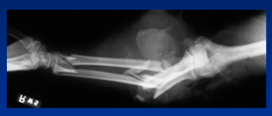
Orthopaedic Trauma Patients, Pelvic Binders, Traction & Splinting, and More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Purpose

- Review Common Care and Treatments for Orthopaedic Trauma patients
  - Pelvic Fractures/Binders
  - Traction and Splinting
  - Compartment Syndromes
  - External Fixator

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Acknowledgements

- The lecture contents are a conglomeration
  - -Lectures For Renown Orthopaedic Trauma
  - -Resident lectures made by the Orthopaedic Trauma Association.

I wish to acknowledge all of their groundwork that helped me today.

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Why are we here?

- Orthopaedic injuries compromise 1 in 5 of all visits to emergency rooms
- In many cases, appropriate initial management can have a significant impact on outcome
  - Compartment syndrome, open fractures, pelvis injuries

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Why do we care?

- Leading Cause of Health Care Visits
  - 77% (65.8 million) of all injury health care visits are for musculoskeletal injuries

    http://www.boneandjointburden.org/docs/By%20The%20Numbers%20-%20MSK%20Injuries.pdf
- 1.5 million people/yr in the US experience an injury serious enough to require hospitalization
- $671 Billion annually for Trauma Health Care Costs and lost productivity

https://www.nattrauma.org/what-is-trauma/trauma-statistics-facts/

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Why do we care?

- Trauma is the leading cause of death for individuals up to the age of 45 years
  - Trauma is 4th leading cause of death for all ages.
  - MVC is leading cause of death in the first three decades of Americans' lives.
  - Motor vehicle crashes killed over 35,000 in 2015
  - MVC injuries send >2.3 million/year to ER
  - Annual Health Care and lost productivity $671 B

    http://www.aast.org/trauma-facts
- CDC 2016- 44,965 recorded suicides
  - U.S. suicide rate increased 24% from 1999-2014

https://www.nimh.nih.gov/health/statistics/suicide.shtml

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Differences in Orthopaedic Trauma Patient

- Relationship with Patient and Providers
- Socioeconomic Status
- Mental Health
- Substance Abuse

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Terminology Review

- Fractures = Broken Bones
- Dislocation = Joint disruption
- Sprain = When a ligament is torn or stretched beyond normal range
  - Huge component of traumatic injuries
  - Often have missed fractures
- Strain = Muscle is stretched beyond normal range

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Physical Exam Terminology

- Deformity
- Tenderness
- Guarding
- Swelling
- Bruising
- Crepitus
- False Motion
- Locked Joint

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Fractures

- What bone is broken?
- Open vs. closed?
- Displaced or non-displaced?
- Isolated injury or polytrauma?
- Associated conditions
  - Vascular Injury
  - Neurologic Injury
  - Compartment syndrome

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Open Fractures

- Often scarier than they really are
- Ok to allow/push exposed bone back in if compromised skin
- Usually reduce with gentle longitudinal traction
- Put sterile compression dressings on and splint
- Still at risk for compartment syndrome

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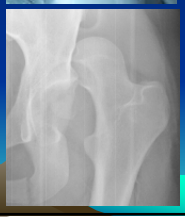
Dislocations

- What joint is it?
  - Acromioclavicular vs. glenohumeral
  - Shoulder and hip most common
- Is it stable or unstable
  - Did it pop out again?
- Distal neurovascular status



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Hip Dislocations

- Traumatic posterior hip dislocations are high energy injuries (Not grandma's total hip)
- Associated injuries are common
- Outcome is highly dependant on time to reduction, associated injuries and post-reduction management
- Unsatisfactory results can be expected in up to 50% of patients
  - Dreinhofer, JBJS, 1994, Yang, Clin Orthop, 1991
- Treatment is directed to the avoidance of complications

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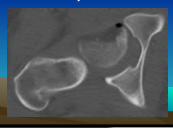
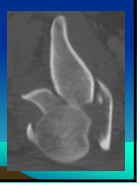
Hip Dislocation Associated Injuries

- Due to mechanism, concomitant injuries are the rule
- Up to 95% require inpatient care
  - Suraci, J Trauma, 1985
- Ipsilateral injuries include
  - Pelvic and acetabular fractures
  - Femoral head, neck or shaft fractures
  - Patella fracture, knee ligament ruptures and dislocations
  - Sciatic nerve injury





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Pelvic Fractures and Pelvic Binders

- Patterns of Pelvic Fracture
  - Anterior to Posterior (The Open Book Type)
  - Lateral Compression
  - Vertical Shear
- Analogy
  - "Life saver never breaks in one spot".
  - Pelvis rarely breaks in one location.
- Open Book benefit with Binders and taping feet and legs to prevent external rotation.

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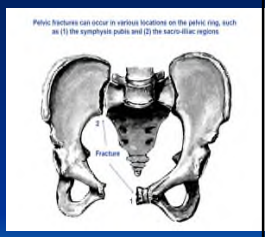
How Binders Work

- The pelvic binder is used to splint the bony pelvis in open book injuries. The binder splints the bony fracture, approximating bone ends and reducing low-pressure bleeding from bone ends and disrupted veins.
- http://www.trauma.org/index.php/main/article/657/



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Physical Exam for Pelvis Stability

- In training we all learn pelvic “rock”
  - Squeeze Together and Push Down-Be Careful
- PEARL for Recognizing Open Book Pelvis
  - Feel your pubic symphysis, just below your belt buckle. Normal gap is one finger or 1cm.
  - Open book pelvis is tender at the symphysis with swelling and a gap greater than your finger width.

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Applying a Pelvic Binder

- The binder should be placed over the greater trochanters, NOT the iliac crests.
- The binder will not control arterial hemorrhage. Patients who do not improve hemodynamically following application of the pelvic binder may require urgent angio-embolization or operative intervention.
- http://www.trauma.org/index.php/main/article/657/

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Pelvic Binders Types

- The manufacturer is less relevant than applying correctly.
- Locally you see T-Pod and SAM Splints.
- A sheet can do the job with towel clips. Nothing fancy or expensive but effective.

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Pelvic Binder Key Points

- Apply with just enough force to close pelvis disruption. Too much pressure can over-reduce the pelvis. If left on pressure breakdown can occur, important not to fold extra material (trim to fit on T-Pod and sheets.)
- Proper placement allows access for embolization and laparotomy. Sheet binders are great as you can just cut holes if needed.

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Femur Fractures

- Femur Fractures
- Locations- Proximal third, middle half, distal third
- Physiology of blood Loss 1000-2000 cc blood loss per CLOSED fx
- Closed versus Open
- Unilateral vs Bilateral

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Types of Pre-Hospital Femur Traction Splints

- Thomas Splints- half circle under proximal thigh

- Hare Splints-about quarter of a circle under the proximal thigh

- BOTH Thomas and Hare require the leg to be lifted, only provide unilateral traction, and have non-quantifiable traction

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Femur Traction Splint Indications

- Middle half without Pelvic/knee/lower leg fractures.

(Sager has an application for proximal/hip fractures)

- Traction relaxes the spasm of muscles that your body does to stabilize fractures.
- Lengthening muscles compresses around the fracture site and diminishes the potential space for blood to collect.
- Maintain proper alignment- Length and Rotation
- Prevents further soft tissue injury by fracture

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Sager Splints

- Do not have to lift leg.
- Made unilateral or bilateral.
- Quantifiable dynamic traction

Unilateral

Bilateral

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Kendrick's Traction Device

- KTD- Kendricks traction device(Now OPD)
- Very compact, does not lift leg
- Fits on lateral thigh
- Non-quantifiable traction
- Does not control rotation, important to tape feet

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CT-6 Carbon Traction Leg Splint

- CT-6- Very compact, very rigid as carbon fiber (versus aluminum KTD)
- Has 4:1 pulley for traction application, and has non-quantifiable traction

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Application technique

- Application technique. Compare extremities in unilateral fractures, for length and rotation.
  - IF unilateral,you can apply traction up till about the **same length as non-injured leg**. This may have a few re-adjustments as Spasm relaxes.

TAPE/BIND feet to stop rotation during handling/transport.

- Measuring Traction. Apply TO RELIEF.

Sager is only one with quantifiable & dynamic and bilateral traction. Focus on relieving the spasm, not the numbers or pounds of traction on a splint.

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Ankle Strap malposition causing Rotation.

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Good position. Straps are on each side/malleoli of ankle. The feet and legs are tied together

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Adjustable for the Ankle Size from Cankle(Calf/Ankle) to Kids

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Skin Traction in the Hospital "Bucks"

Used for inpatient Hip/Proximal Femur Fractures

Friction Applied to skin & soft tissues

- Provides light, temporary pull
  - 5-10 lbs
- KEY POINT
  - In Pre-Hospital training we hear "Don't Put Traction on Proximal Femur/ Hip Fractures". (Sager says OK)
  - I am telling you we put traction on these in the hospital. So if you accidentally apply traction to a proximal femur fracture, don't panic or worry.

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Skeletal Traction

- Direct, longitudinal pull applied to bone with use of a traction bow
  - Steinmann pin
  - Kirschner wire
  - Tongs
- Strong, steady traction force
  - 15 - 40 lbs (depends on pin size and location of pin)
- Risk for:
  - Pin track infection
  - Osteomyelitis

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Skeletal Traction Sites

- Skull for Cervical
- Pelvis
- Distal End of Femur
- Proximal Tibia
- Calcaneus

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Splint's Indications

- Fractures
- Sprains/Dislocations
- Joint infections
- Tenosynovitis
- Acute arthritis / gout
- Lacerations over joints
- Puncture wounds and animal bites of the hands or feet

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Proper Application

- Materials-Plaster / Fiberglass / SAM type
- All splints should have a minimum of two layers of padding applied at the skin, even the "prepadded" splint materials/packages.
- Cover all edges. When trimming prepadded, the padding can be pulled over ends after cut from package.
- Do not fold in "corners", they cause pressure points and breakdown.
- Too Hot Water can splint reaction/curing hotter and cause burns.

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Proper Application continued

- Straighten out with gentle longitudinal traction while splinting.
  - To allow splinting in "normal position"
- Splint in near anatomic position as possible protects nerves and vessels.
- Don't feed injured patients

Comments on Vacuum Splints and ease of malpositioning or splint in non-anatomical positions

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Examples of Splint Types (there are many more!)

Upper Extremity

- **Elbow/Forearm**
  - Long Arm Posterior
  - Double Sugar – Tong
  - Coaptation (stirrup)
- **Forearm/Wrist**
  - Volar Forearm / Cockup
  - Sugar – Tong/ Reverse
- **Hand/Fingers**
  - Ulnar Gutter
  - Radial Gutter
  - Thumb Spica
  - Finger Splints

Lower Extremity

- **Knee**
  - Knee Immobilizer / Bledsoe
  - Bulky Jones
  - Posterior Knee Splint
- **Ankle**
  - Posterior Ankle
  - Stirrup
  - Three-sided (Posterior and Stirrup)
- **Foot**
  - Hard Shoe

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Coaptation

- Indicated for humeral shaft fractures.
- A sugar tong that starts in armpit and wraps OVER the shoulder.
- PEARL: Combine with sugar tong on the forearm for excellent control of humerus/elbow/forearm injuries.

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Reverse Sugar Tong

- Controls wrist and elbow flexion and forearm rotation.
- Often have “extra” when wrapping sugar tongs on forearms and ankles. Cut through the extra/loop and overlap to avoid pressure points.
- As seen in Sugar Tong splint photo next.

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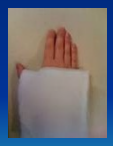
Sugar Tong

- Not as commonly /correctly ordered but very effective.
- Loop End placed at hand after a notch is cut to sit in the thumb web space.
- Then two ends overlapped at elbow avoiding folds or corners.



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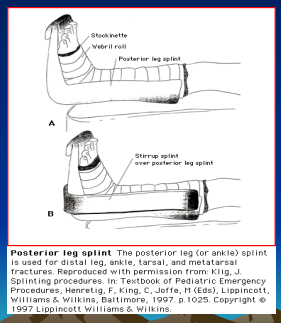
Three Sided Ankle Splint



Posterior leg splint The posterior leg (or ankle) splint is used for distal leg, ankle, tarsal, and metatarsal fractures. Reproduced with permission from: Klig, J. Splinting procedures. In: Textbook of Pediatric Emergency Procedures, Henretig, F, King, C, Joffe, M (Eds), Lippincott, Williams & Wilkins, Baltimore, 1997. p.1025. Copyright © 1997 Lippincott Williams & Wilkins.

- Most stable ankle splint construct as it controls rotation and flexion/extension at ankle.
- If reducing fracture/ dislocation of ankle, use this for best control.

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Review tricks For Pre-Hospital Adjustable Collars.

For proper C-collar placement (lock the height and the "claw") to squeeze the sides in.

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Compartment Syndrome

- Compartment syndrome is an important clinical entity
- Condition in which intramuscular pressure within an enclosed fascial space exceeds capillary blood pressure
- If untreated, damage to tissues can be irreversible
- Approximately 40% occur in fractures of the tibial shaft with an incidence of 1 to 10%.
  - Blick, JBJS 1986

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Importance of Compartment Syndrome

- Sequelae of compartment syndrome can be devastating
  - Volkmann's Contractures
  - Irreversible ischemia
  - RSD/CRPS
  - Sepsis
  - Renal Failure
  - Death
- Missed diagnosis or delay in treatment is the #1 reason for lawsuits involving Orthopedic surgeons with average settlement of $280K
  - Templeman, Orthop Trans, 1994, Bhattacharyya, JBJS, 2004
- Complication rates of early vs. late fasciotomy are 4.5% vs. 54%
  - Williams, Surgery, 1997, Sheridan, JBJS, 1976

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Etiology

- There are a multitude of causes of compartment syndrome and its etiology is probably multifactorial

1- A decrease in size of the compartment

2- An increase in the content of the compartment

3- Swelling due to abnormal muscle → chronic compartment syndrome

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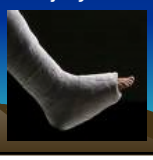
Etiology

- Decreased Compartment size
  - Constrictive dressings or casts
  - Tight closure of fascial defects
  - Traction/reduction of fractures
  - Thermal injury
  - Crush Injury



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Etiology

- Increased Contents
  - Hemorrhage
    - Bleeding disorders
    - Anticoagulant therapy/overdose
    - Arterial laceration
  - Hemorrhage plus edema
    - Fractures
    - Soft tissue crush injuries

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Etiology

- Increased Contents
  - Edema
    - Postischemic swelling from injury, arterial thrombus, or embolism
    - Vascular reconstruction and bypass surgery
    - Replantation
    - Prolonged tourniquet time
    - Prolonged immobilization (drug OD, entrapment)
    - Snake bite/invenomation

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Common Causes

- Fracture
- Crush
- Arterial Injury
- Limb Compression
  - with or without hypotension
  - constrictive cast/bandages
- Burns

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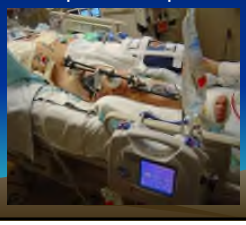
Diagnosis

- Unreliable, uncooperative, or comatose patients
  - Physical Exam unreliable
  - Measure compartment pressures



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Diagnosis

- Differs for alert or comatose patients, adults or children
- Alert/cooperative patients can assess 6 P's
  - **Pain** out of proportion
  - **Pain** on passive stretch
  - Pressure to palpation (compartment not soft)
  - Paralysis (due to pain or nerve injury)
  - Paresthesia (occurs early)
  - Pulselessness (Often Very Late)

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Diagnosis

- Any compartment can get compartment syndrome
- Upper Extremity
  - Deltoid
  - Scapula
  - Arm
    - Anterior
    - posterior
  - Forearm
    - Dorsal
    - mobile wad
    - deep volar
    - superficial volar



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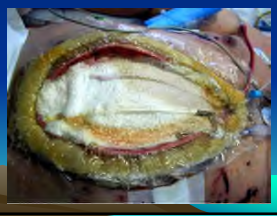
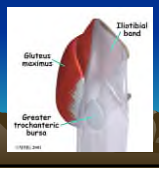
- Upper Extremity
  - Hand
    - 10 compartments
- Abdomen
- Pelvis
  - Iliacus
  - Gluteal



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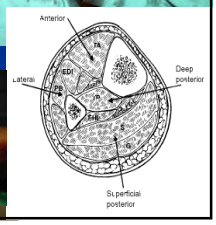
- Lower Extremity
  - Thigh
    - anterior, posterior, medial
  - Calf
    - Anterior
    - Lateral
    - Superficial posterior
    - Deep Posterior





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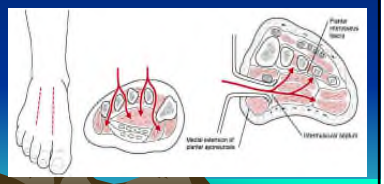
- Lower Extremity
  - Foot
    - 9 compartments
      - Medial
      - Superficial
      - Lateral
      - Adductor
      - 4 interosseous
      - Calcaneal



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Treatment

- First Aid to hypoxic cells
  - Keep patient normotensive
  - Remove constricting bandages
  - Elevate limb to heart height
  - O2 administration to keep fully oxygenated

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Treatment

- Post fasciotomy
  - elevate to heart
  - delayed primary closure
    - at one sitting
    - gradually using skin stretching techniques
      - shoelace
      - subcuticular technique (i.e. prolene)
      - mechanical wound closure devices
    - Wound Vac-closed system
  - Skin grafting 5-7 days later if closure not possible

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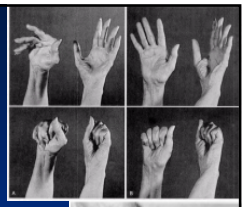
Outcomes



- Good if treated early
  - 4% Complication rate
  - Some complaints of scarring
  - Pain with exercise
- Untreated Compartment Syndrome
  - Volkmann's Ischemic Contracture
    - paralysis and contracture
  - Late fasciotomy (after 48 hrs)
    - Often not helpful
    - may be more injurious - open, necrotic muscle
    - Amputation rate is high (5/5 patients, Finklestein)

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Compartment Syndrome Summary

- Do not miss compartment syndrome
- If you think CS, you should do something about it
  - rule it in or out
- Act promptly for the patients' best interest

Don't elevate, don't refrigerate, don't hesitate, OPERATE

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External Fixators

- Provide stability to fractures and/or ligamentous injuries.
- Recently, they were used for definitive treatment
- Significant improvements in surgical implants (plates, screws, nails) have made external fixators temporary in their uses.
- There are indications for definitive treatment. A specialty exists for "fine wire" or Illizarov method for the treatment of malunions, nonunions, and congenital/hereditary skeletal malformations.

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External Fixation

- Pins / wires connected by clamps to bars creating a rigid external frame
- Uses:
  - Open comminuted fractures
  - Extensive soft tissue damage
  - Multiple trauma
  - High risk of infection
  - Closed fracture with difficult positioning or length
  - Surgical joint fusion or bone grafting

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External Fixation: Advantages Immediate stabilization

- Rigid fixation w / compression
- Increased comfort
- Ability to observe soft tissue / wounds
- Facilitates vessel / tissue reconstruction
- Maintains motion of adjacent joints
- Fewer complications of immobility

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DVTs in Orthopaedics

- Thromboses start at the time of injury/surgery and can form at anytime after, until fully recovered.
- Before Prophylaxis- Ortho Joint Replacement
  - DVT rates 30-50+%
  - Mortality Rate of Total Joints Prophylaxis w/PE 3-6%
- Even on Prophylaxis- DVT Rates of 1-4%

The answer seems obvious, but there is very little data to document that prophylaxis against DVT actually prevents fatal PE

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Other Emboli In Orthopaedics Fat Emboli Syndrome

- Fat emboli occurs in up to 90% of all patients with severe injuries from fracture of pelvis, long bones, trauma to soft tissue, burns, and fatty liver.
- Only 10% of these patients with fat emboli are symptomatic.
- The risk is believed to be reduced with early immobilzation and early surgical intervention.
- Symptoms can occur 1-3 days from injury and may include:
  - Pulmonary
  - Neurologic
  - Dermatologic
  - Hematologic

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Conclusion

- Thank you for your time.
- Please ask any remaining questions.
- Always feel free to call or email me if you have any other questions or want a copy of the talk.
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- dcoll@tfhd.com

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