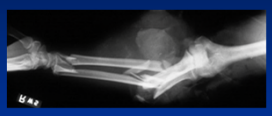
Orthopaedic Trauma Patients, Pelvic Binders, Traction & Splinting, and More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1

Purpose

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

2

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.

3

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

4

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/

5

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 are declining but are leading cause of death in the first three decades of Americans' lives.
  - MVC killed over 42,939 in 2021 (NHTSA)
  - MVC injuries send >2.3 million/year to ER
  - Annual Health Care and lost productivity $671 B

    http://www.aast.org/trauma-facts
- CDC 2022-49,449 recorded suicides 14.3/100K
  - U.S. suicide rate rising for 30 yrs(11-25 attempts)

https://www.beckersbehavioralhealth.com/behavioral-health-mental-health/cdc

6

Differences in Orthopaedic Trauma Patient

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

7

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

8

Physical Exam Terminology

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

9

Fractures

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

10

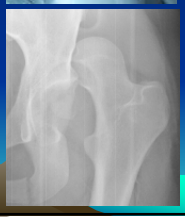
Open Fractures

- 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

11

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



12

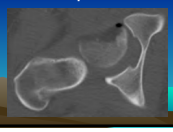
Hip Dislocations

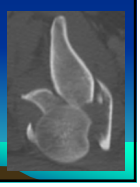
- Traumatic posterior hip dislocations are high energy injuries (Not grandma's total hip)
- Associated injuries are common
- Outcome is highly dependant on time to reduction, associated injuries and post-reduction management
- Unsatisfactory results can be expected in up to 50% of patients
  - Dreinhofer,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

13

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





14

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.

15

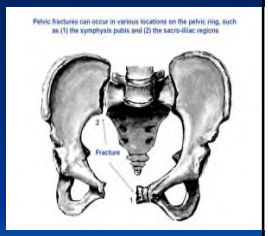
Physical Exam for Pelvis Stability

- 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.

16

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/



17

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/

18

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.

19

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.

20

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

21

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

22

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

23

Sager Splints

- Do not have to lift leg.
- Made unilateral or bilateral.
- Quantifiable dynamic traction
- Pediatric vs adult sizing Comments

Unilateral

Bilateral

24

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

25

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

26

Slishman Traction Leg Splint

- Can Pull at Femur/Calf/Ankle
  - Can work with tibia and femur fx
  - Works with Amputations/Blast/etc
  - Patient can adjust traction
- Disadvantage- UNILATERAL
- Fits on lateral thigh
- Non-quantifiable traction
- Does not control rotation, important to tape feet

27

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.

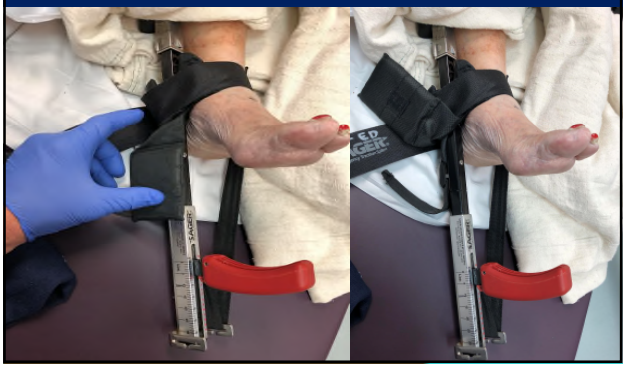
TAPE/BIND feet to stop rotation during handling/transport.

- 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.

28

We can always do better



29

Ankle Strap malposition causing Rotation.

30

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

31

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

32

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.

33

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

34

Skeletal Traction Sites

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

35

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

36

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.

37

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

38

Examples of Splint Types (there are many more!)

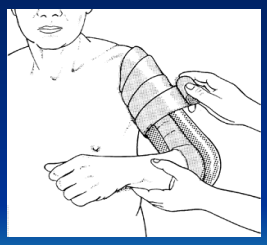
Upper Extremity

- **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

39

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.

40

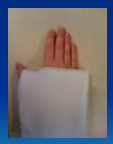
Reverse Sugar Tong

- 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.

41

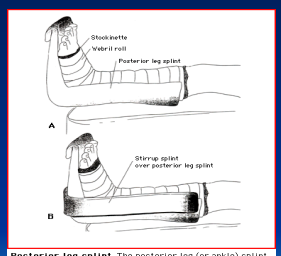
Sugar Tong

- 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.



42

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.

43

Review tricks For Pre-Hospital Adjustable Collars.

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

44

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

45

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

46

Etiology

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

1- A decrease in size of the compartment

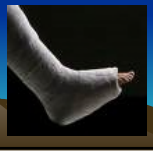
2- An increase in the content of the compartment

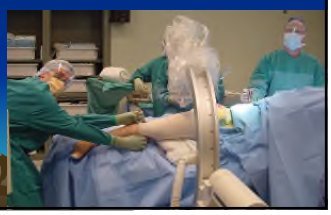
3- Swelling due to abnormal muscle → chronic compartment syndrome

47

Etiology

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





48

Etiology

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

49

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

50

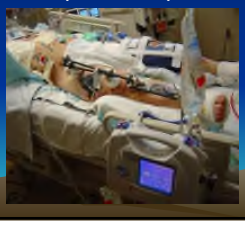
Common Causes

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

51

Diagnosis

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



52

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)

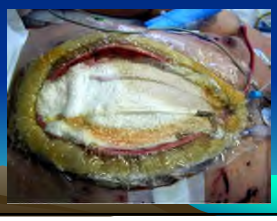
53

Diagnosis

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

54

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



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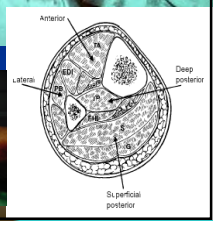
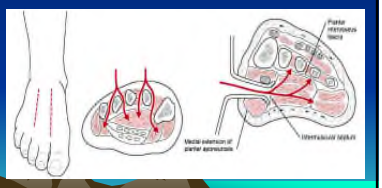
- Lower Extremity
  - Thigh
    - anterior, posterior, medial
  - Calf
    - Anterior
    - Lateral
    - Superficial posterior
    - Deep Posterior



56

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



57

Treatment

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

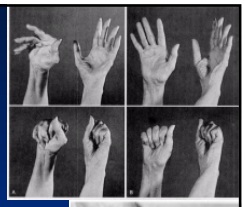
58

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

59

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)

60

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

61

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.

62

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

63

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

64

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

65

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

66

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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- danieljohncoll@gmail.com

67