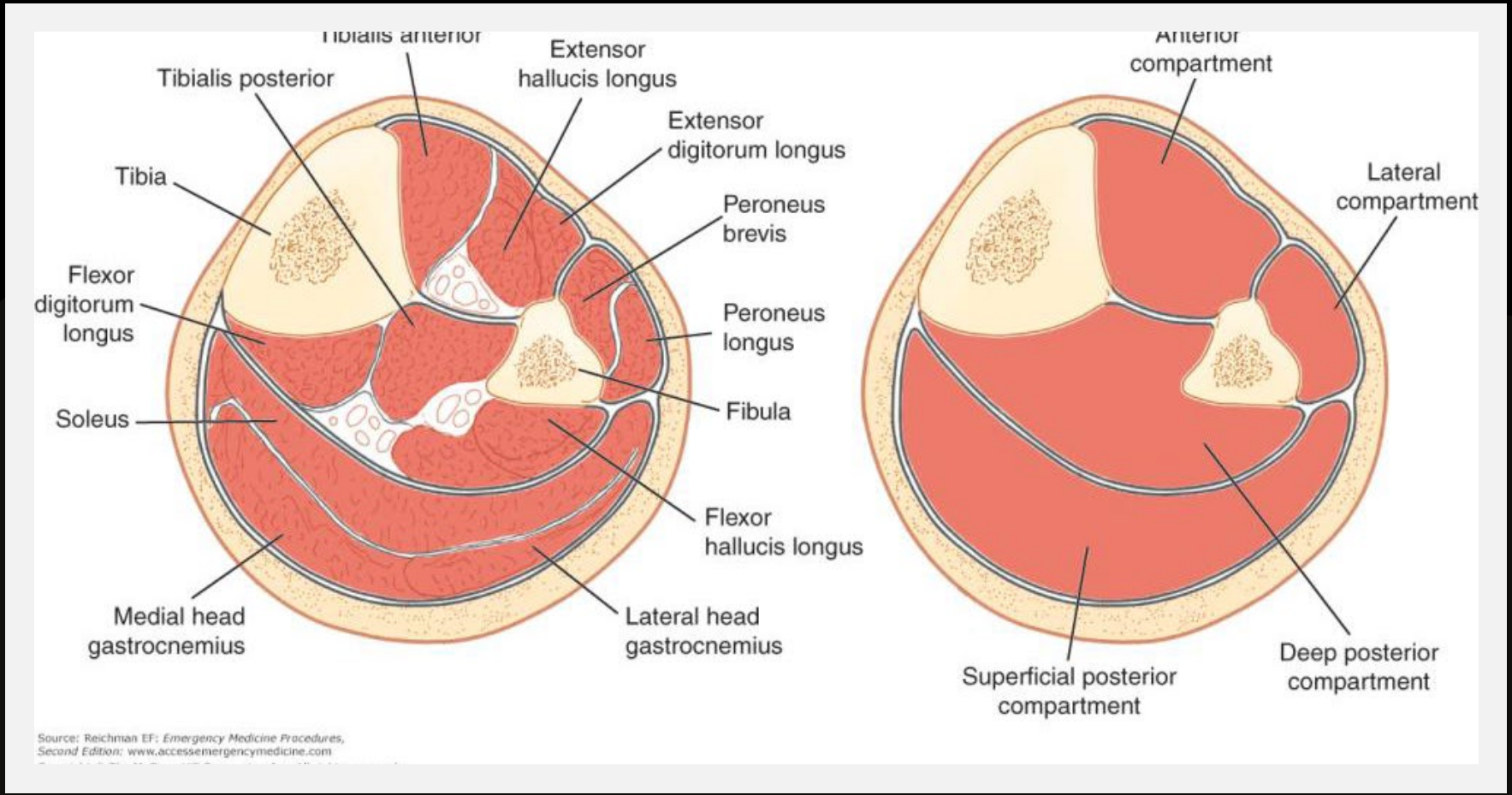
Compartment Syndrome Exam: The 5 (or 6) P's

- Su
- ect
  - aresth
  - aralysis
  - lor
  - hermia
  - Pu

Compartment Syndrome Exam

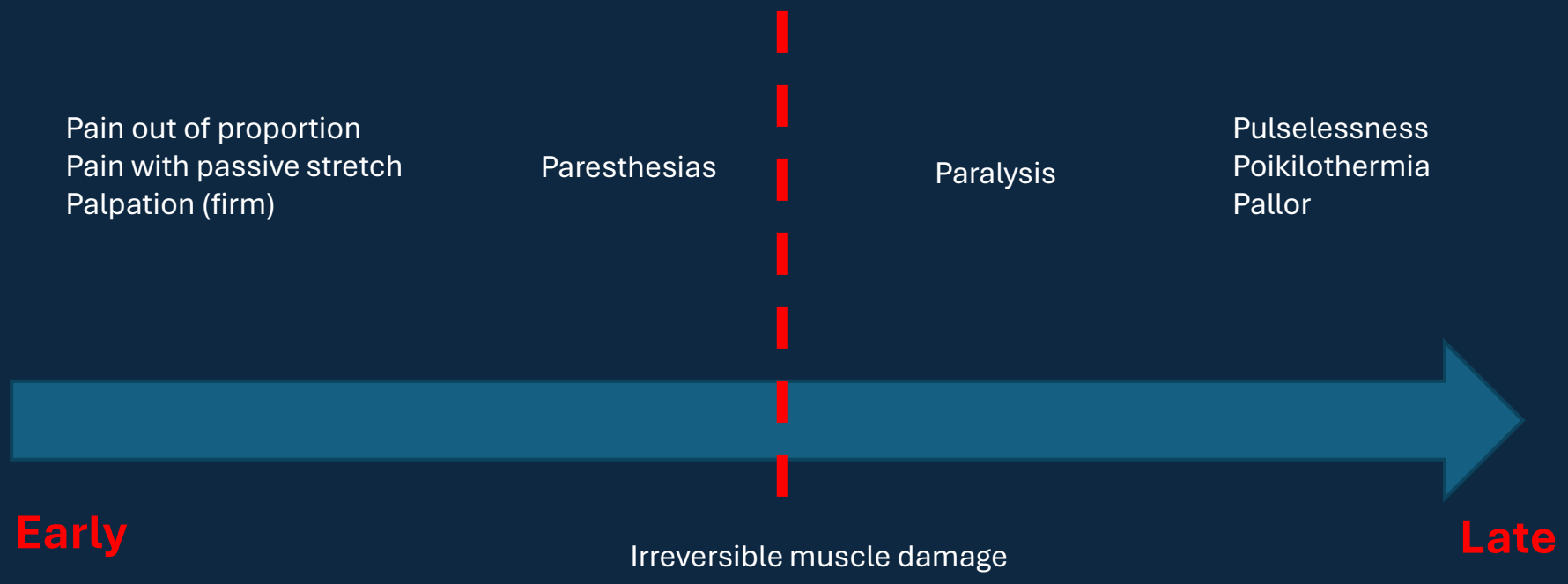
- Subjective
  - Pain out of proportion
- Objective
  - Palpation (firm or tense)
  - Pain with passive stretch
  - Paresthesias

- GET A REALLY GOOD EXAM
  - Every 2 hours minimum
  - Same examiner if possible



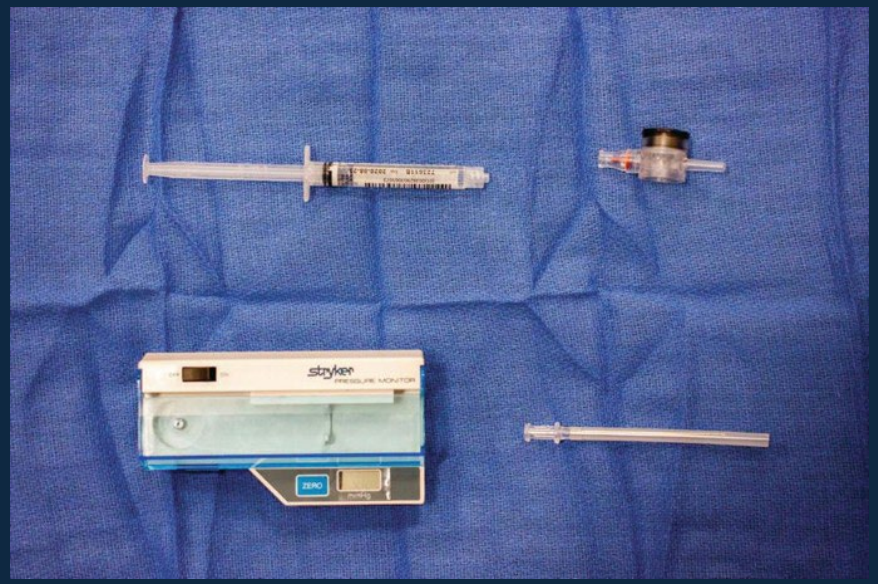
Relevant anatomy

Timing of Symptoms



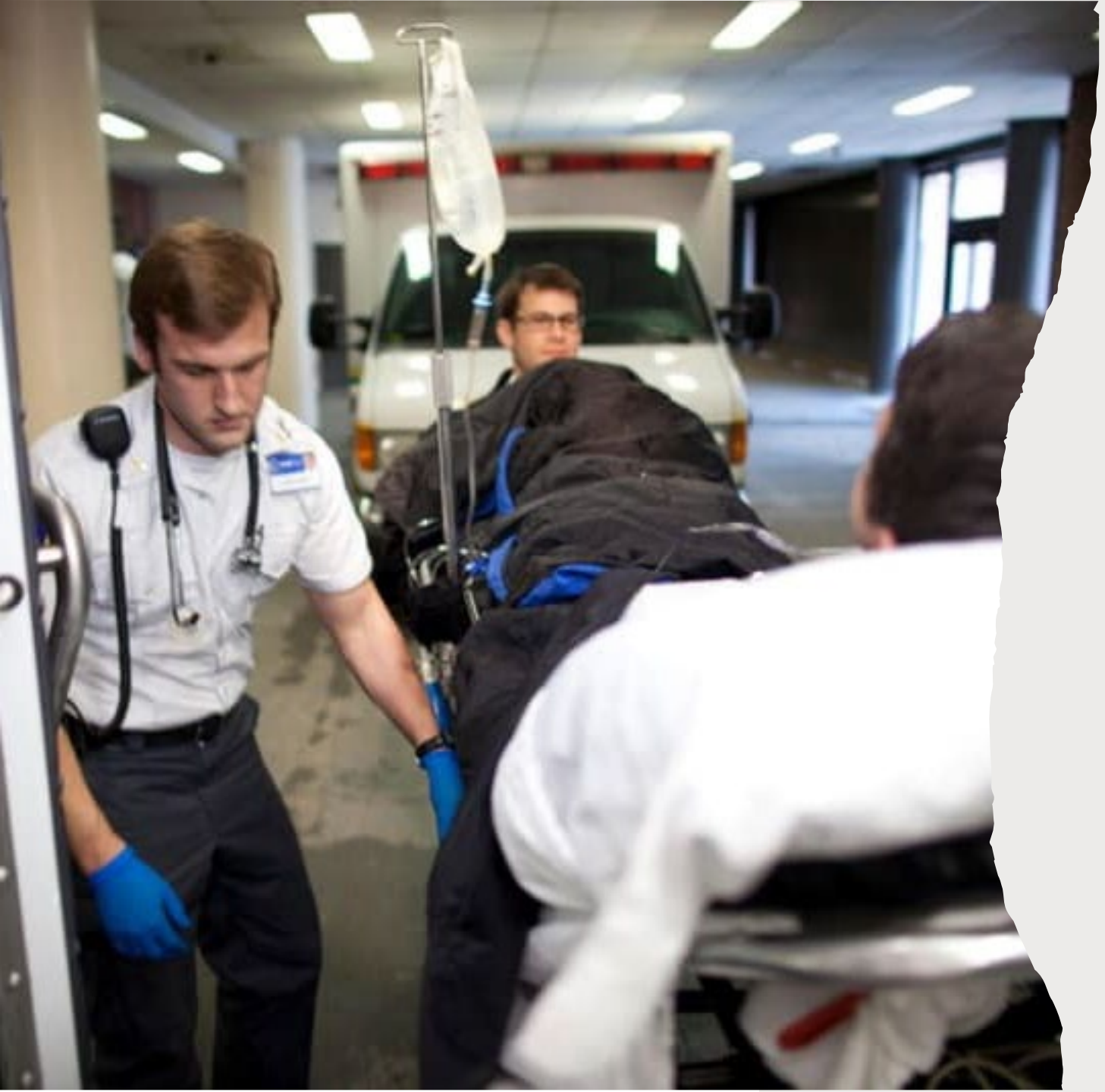
When the diagnosis is unclear

- Obtunded patient
- Intubated patient
- Uncooperative patient



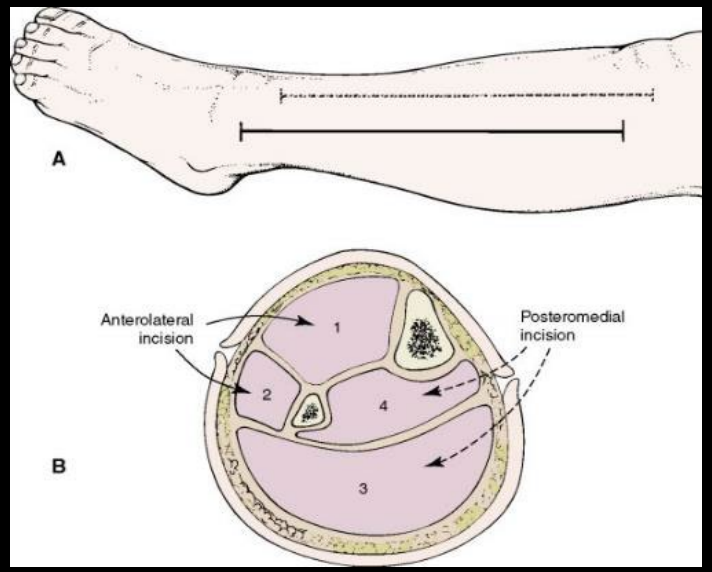
Interpreting pressures

- ΔP = Diastolic pressure – Compartment pressure
- **ΔP ≤ 30mmHg = ACS**



Transfer?

- Elevation
- Remove any offending agent
  - Cast/splint
  - Stop infusion
  - Reverse anticoagulation
- Fasciotomy?
  - Earliest definitive care
    - What help do you have available?



ACS Treatment: Fasciotomy

Compartment Syndrome

- Evolving/missed ACS
  - Rhabdomyolsis
  - Acute renal injury
- Documentation
  - Frequent medical-legal issue

Open Fractures

- Treatment priorities
  - Clean
    - Debride
    - Irrigate
    - Antibiotics
  - Stabilize
  - Cover (or close)

- Classification
  - AO/OTA
  - Gustil-Anderson

Open Fracture?

- Open until proven otherwise
  - Proximity to the wound
  - Persistent bleeding

ED Management

- Clean
  - Irrigate
  - Antibiotics
  - Remove gross debris
- Stabilize
  - Reduce fracture
  - Traction
- Cover
  - Moist gauze (+/- prep solution)
  - Don’t close the wound

Definitive treatment:

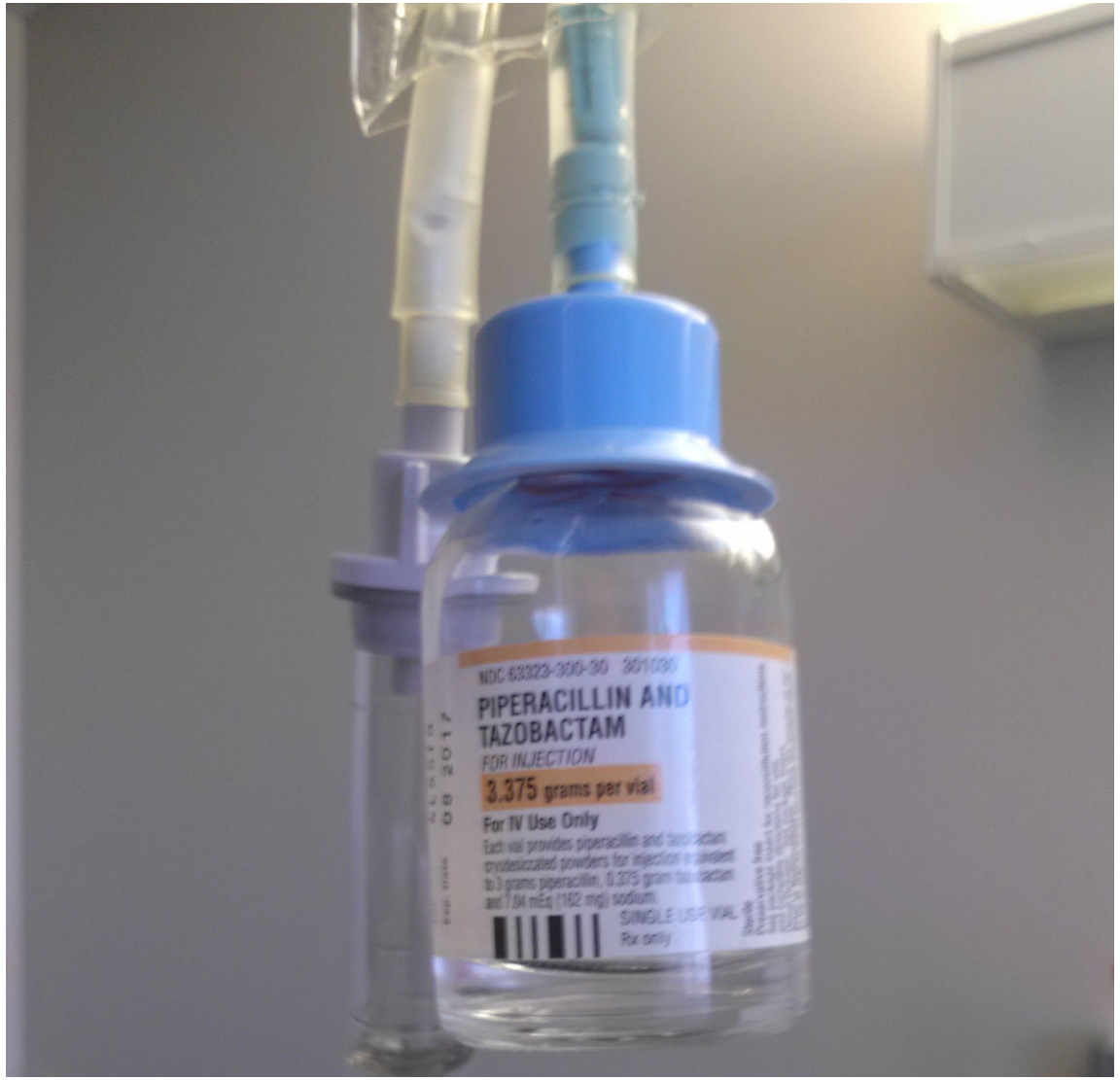
- Clean
- Stabilize
- Cover

Irrigation

- With what?
  - Doesn’t matter
  - Additives (antiseptic or antibacterial solutions) offer no benefit
    - May be worse
- No benefit from high pressure
- Debridement may be as or more important
  - Rupp et al
    - Injury, 2020

Antibiotics

- Timing
  - As soon as possible
    - 1 hour
    - 3 hours
    - 6 hours
- Duration
  - No evidence for over 72 hours



What Flavor?

- All
  - Gram positive
    - 1st generation cephalosporin
      - Cefazolin (2 grams)
- More severe
  - Add gram negative
    - Aminoglycoside
    - Ceftriaxone (2 grams)
- Grossly contaminated
  - “Barn yard”
  - ? Add anaerobics

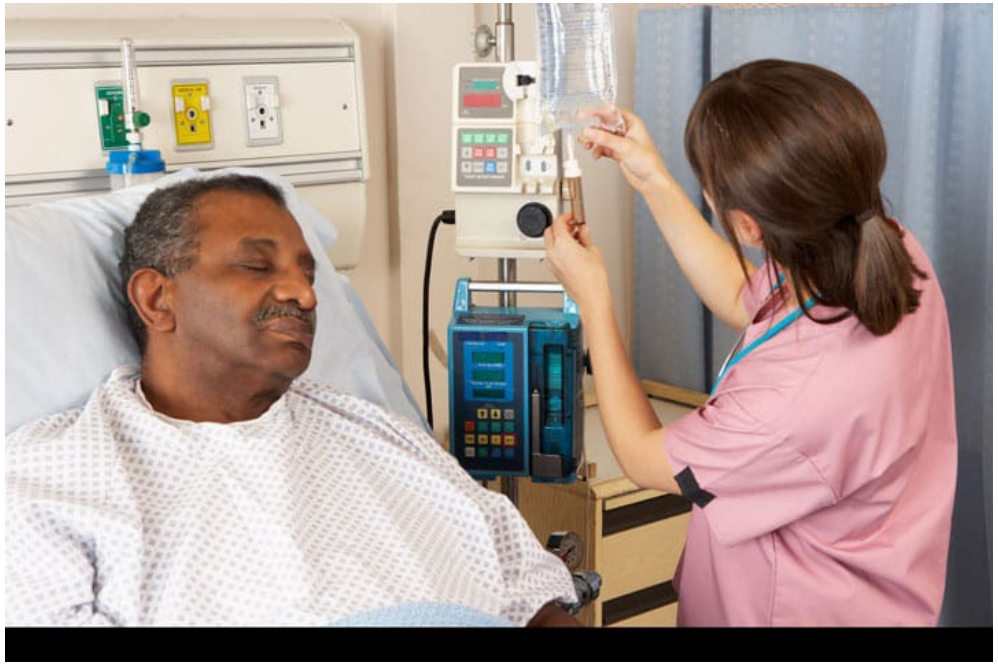
Splinting

- Good splinting of the bones and soft tissues makes a difference
  - Splint in 2 planes
    - Nothing circumferential
  - Cover wounds with moist gauze or xeroform
    - Claireaux et al
      - Injury, 2021

Dislocations

Primary Pitfall - Inadequate Analgesia and/or Sedation

- Appropriate analgesia/sedation is key to safe, effective, and humane joint reduction
- What medication to use?
  - Fentanyl
  - Versed
  - Propofol
  - Ketamine



Sedation

- Randomized, double-blinded, clinical trial of propofol, 1:1 propofol/ketamine, and 4:1 propofol/ketamine for deep procedural sedation in the emergency department
  - Miner et al
    - Ann Emerg Med, 2015

Intra-articular Injections

- Intra-articular lidocaine vs. IV sedation for closed reduction of anterior shoulder dislocation in the ED: A systematic review and meta-analysis
  - Sithamparapillai et al
    - CJEM, 2022
    - No difference in reduction success
    - Fewer adverse events
    - Shorter ED stay
    - No difference in pain score

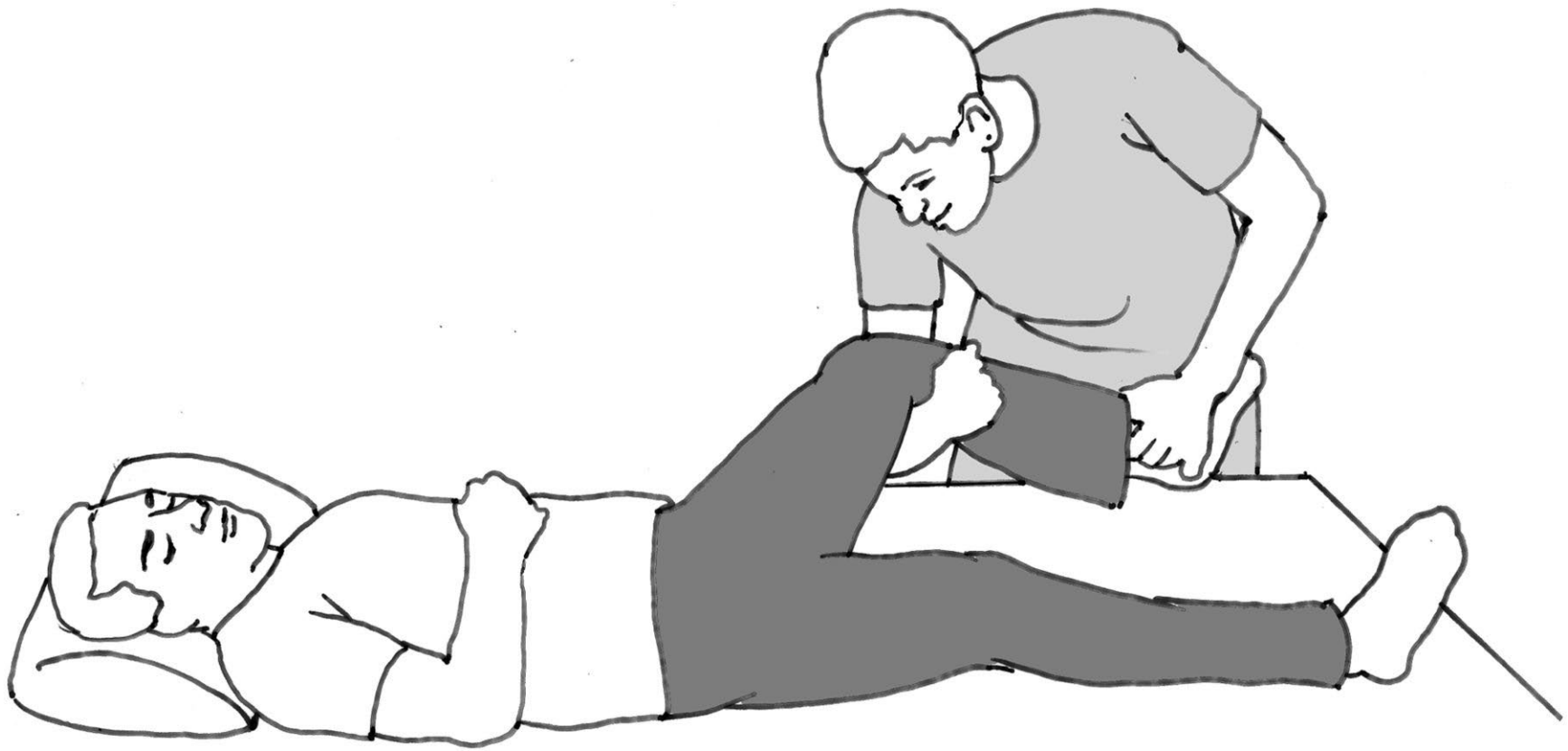
Hip Dislocation Pitfalls

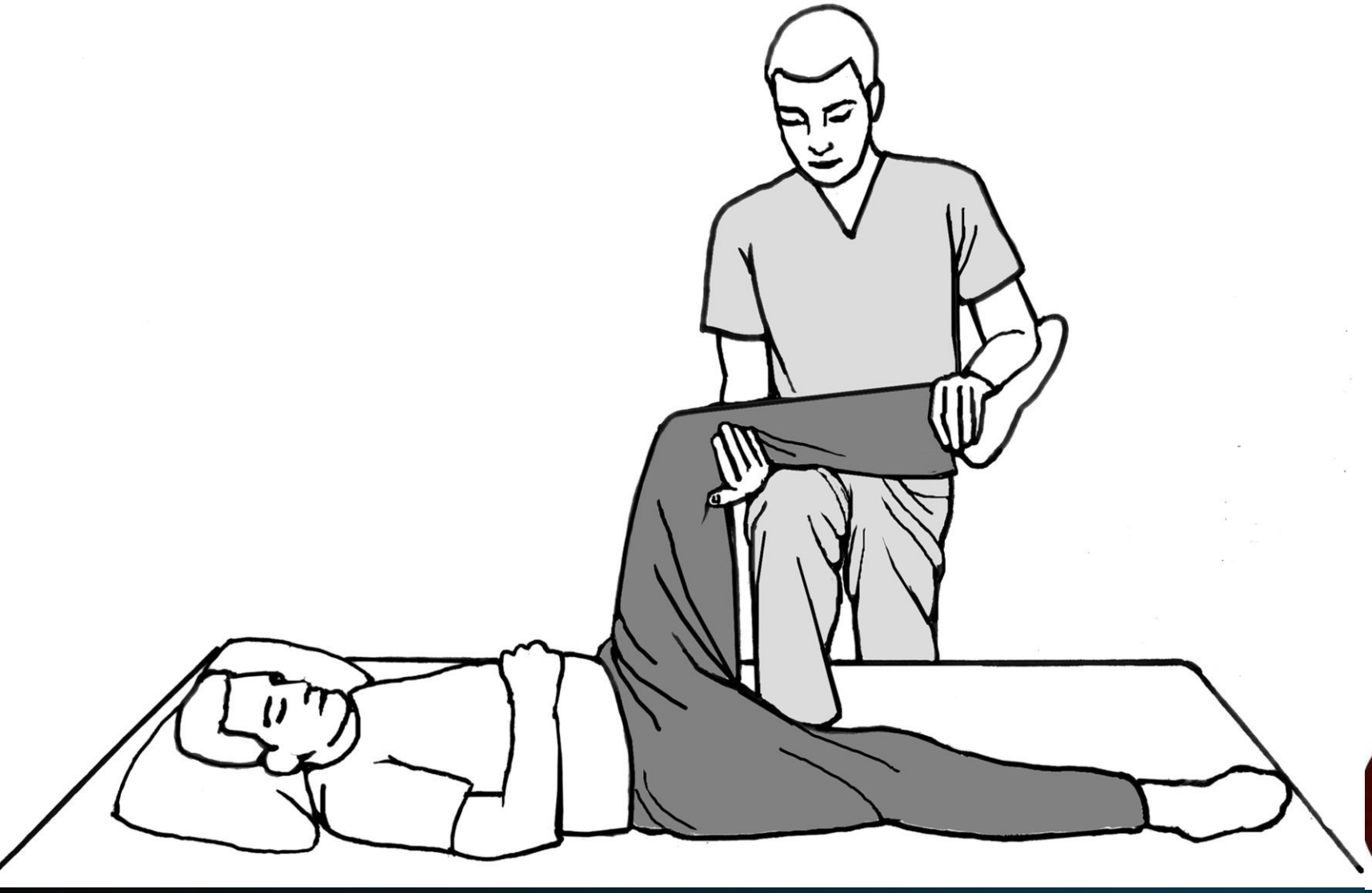
- Time from injury
  - > 3.5 hours resulted in significantly reduced success rates
    - Lai et al
  - Avascular necrosis
    - Lai et al
      - J Ortho Traumatology, 2022
- Missing other injuries
  - Hip dislocation requires significant force
- Sciatic nerve injury
  - Common peroneal branch

Hip Reduction

Hip Reduction

Hip Reduction



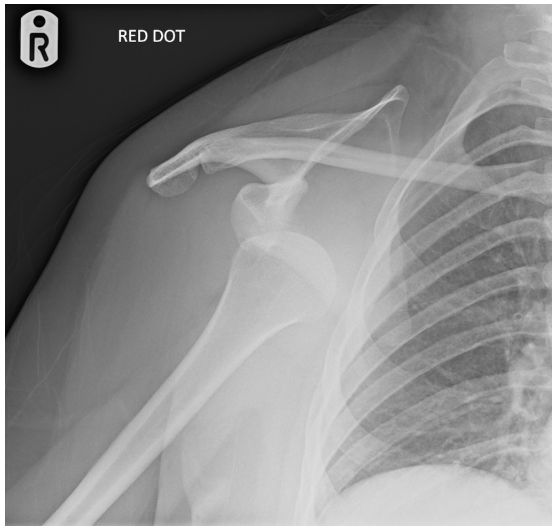


Hip Reduction

Anterior Hip Dislocations

- Anterior Dislocations
  - Drop the leg off the side of the table
  - Traction, external rotation to unlock, internal rotation, flexion
  - Abduction of the proximal thigh if needed

Shoulder Dislocation

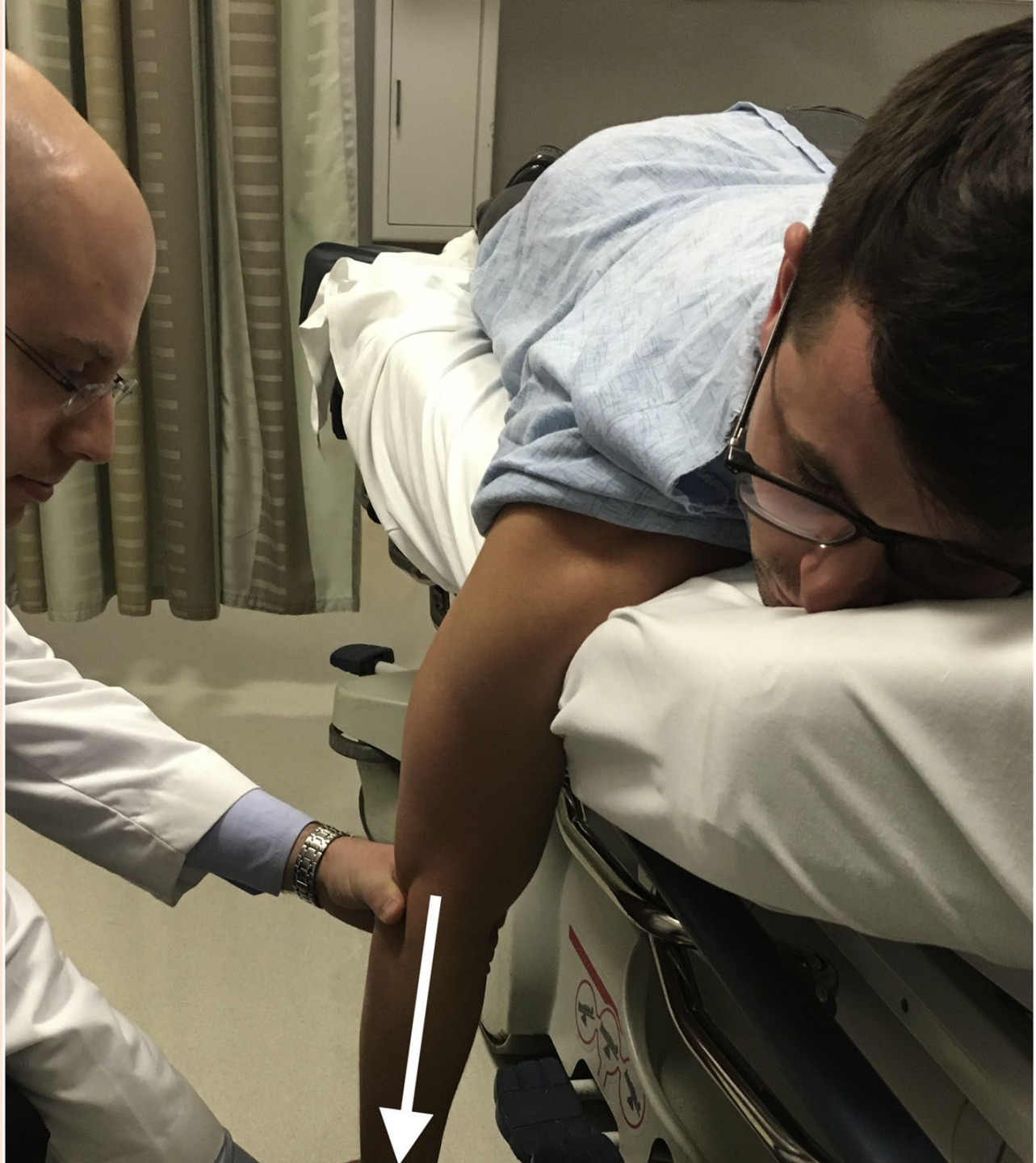


- Back up techniques
  - Have 2
    - Traction – countertraction
    - Scapular manipulation
    - Stimson technique
    - External rotation
    - FARES method
      - Gottlieb M.
        - J Emerg Med, 2020

Traction – Countertraction

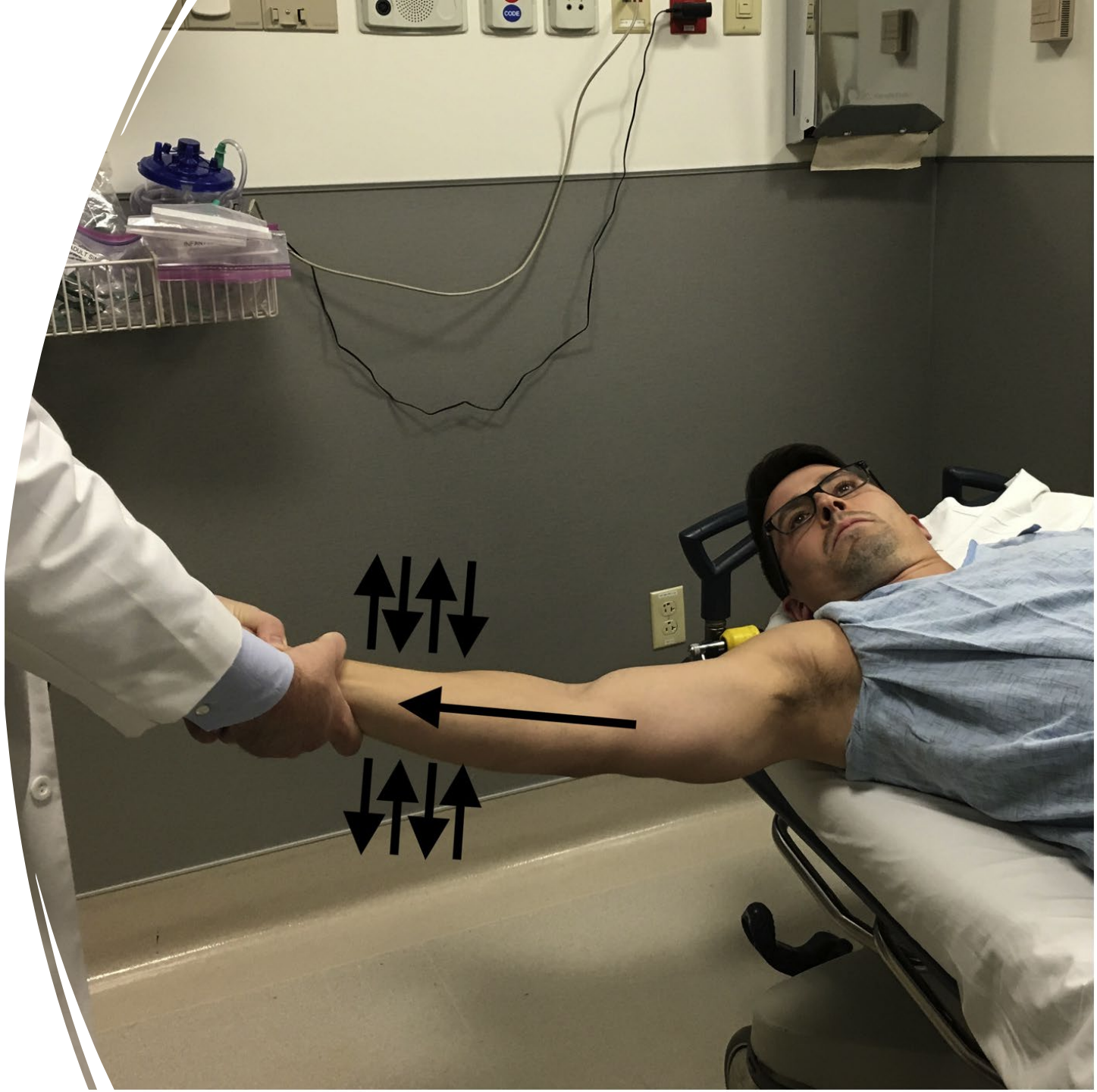
Scapular Manipulation

Stimson Technique



External Rotation

FARES Method

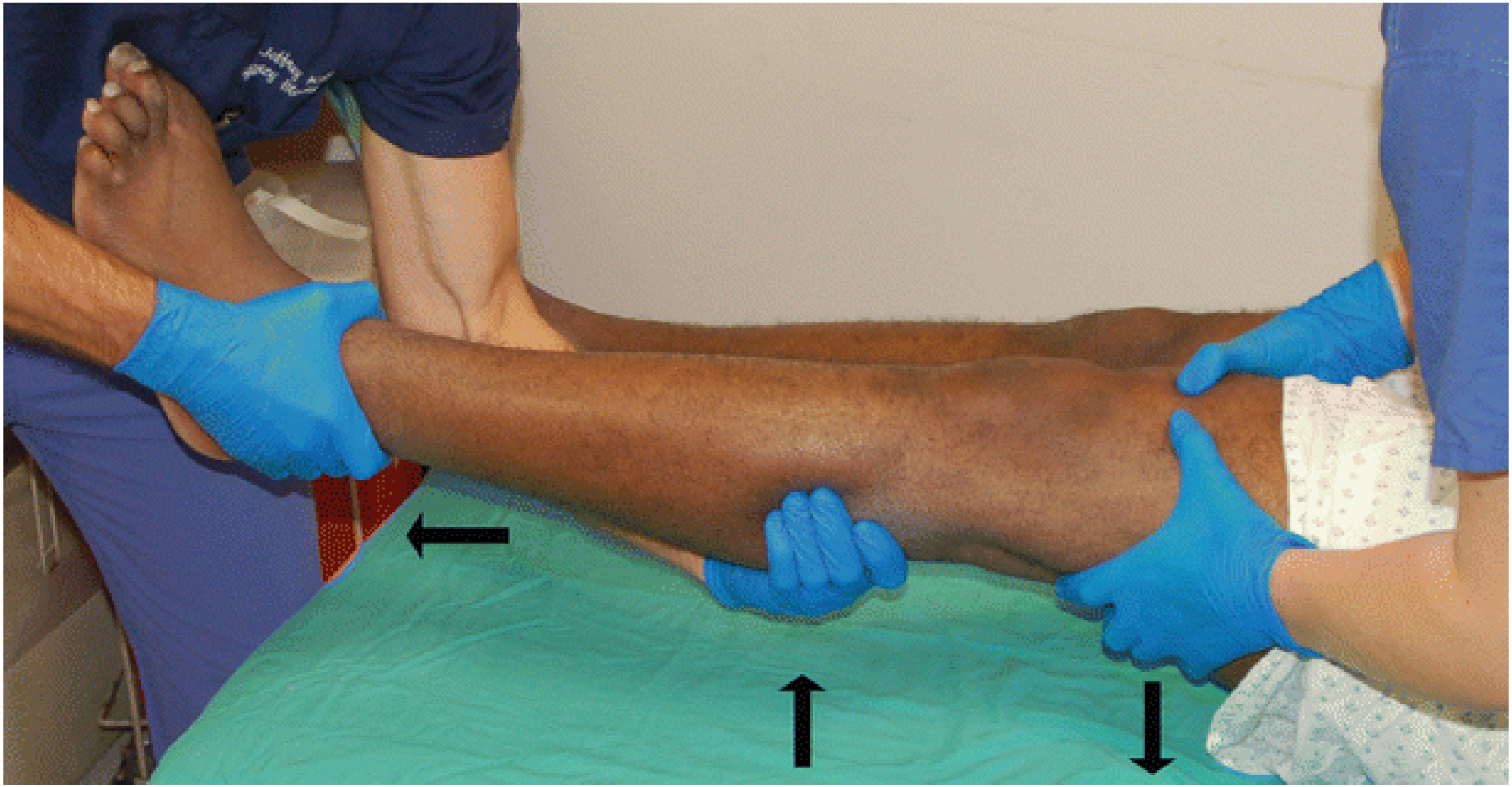


Shoulder Dislocation Pitfalls

- Believing it is a procedure of strength
- Not recognizing posterior dislocations
  - 2-5% of all shoulder dislocations
  - More common after
    - Seizures
    - Electrical injury
    - High energy trauma
  - Almost 80% missed or delayed

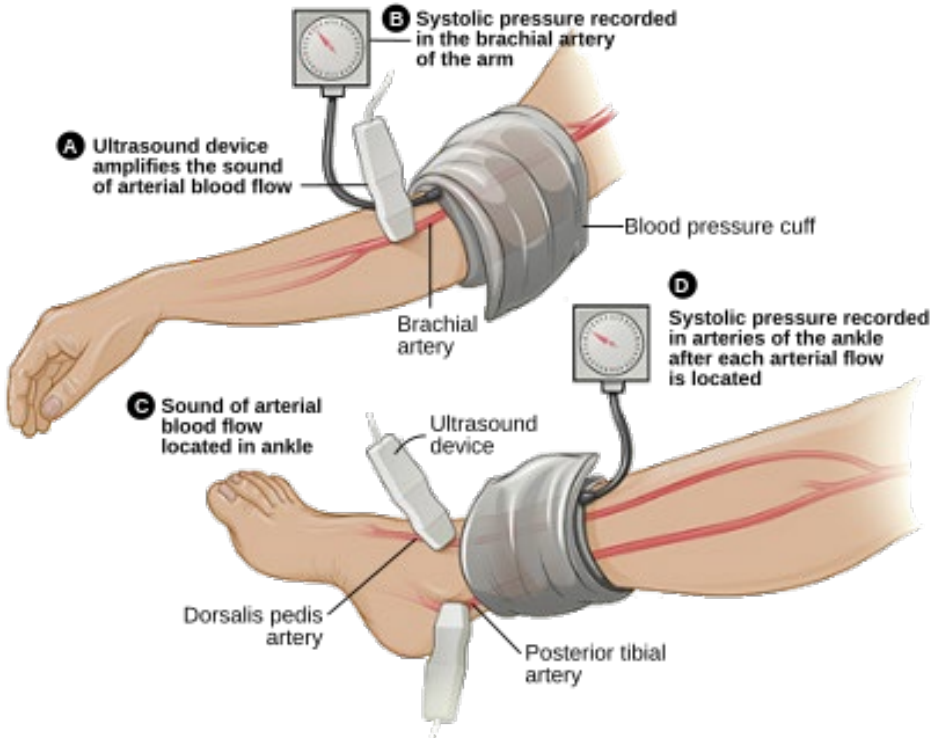
Knee Dislocation Pitfalls

- Not appreciating a dislocation occurred
  - 50% self-reduce before ED arrival
    - Sillanpaa et al
      - J Trauma Acute Care Surg, 2014
- Associated injuries
  - Popliteal artery
  - Peroneal nerve
- Normal exam does not exclude vascular injury



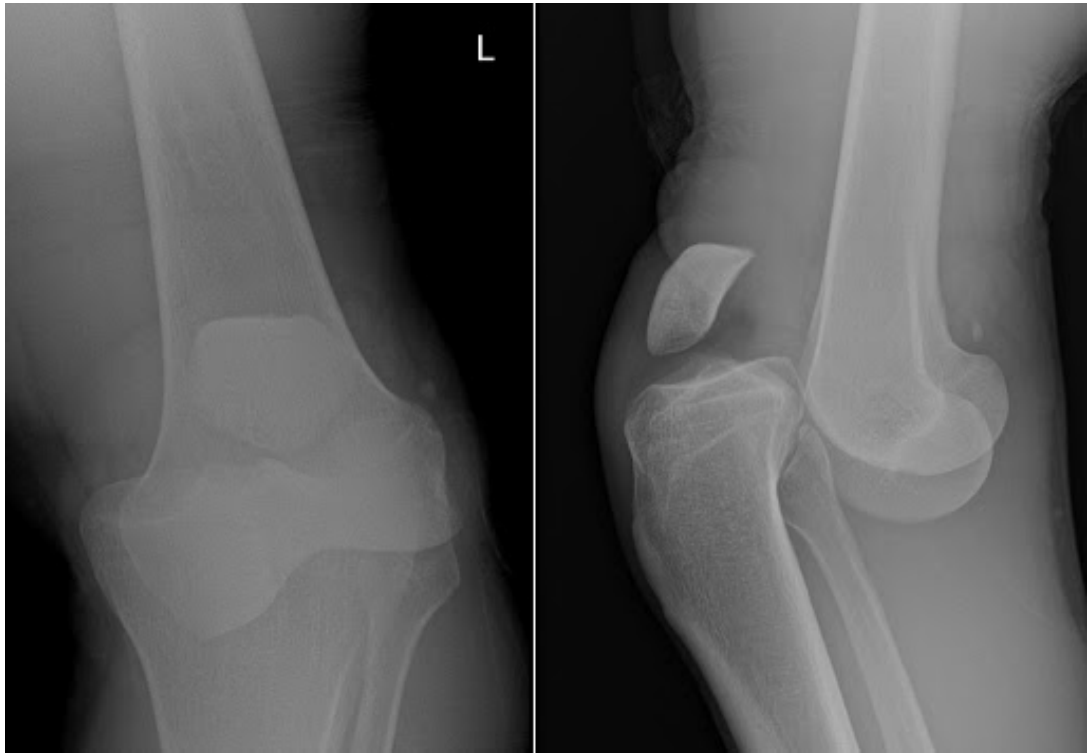
Knee Dislocations

- Careful neurologic exam
  - Signs of peroneal nerve injury
    - Foot drop
    - Weakness in dorsiflexion
    - Numbness/paresthesia in the lateral leg/dorsal foot
- Ankle-brachial index (ABI)
  - Ratio of the systolic blood pressure of the lower extremity (ankle) and upper extremity
    - Normal is > 0.9



Knee Dislocations

- Larger individuals can dislocate with more minor mechanisms
- Posterolateral dislocations are very difficult to reduce in the ED
- Delay of popliteal artery repair of greater than 8 hours often results in amputation



Patella Dislocations

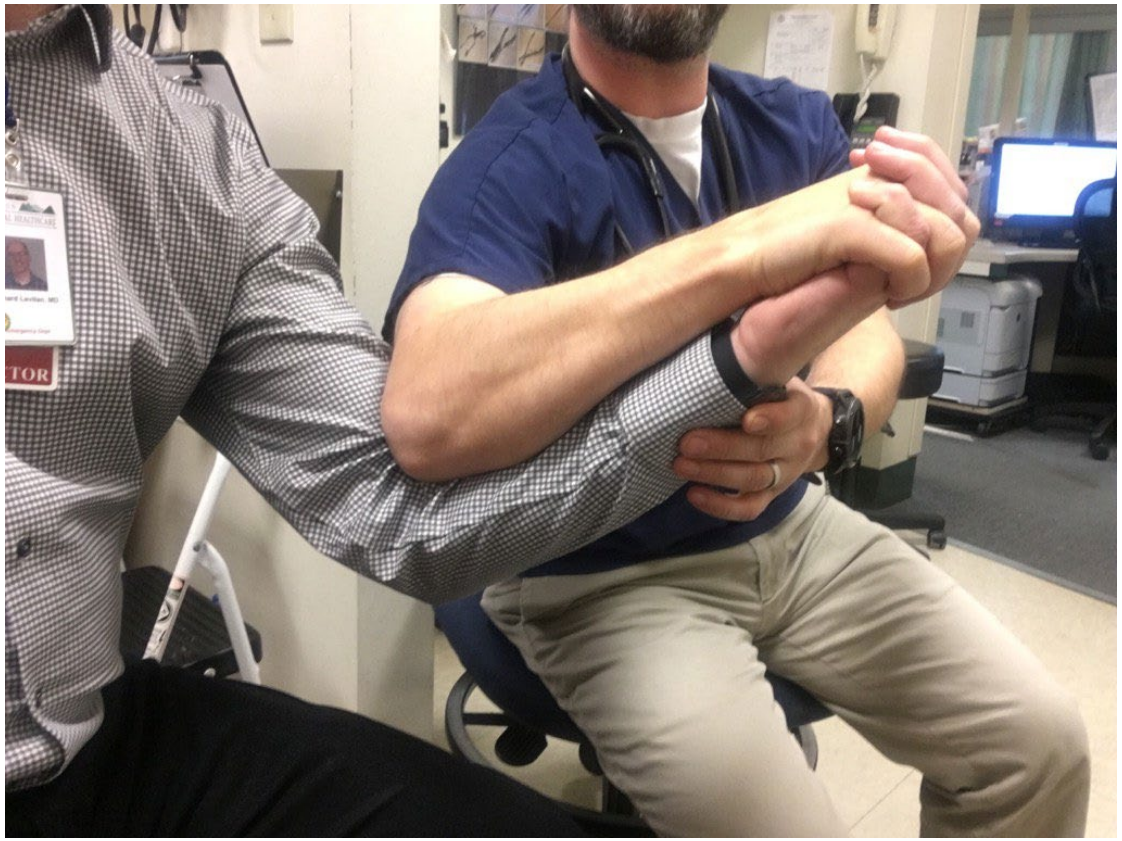
- Hyper-extend the knee
- Flexion at the hip shortens the quadriceps

Ankle Dislocation

- Ankle rarely dislocates without associated fractures
  - Ligamentous injury
- Imaging is not needed prior to reduction
- Counter-traction is key
  - May need to “re-create” the injury (direction)

Elbow Dislocation

- Slow, steady traction-counter traction
  - Matched with appropriate sedation/analgesia
- May require a particular “closeness” with your patient
- Brachial artery
- Ulnar and median nerves



Elbow Dislocation

Wrist Dislocation

- This can be for
  - Wrist dislocation
  - Displace distal radius fracture
    - Works great with hematoma blocks

Wrist Dislocation/Reduction

Infected Joints

- PE – Warm, red, swollen joint, pain with even mild motion
  - Infected joints are very painful
    - If the patient is distractable and you can move the joint without much pain when distracted then it is unlikely to be infected
- Gout, pseudogout, and inflammatory arthritis can mimic septic arthritis
  - Both can be present

Summary

- Adequate analgesia/sedation is the key
- Have a go to method
  - At least 1 back up
    - 2 for shoulders
- Good neurovascular exam before and after
  - Specific to the injury

Thank You!

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