Orthopedics in the Outdoors: Splinting with What You've Got

Nels Carlson, MD

- Professor, Department of Orthopaedics & Rehabilitation
- Oregon Health & Science University

Overview

- Principles
  - Injury Assessment
  - Injury Management
- What to Bring
  - *Be Prepared!*
- Injuries
  - Fractures/Dislocations
- Splinting
  - Forearm
  - Humerus
  - Ankle



Principles of Assessment & Management

1-General 2-History 3-Inspect 4-Exam 5-HIRICE 6-Immobilize 7-Evacuate 8-Monitor

- 1. **General**
  - Assess scene safety, ABCs
- 2. **History**
  - Mechanism, Location of pain, 'Crack'
- 3. **Inspection**
  - Deformity
  - Open Skin/Visible Bone
  - Skin Perfusion/Color
  - Bleeding
- 4. **Examination**
  - Palpable tenderness
  - Crepitus
  - ROM (Fracture vs Dislocation)
  - Swelling/Bruising
  - Weight-bearing
  - Circulation/Pulses
  - Sensory and Motor Function
- 5. **Diagnostic Uncertainty**
  - (HI)RICE
  - Treat as Fracture
- 6. **Immobilize**
  - Splinting
    - Positioning
      - Reduction vs Position found?
      - Traction?
    - Joint above and below fracture
    - Padding and Securing
- 7. **Evacuation Decision**
  - Significant displacement/deformity
  - Open fractures
  - Bleeding
  - Vascular compromise
  - Neurologic Compromise
- 8. **Continue to monitor**
  - Pain, Shock
  - Distal Extremity CSM (Circulation, Sensation, Motor)
  - Splint fit

Perform an Initial Environmental Assessment

- Assess the Scene
  - Survey the situation
  - Try to determine mechanism of injury
  - Don’t rush in and have additional injuries



Perform an Initial Patient Assessment

ABCDE

- **Airway**
  - Speaking = open airway
- **Breathing**
  - Speaking does not rule out difficulty breathing
- **Circulation**
  - Scan for bleeding
  - Control bleeding
- **Disability**
  - Immobilize if spinal injury suspected
- **Environment**
  - Consider ambient/body temperature
  - If necessary, treat for shock



Perform Musculoskeletal Injury Overview

LAF

- **Look**
  - For blood and discoloration
- **Ask (if conscious)**
  - Ask about pain, bleeding, popping or snapping sounds
  - Ask the patient how bad the pain is on a scale of 1-10
- **Feel**
  - Gently palpate area of injury



Perform a Musculoskeletal Injury Assessment

DOTS

- **Deformities**
  - Compare sides
  - Often seen with fracture
- **Open wounds**
  - May be hidden, have to look
  - Stop bleeding
- **Tenderness**
  - Will occur prior to swelling or bruising
  - Gently palpate area of injury
- **Swelling**
  - Seen with soft tissue injuries and fractures
  - May not be obvious with initial assessment



Principles of Injury Management

HI-RICE

- Hydration
  - With MSK injury, make sure patient stays hydrated
- Ibuprofen
  - Consider an NSAID/analgesic if in significant pain
- Rest
  - Minimize motion of affected area
- Ice
  - Use chemical ice pack or towel/clothes soaked in cold water
- Compression
  - Compression and splinting to stabilize injury
  - Check circulation and sensation
- Elevation
  - Elevate limb higher than heart to limit swelling



What to Bring

- Essentials
  - Day hike
  - Overnight
- First Aid Kit
- Splint Kit
- Survival Kit
- Garmin/iPhone SOS
- Be Creative
  - Use what you have

Emergency Kit

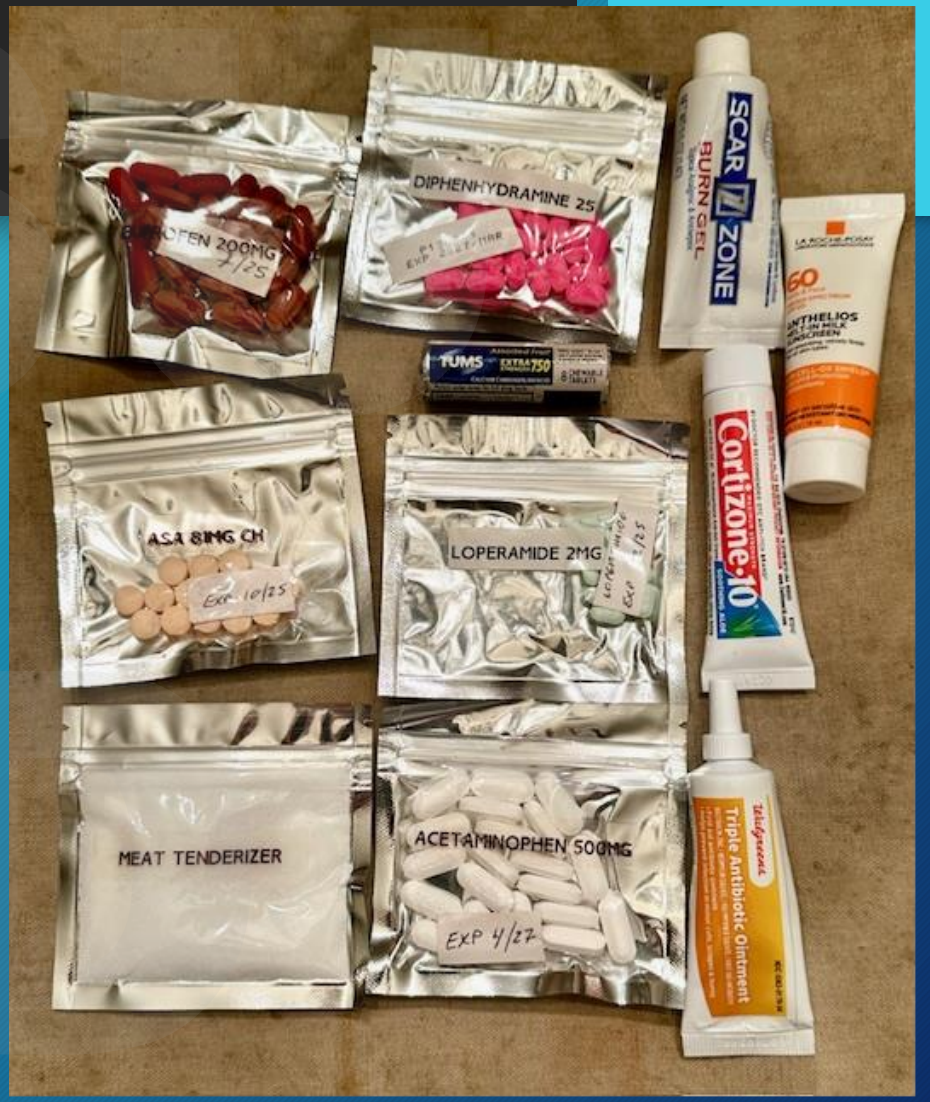




First Aid Kit







Splint Kit


eagle creek

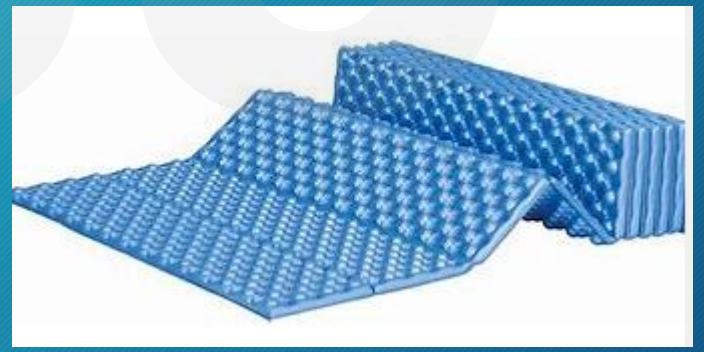

SAM SPLINT
RADIOLUCENT
SAM
SAM SPLINT
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SAWYER +
SAM

Splinting Materials in the Field

















Be Creative~

Use What You Have





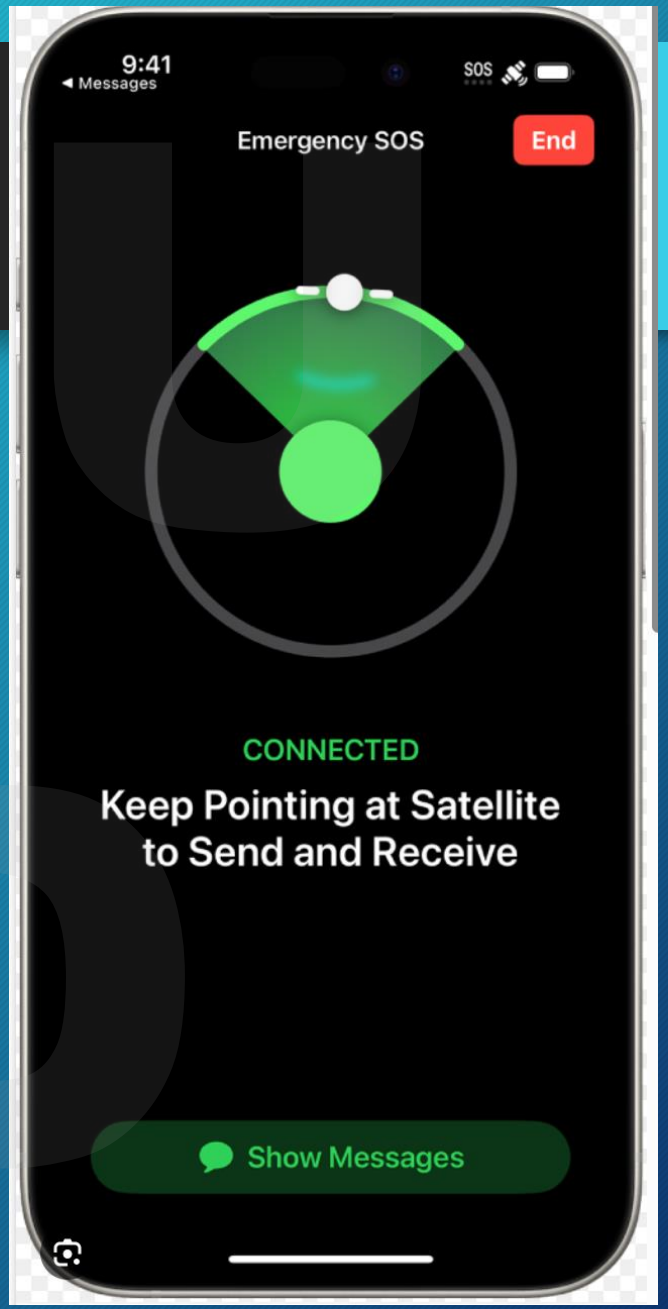


Getting Help









Splinting Decision Making:
To Reduce or not to Reduce?





Deformity - Reduce if neurovascularly intact?

- Yes – an attempt is reasonable, but challenging without Xray
- Reduce if obvious dislocation or significant deformity
- Splinting goals:
  - Pain control
  - Protect skin and soft tissues for the hours ahead
  - Prophylactically protecting perfusion



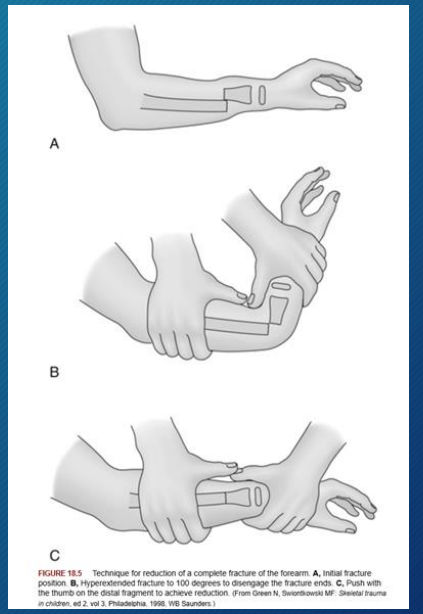


FIGURE 18.5 Technique for reduction of a complete fracture of the forearm. **A,** Initial fracture position. **B,** Hyperextended fracture to 100 degrees to disengage the fracture ends. **C,** Push with the thumb on the distal fragment to achieve reduction. (From Green N, Swiontkowski MF: *Skeletal trauma in children*, ed 2, vol 3, Philadelphia, 1998, WB Saunders.)

Reduction based on injury type:

- Dislocations
  - Reduce and reduce early
  - This is the highest-yield field intervention

  - Knee dislocation
  - Ankle fracture-dislocation
  - Patella
  - Shoulder
  - Digits



Reduction based on injury type:

- Shaft fracture with gross angulation
  - Lean toward splinting in-situ
  - Gentle sustained in-line traction and axial realignment is reasonable

  - Tibia
  - Humerus
  - Both-bone forearm



Reduction based on injury type:

- Periarticular/intra-articular fracture without dislocation
  - Do not attempt reduction
  - Splint in position of comfort

  - Tibial plateau
  - Pilon
  - Proximal humerus
  - Intra-articular distal radius



Neurovascular Compromise

- Reduce immediately
  - Sustained in-line traction
  - Correct angulation
  - Reassess pulse/cap refill/temperature/ sensation before and after
  - Write time down
  - Mark spot of pulse check with pen (so the next person can check the same spot)



Neurovascular Compromise

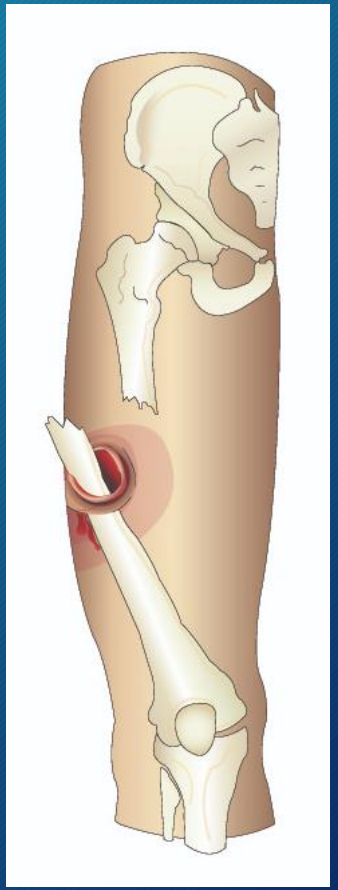
- Areas of Emphasis
  - Warm ischemia clock is 6 hours
    - This is the amount of time tissue can remain at normal body temperature without a blood supply
    - This is a key component in your call for help
  - Cold and hypothermia confound the exam
    - An injured immobile patient gets cold fast
    - Peripheral vasoconstriction can make a perfused limb look compromised
    - Warm/insulate the patient before making a decision on a cold foot/hand



Open Fractures

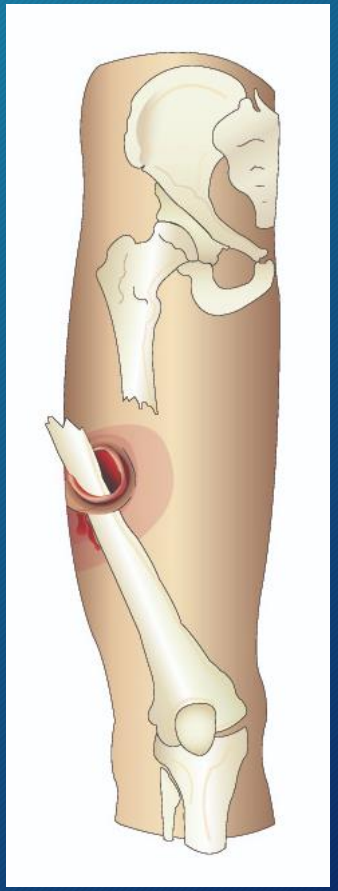
Priority order:

1) Hemorrhage control – direct pressure (tourniquet only if life-threatening)
2) Antibiotics – single highest-value intervention, better than early irrigation
   - Cephalexin or Amoxicillin-Clavulanate PO
   - Target is within one hour
3) Gross debris removal – low pressure, high volume irrigation with cleanest available water
   - Potable is adequate, don't chase sterile
   - No scrubbing
   - No iodine/peroxide/alcohol
4) Photograph wound, cover with moist clean dressing and leave it alone
5) Splint



Open Fractures

- Reduction
  - 1-2 attempts
    - Repeat attempts can cause more harm and burn time
  - Splint in best achieved position
  - Evacuate patient
- The exception – a pulseless limb
  - Justifies one additional attempt with better technique – more analgesia, a second set of hands, longer traction



Compartment Syndrome



Presentation

- Severe pain
- Tight muscle compartment
- Increased pain with pressure
- Pain with passive stretch of involved muscles
- Often associated with fracture, crush injury
- ”Neurovascular Intact” checkboxes can miss it

5 P’s (Late Findings)

- Pain, Pallor, Paralysis, Paresthesia, Pulselessness
- Pulse and capillary refill often present late



Treat

- Emergency evac (> 8 hours is limb-threatening)
  - Release all circumferential dressings, remove watches and rings
- ACE wrap ”hazard” over multi-hour timeline
- Limb at heart level

Other Considerations

- Check and continually recheck neurovascular status
  - Every 30-60 minutes, after every intervention
- Hydration, hypothermia prevention, analgesia
- Knee dislocation
  - Frequently reduces spontaneously, initial finding can be multiplanar instability without deformity
  - Popliteal artery injury rate is high (40%), declares late
  - Treat as vascular emergency even with palpable pulses
  - Reduce, splint at 20 degrees flexion, serial checks, emergent evacuation
- Humerus fracture
  - Radial nerve neuropraxia is common – splint, document
  - Evacuate on normal timeline – wrist drop does not need helicopter





Extremity Injury Algorithm

Dislocation or Fracture Dislocation - reduce, ✅ NV , splint, re ✅ NV

Fracture, NV intact

- Pain, no deformity - splint in position of comfort
- Pain, deformity (shaft) - reduce, splint, re ✅ NV
- Pain, deformity (peri/intra-articular) - splint in position of comfort, no reduction
- Open - hemorrhage control, Abx, irrigate, photograph, dress, realign if grossly deformed, splint, re ✅ NV

Fracture, NV compromise

- Pain, deformity - realign immediately (2-3 attempts), re ✅ NV, splint, re ✅ NV, emergency evac - communicate “pulseless limb”
- Open - hemorrhage control, realign first (6 hour clock), Abx, irrigate, dress, splint, re ✅ NV, emergency evac - communicate “pulseless limb”

Splinting

Immobilizes bone/joint

Prevents further damage to tissue, nerves, vessels

Decrease pain





Splinting Principles

- Visualize the injured body part
- Cover open wounds with sterile dressings
- Use other limb to mold/measure splint material







Splinting Principles

- Immobilize the joints above and below the injury
- Padding prevents further tissue damage
- Ice and elevate the injury after immobilization
- Splint the patient before transport (if stable)





Splinting Principles: Position

- Functional Position
  - Leg slightly bent at knee – 20 degrees
  - Ankle, Elbow at 90 degrees
  - Wrist straight
  - Fingers flexed





Fractures

- Distal Radius*
- Humerus*
- Metacarpal*
- Clavicle
- Radial and/or Ulna Shaft
- Wrist/Carpals
- Metacarpal
- Phalanx
- Ankle*
- Tibia and/or Fibula*
- Hip (Proximal Femur)*
- Femoral Shaft*
- Pelvis
- Talus/Calcaneus
- Metatarsal
- Phalanx

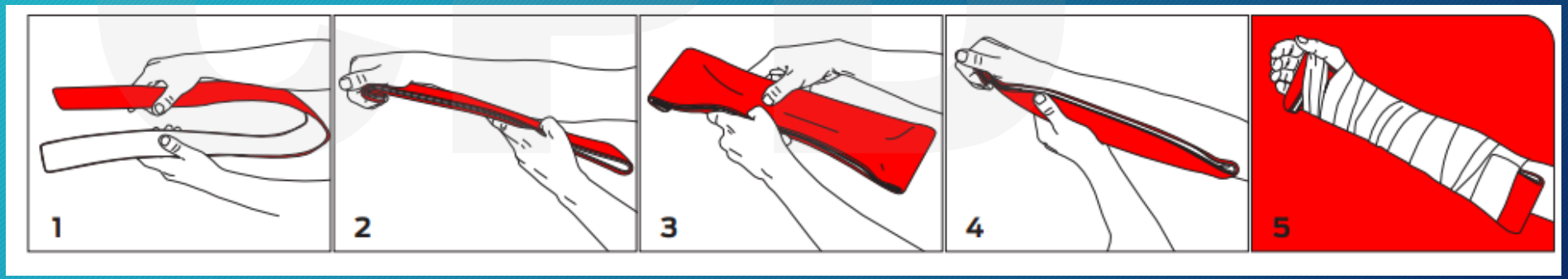
Fractures: Distal Radius (Colles)

1-General 2-History 3-Inspect 4-Exam 5-HIRICE 6-Immobilize 7-Evacuate 8-Monitor

- Fall onto outstretched hand
- May have associated ulnar fracture
- Dinner fork deformity
- Treatment
  - Splint to immobilize wrist and elbow
  - Sling to decrease rotation







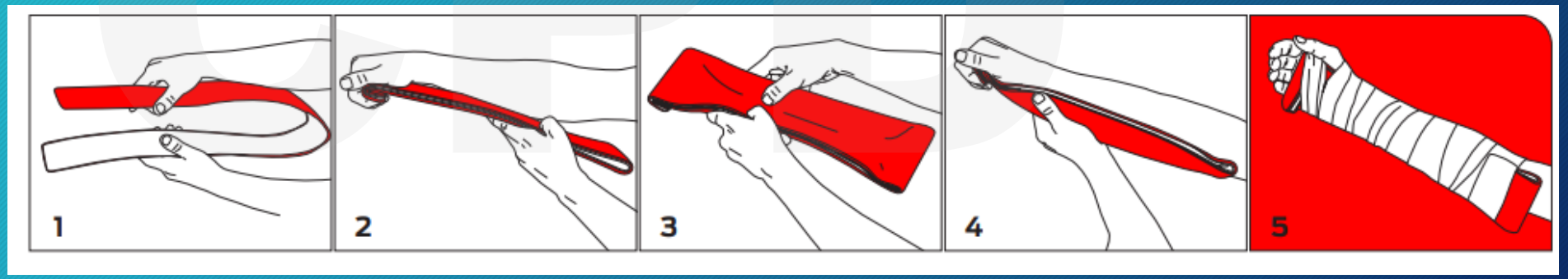
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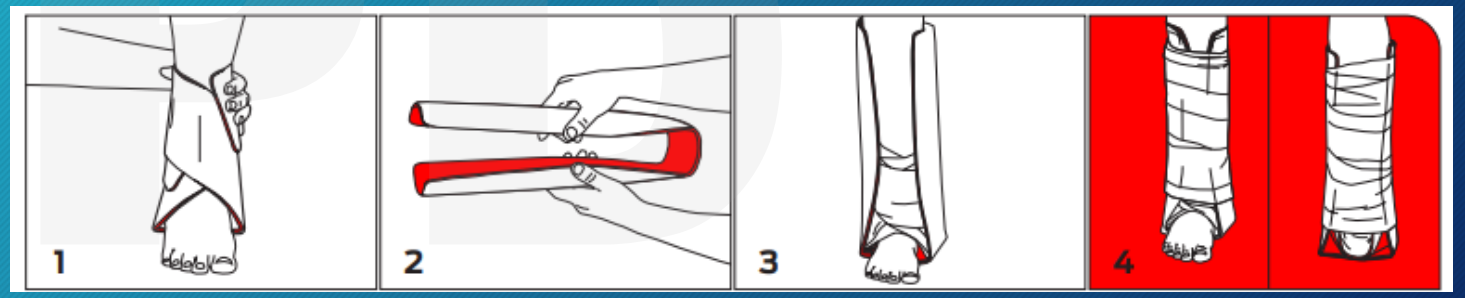
Fractures: Ankle

1-General 2-History 3-Inspect 4-Exam 5-HIRICE 6-Immobilize 7-Evacuate 8-Monitor



- Falls, jumps, twisting injuries
- Evaluation
  - Significant pain, swelling
  - Crepitus, deformity
  - Palpate medial/lateral malleolus
- Treatment
  - Realign rotational deformity
  - U-shaped splint



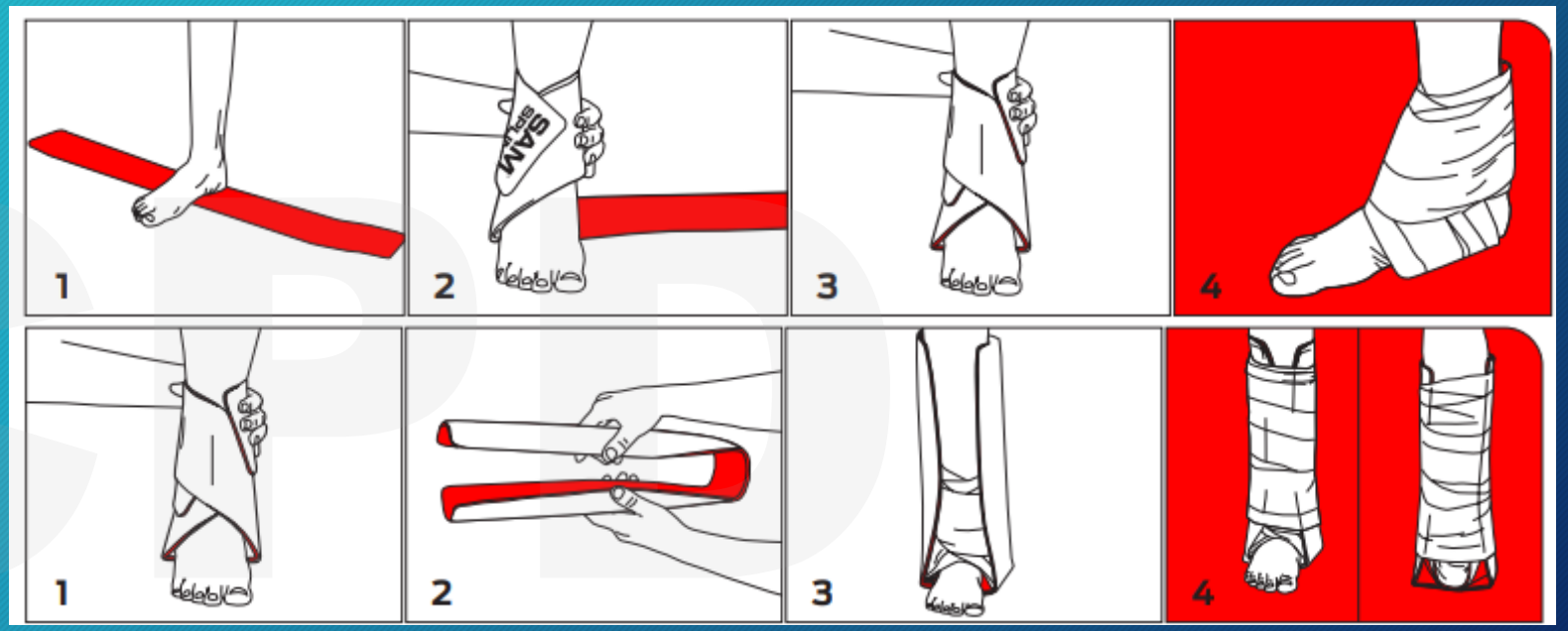


Fractures: Ankle

1-General 2-History 3-Inspect 4-Exam 5-HIRICE 6-Immobilize 7-Evacuate 8-Monitor



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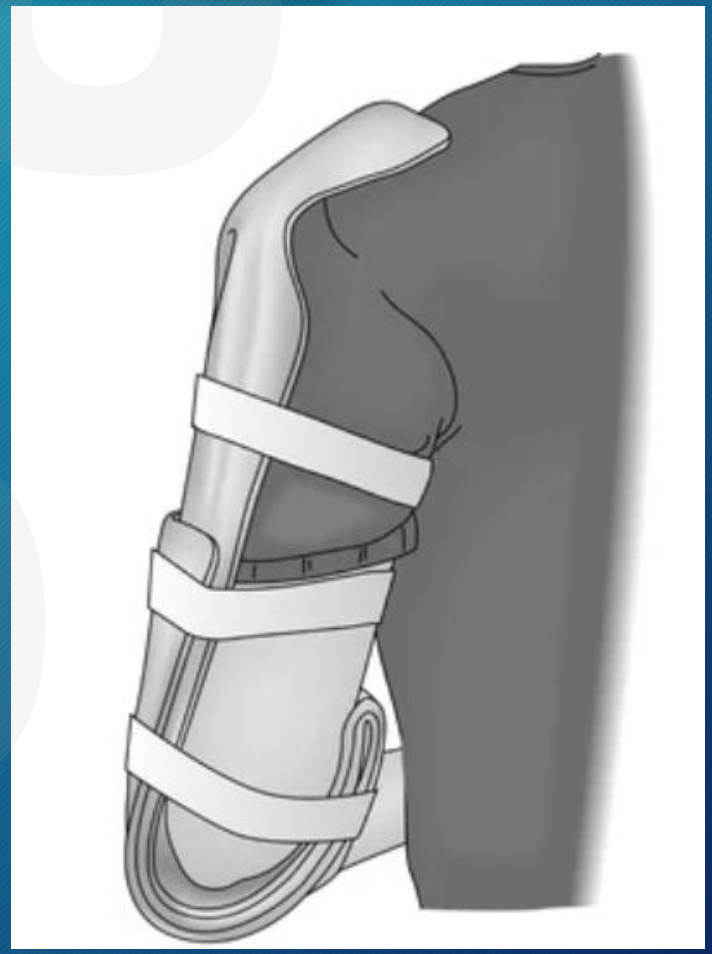


Fractures: Humerus

1-General 2-History 3-Inspect 4-Exam 5-HIRICE 6-Immobilize 7-Evacuate 8-Monitor

- Falls, Skiing,
  - Direct or Rotational Forces
- May be difficult to distinguish proximal humerus fracture vs dislocation
  - Anterior fullness suggestive of dislocation
- Severe pain with ROM
- Treatment
  - Splint both sides of humerus across shoulder + elbow
  - Sling/Swath



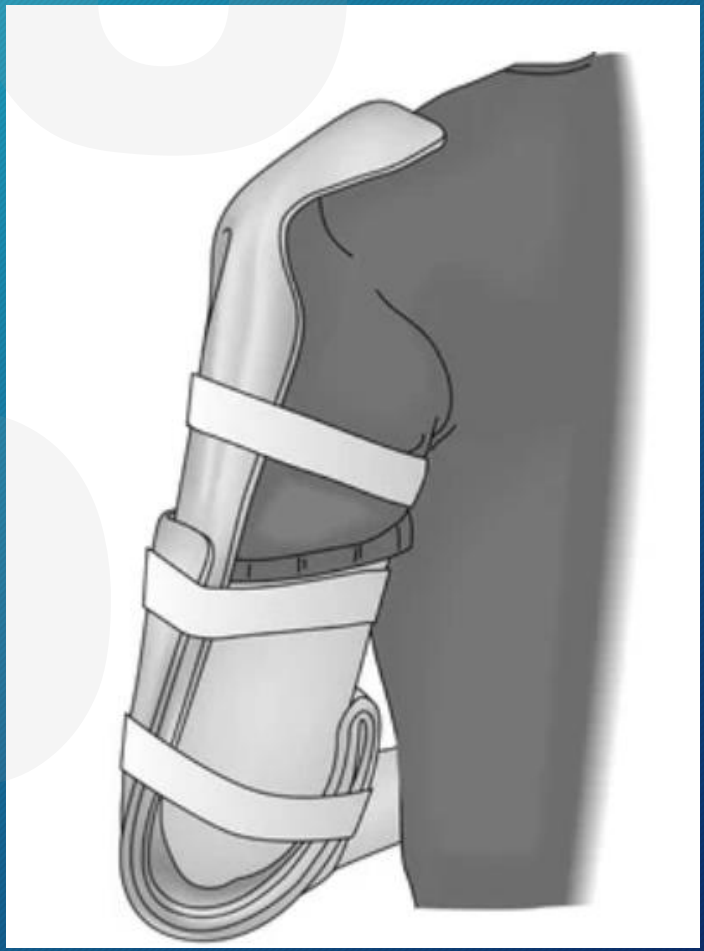


Fractures: Humerus

1-General 2-History 3-Inspect 4-Exam 5-HIRICE 6-Immobilize 7-Evacuate 8-Monitor

- https://youtu.be/6HR6wqaT-CM
- https://youtu.be/2zv_9bmjw98





Splinting – your turn

- Splints
  - Ankle
  - Distal Radius
  - Humerus
- Faculty/experienced splinters will circulate and help



Thank you!

References & Resources

- www.wildernessarena.com/skills/first-aid-health-and-first-aid/treating-broken-bones
- Wilderness First Aid Curriculum and Doctrine Guidelines, BSA
- University of Colorado, Section of Wilderness and Environmental Medicine
- Field Guide to Wilderness Medicine 5th Edition, Auerbach
- Wilderness First Aid Guide for Common Muscle and Joint Injuries, Polansky 2020
- What does DOTS Stand For? Furst 2015
- National Outdoor Leadership School
- University of South Carolina