Wilderness Orthopaedics

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Overview

- Principles
  - Injury Assessment
  - Injury Management
- Injuries
  - Fractures
  - Dislocations
- What to Bring
  - *Be Prepared!*

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

Be Prepared!

Controlled ~ Competent ~ Confident

Leadership

- Control the Situation
  - Have a plan in case of an emergency *before* a situation arises
  - Work as a team
- Be Competent
  - Be capable and ready to act
  - Know your equipment
- Appear Confident
  - Speak with quiet authority
  - Listen

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 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

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

If minimally displaced

- Stabilize in place
  - Anatomical position
- Immobilize
  - Functional Position
    - Leg straight or slightly bent at knee
    - Ankle, Elbow at 90 degrees
    - Wrist straight
    - Fingers flexed

Splinting Principles: Open Fractures

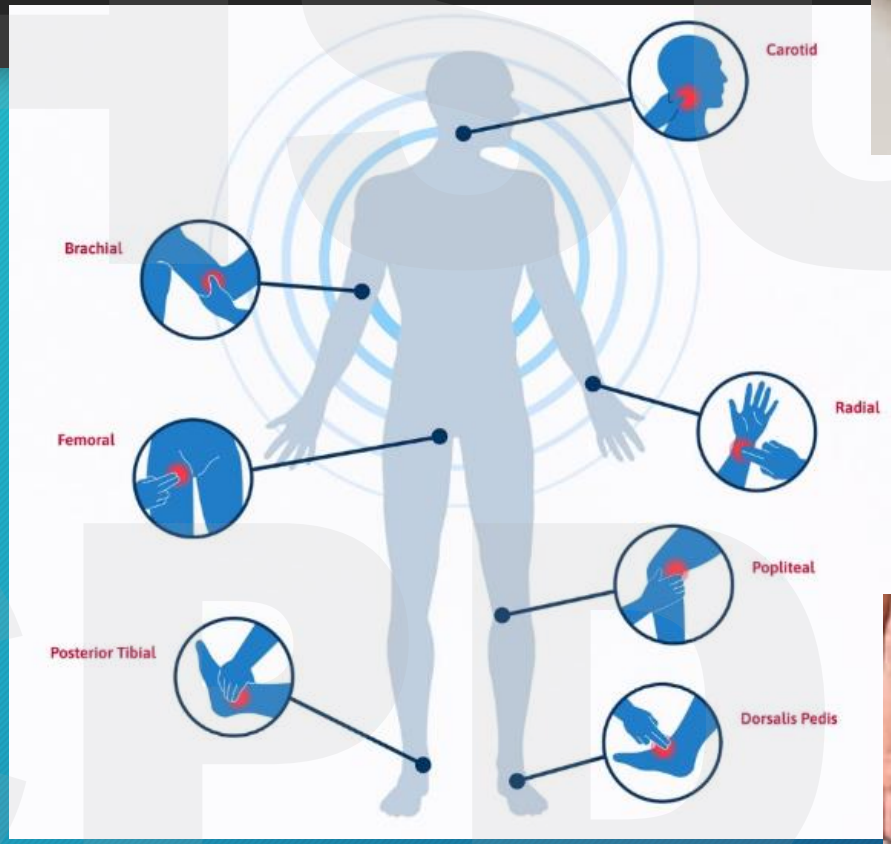
- In general do not reduce open or protruding fractures
- Clean compression dressing
- Splint the extremity in the position in which it was found
- If delayed evacuation consider irrigation

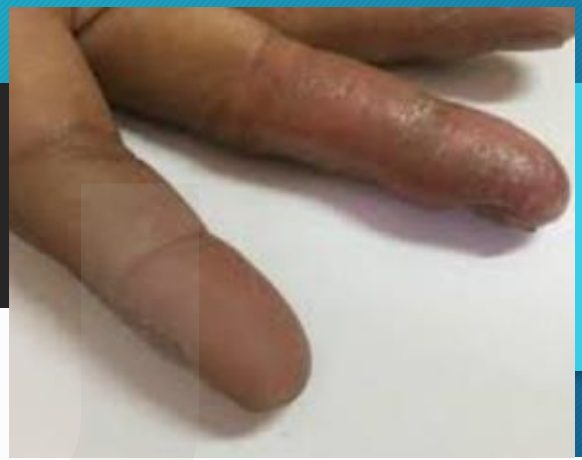
Splinting Principles: Vascular Compromise

- Check and continually recheck neurovascular status
- Consider Reduction and/or Traction if the pulse is not palpable
- CSM
  - Circulation, Sensory, Motor

Splinting Principles: Vascular Evaluation

- Check Pulses
  - Upper Extremity
    - Brachial, Radial, Ulnar
  - Lower Extremity
    - Femoral, Popliteal, Posterior Tibial, Deep Peroneal
- Pulses may be difficult to assess
  - Blood loss, Hypothermia
- Other Evaluations
  - Skin Warmth/Color
  - Capillary Refill
  - Pulse Oximetry



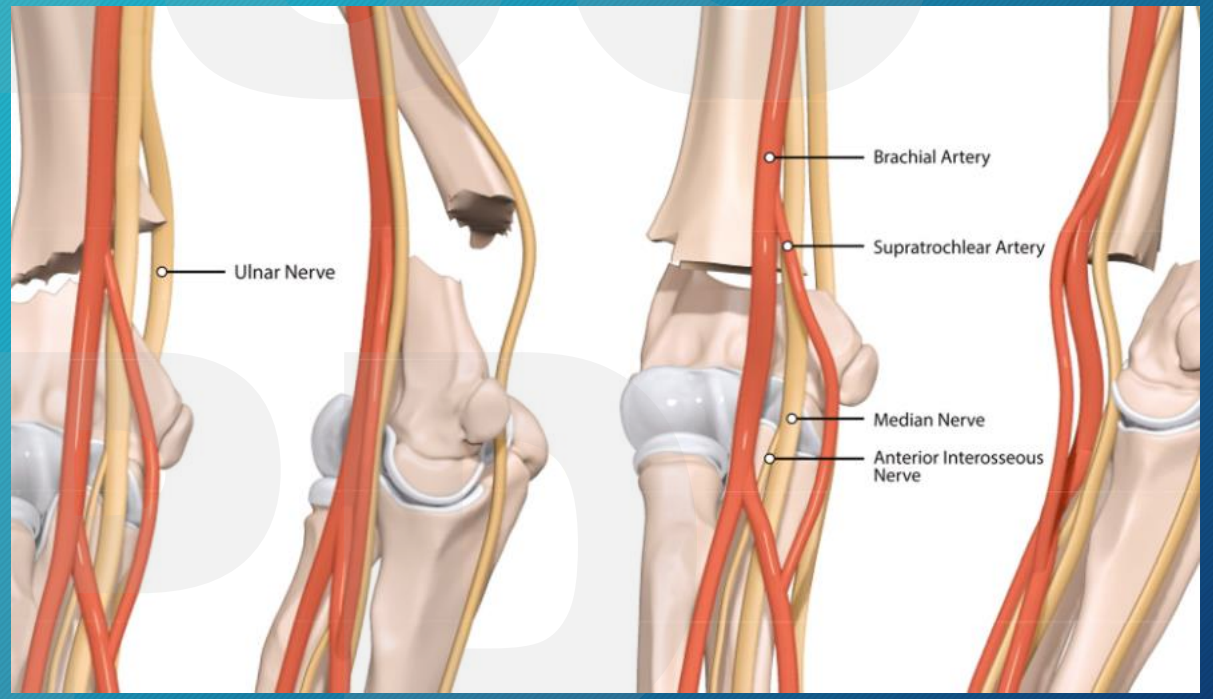


Splinting Principles: Pulse Oximetry

- Benefits
  - Assists in determining adequate blood flow distal to extremity
  - Complimentary to Exam
    - Pulses
    - Capillary refill
    - Skin Color/Temperature
- Useful for Other Conditions
  - Altitude sickness/hypoxia
- Limitations
  - Accuracy impacted by
    - Cold temperatures
    - Motion artifact
    - Poor Circulation
    - Skin thickness
    - Nails/polish
  - Unclear how helpful with compartment syndrome

Reducing Fractures/Dislocations

- Indications
  - Vascular Compromise
  - Neurologic Injury
- Complications
  - Increased injury to nerves, vessels, soft tissue



Reducing Fractures/Dislocations

Techniques

- ‘Unlocking Fracture’
- ‘Traction in Place’
- Joint Reductions

Considerations

- Extremely painful
  ‘OUCH Block’
- Limit multiple attempts

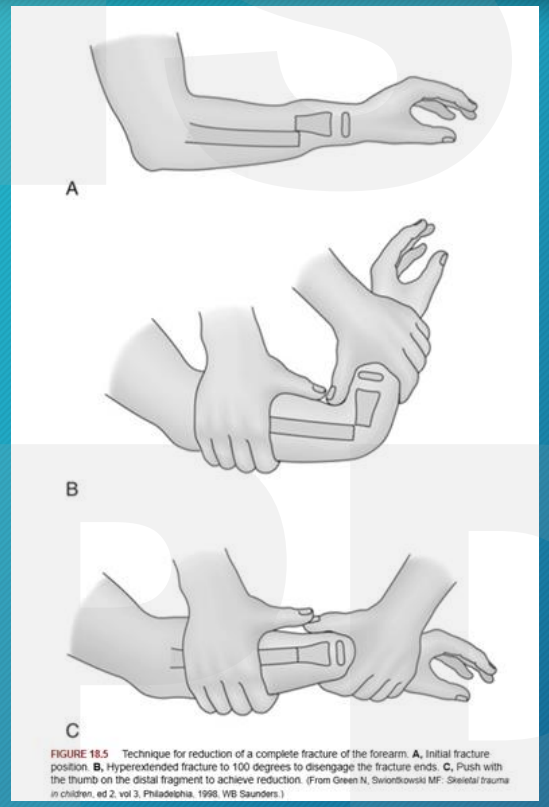


FIGURE 18.5 Technique for reduction of a complete fracture of the forearm. **A,** Initial fracture position. **B,** Hyperextended fracture to 100 degrees to disengage the fracture ends. **C,** Push with the thumb on the distal fragment to achieve reduction. (From Green N, Swiontkowski MF: *Skeletal trauma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

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

5 P's (Late Findings)

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

Treat

- Evacuate
- Avoid tight splints, dressings
- Avoid elevating limb
  - Decreased arterial pressure

Fractures

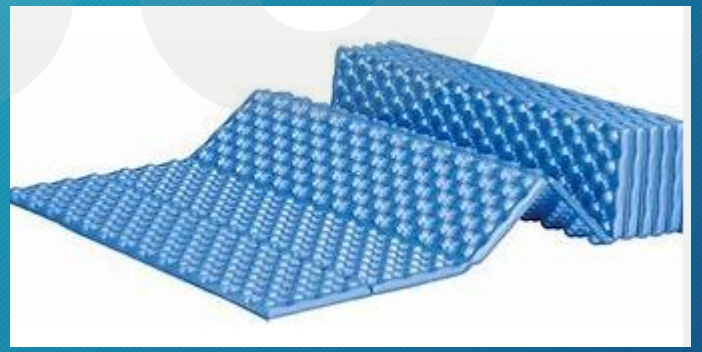
1-General 2-History 3-Inspect 4-Exam 5-HIRICE 6-Immobilize 7-Evacuate 8-Monitor

- 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

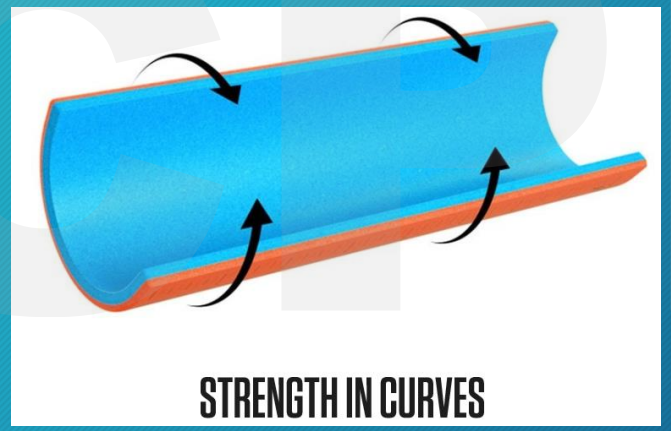
Splinting Materials in the Field





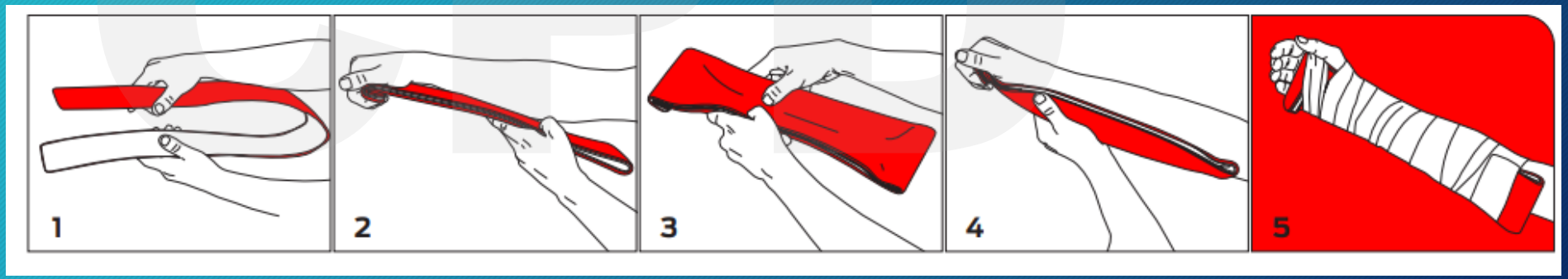
Splinting Materials for your First Aid kit



Fractures: Distal Radius (Colles)

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

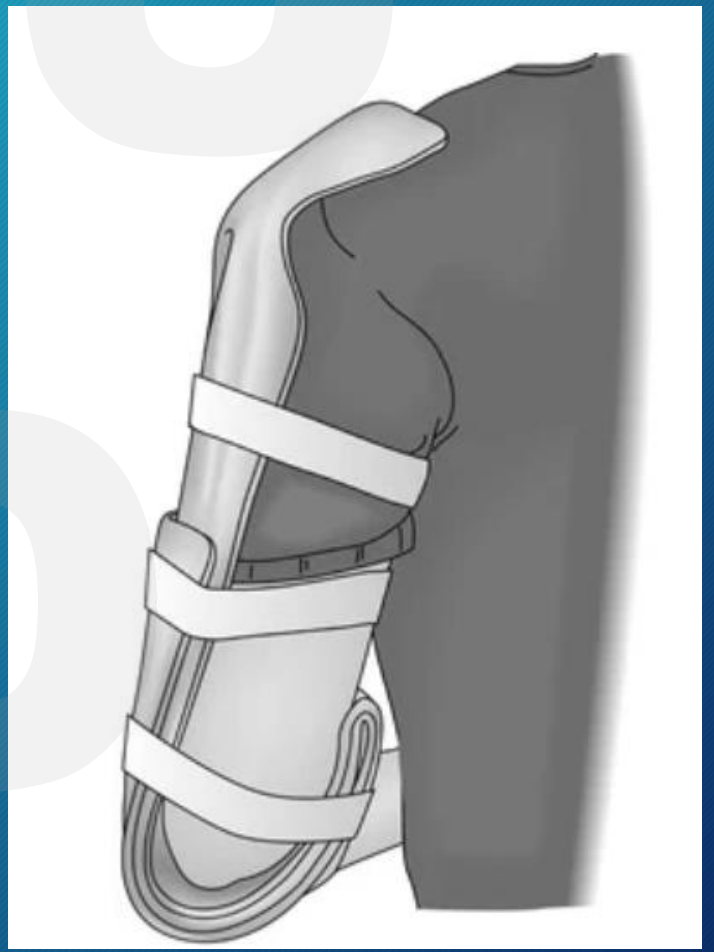
- Fall onto outstretched hand
- May have associated ulnar fracture
- Dinner fork deformity
- Treatment
  - Splint to immobilize wrist and elbow
  - Sling to decrease rotation



Fractures: Humerus

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

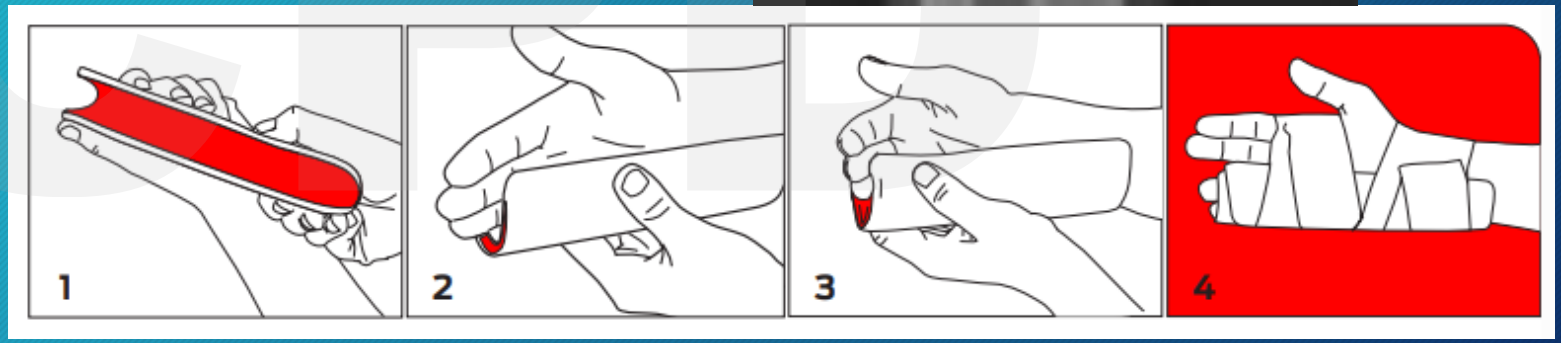
- Falls, Skiing,
  - Direct or Rotational Forces
- May be difficult to distinguish Proximal Humerus fracture vs dislocation
  - Anterior fullness suggestive of dislocation
- Severe pain with ROM
- Treatment
  - Splint both sides of humerus across shoulder + elbow
  - Sling/Swath
  - Similar if fracture/dislocation
- Complications
  - Possible Radial nerve injury with mid/distal 3rd fractures



Fractures: Metacarpal

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

- Axial load, crush
- Swelling, rotational deformity
- Treatment
  - Short arm splint extending to PIP



Fractures: Clavicle

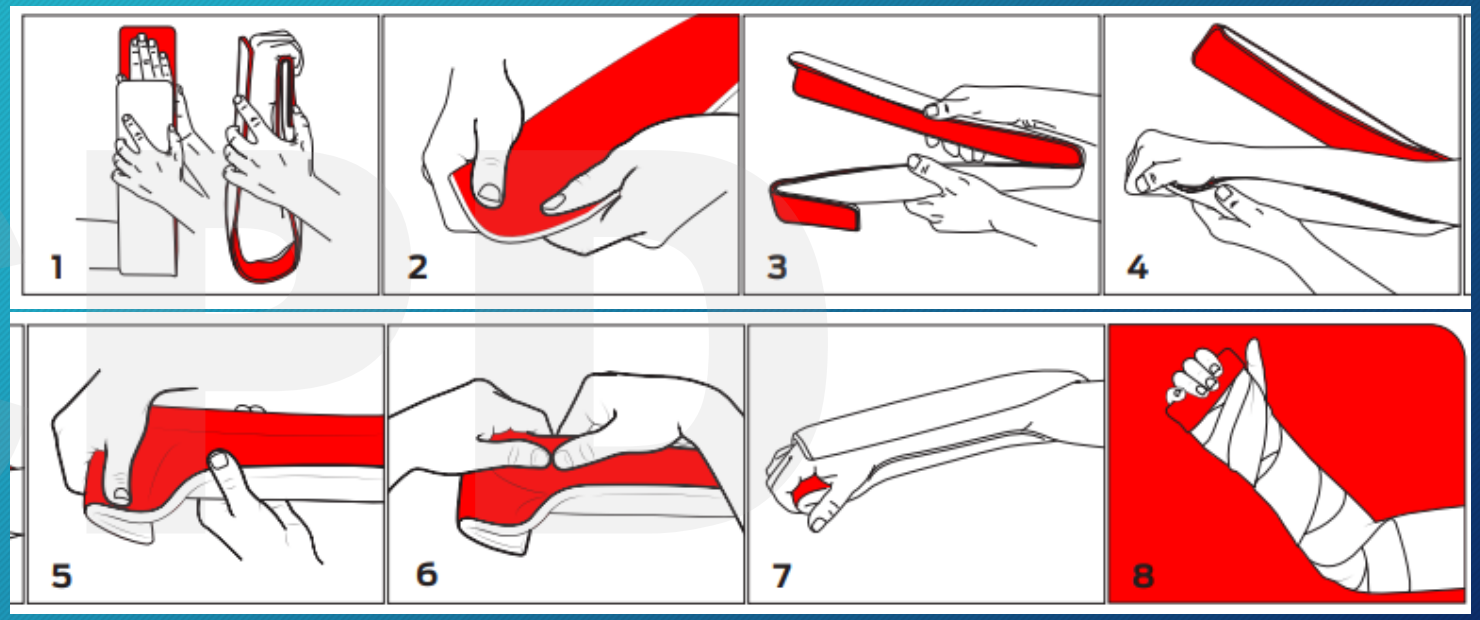
1-General 2-History 3-Inspect 4-Exam 5-HIRICE 6-Immobilize 7-Evacuate 8-Monitor

- Fall, Direct Force
- Can be confused with Sternoclavicular Dislocation
- Evaluation
  - Crepitus, pain with ROM
  - Check breath sounds, SOB, pain with respiration
  - Extremity neurovascular exam
- Treatment
  - Sling or Figure 8
- Complications
  - Rare pneumothorax
  - Associated brachial plexopathy, arterial injury

Fractures: Radial and/or Ulna Shaft

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

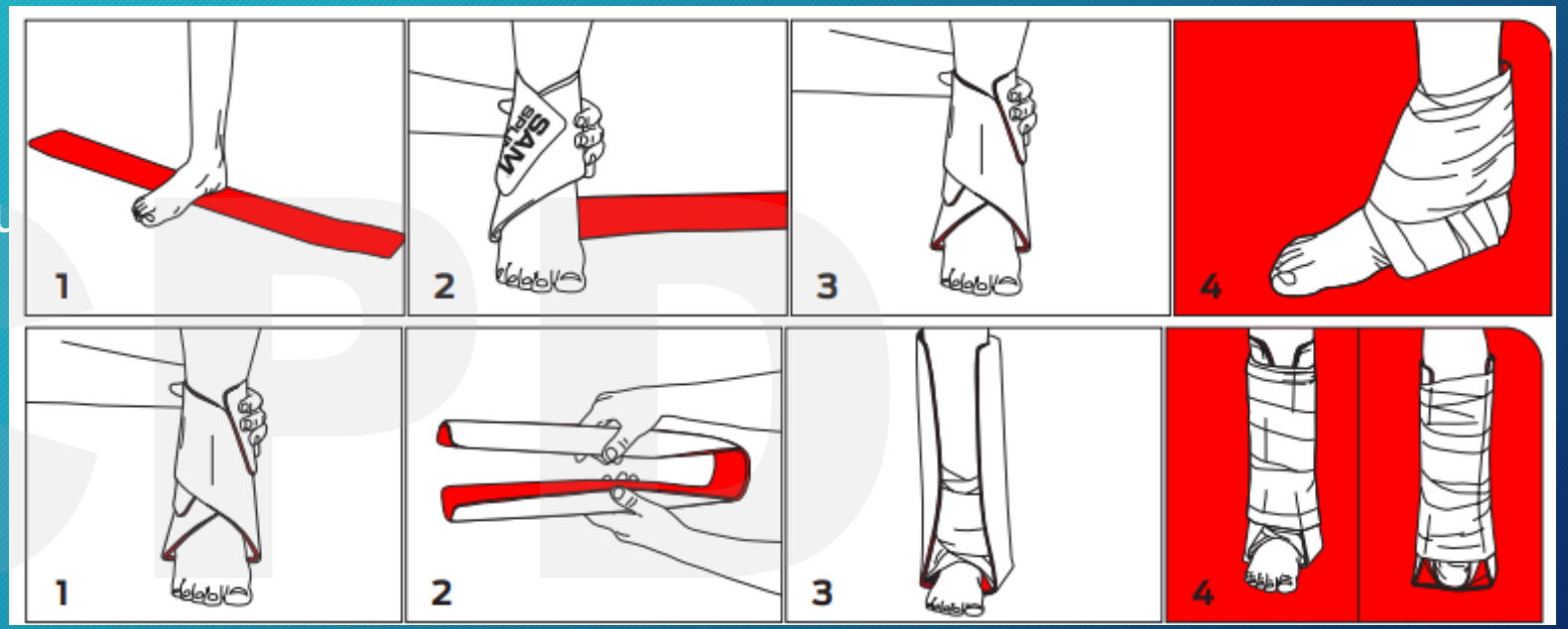
- Falls
  - Associated radial head fracture
  - Associated intra-articular distal humerus fracture
- Evaluation
  - Pain, swelling, crepitus
  - Evaluate elbow/shoulder ROM
- Treatment
  - Splint
  - Posterior splint if Open Fracture



Fractures: Ankle

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

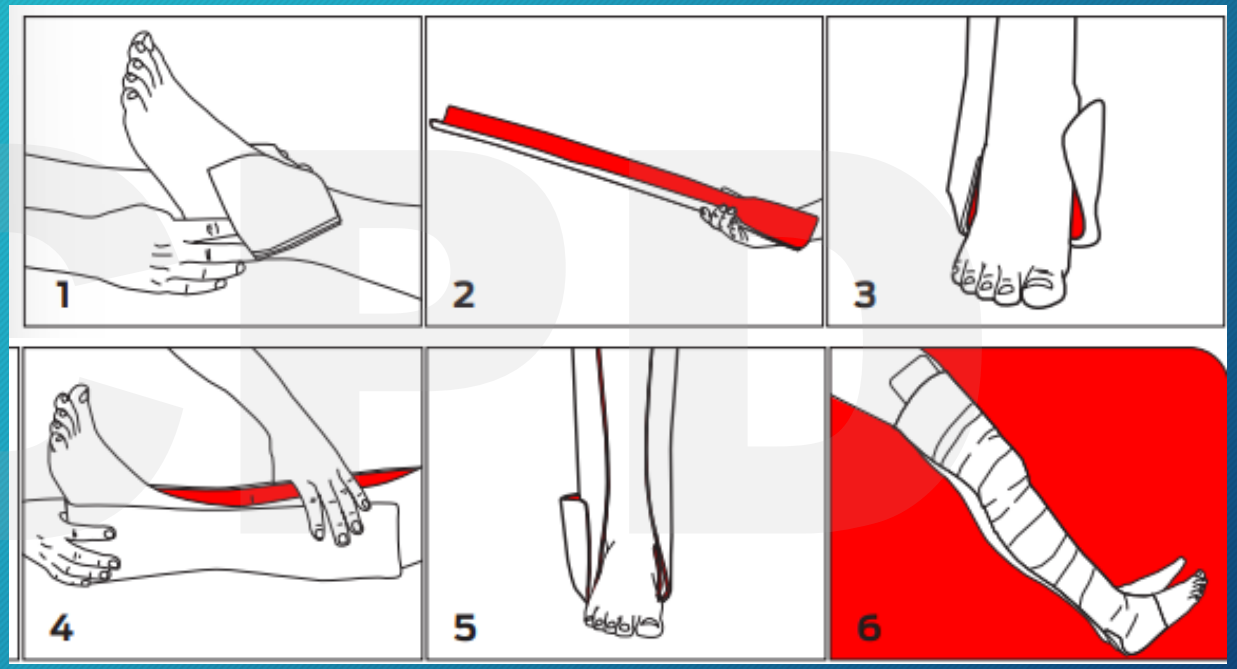
- Falls, jumps, twisting injuries
- Evaluation
  - Significant pain, swelling
  - Crepitus, deformity
  - Palpate medial/lateral malleolu
- Treatment
  - Realign rotational deformity
  - U-shaped splint

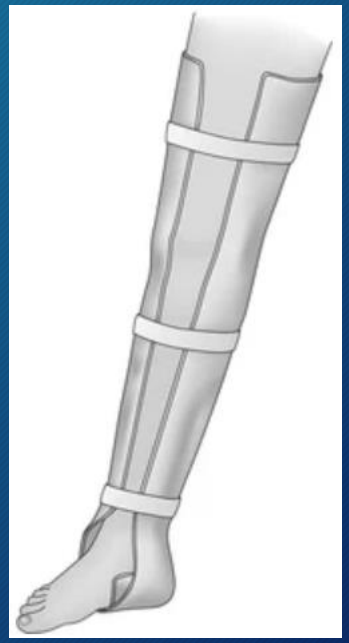


Fractures: Tibia and/or Fibula

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

- High impact, fall, jump from height
- Tibia fractures routinely involve fibula
- Possible knee dislocations
- Evaluation
  - Pain, swelling, deformity
  - Frequent CSM
- Treatment
  - Sugar-tong style Splint
- Complications
  - Possible popliteal artery injury

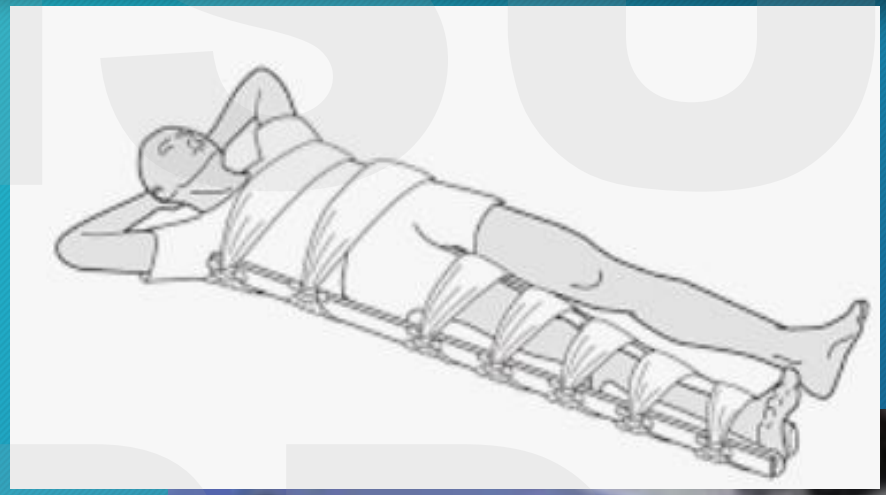




Fractures: Hip (Proximal Femur)

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

- Falls
- Differential
  - Pelvic Fracture, Hip dislocation
- Evaluation
  - Proximal thigh pain, painful ROM
  - Shortened, rotated leg
  - Pelvic stability
- Treatment
  - Splint in anatomic position
  - Consider traction if no pelvic fracture
- Complications
  - Significant blood loss into proximal thigh



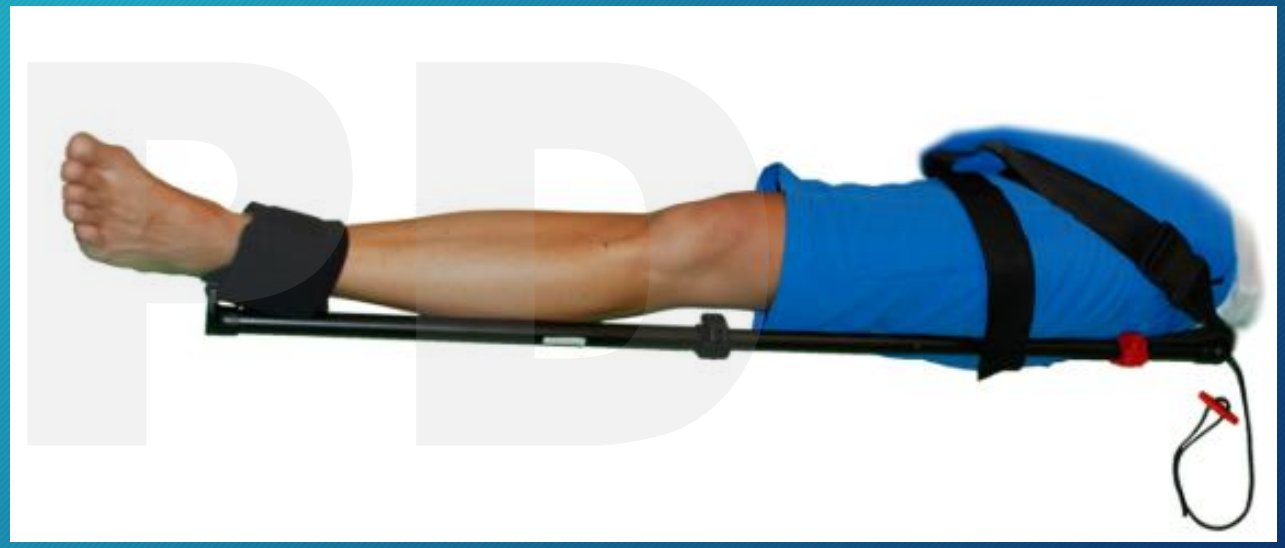
Fractures: Femoral Shaft

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

- Fall from height, high velocity injury
- May have associated
  - Femoral neck fracture
  - Pelvis fracture
- Evaluation
  - Mid thigh deformity/crepitus
  - Severe pain
  - Massive swelling
- Treatment
  - Traction splint
- Complications
  - Possible open injury
  - Significant blood loss into thigh

Splinting with Traction

- Limit blood loss into the thigh with femur fracture
  - Gentle traction involves less than 10 lbs of force
- Benefits
  - Maintains Limb Length and Alignment
  - Protect Soft Tissue and Vascular Structures
  - Reduces Pain and Muscle Spasm
- Considerations
  - Associated Pelvic Fracture
- Complications
  - May angulate/rotate fracture
  - Neurovascular compromise
  - Discomfort



Fractures: Pelvis

- High velocity injury, fall from height
- May present similar to Hip fracture/dislocation
- Evaluation
  - Instability of pelvis
    - Compression/Distraction force
  - Leg length discrepancy, swelling, ecchymosis
- Treatment
  - Pelvic stabilization
- Complications
  - Significant hemorrhage
    - Cancellous bone, Venous plexus, Pelvic arteries
  - Neurologic injury
  - Gastrointestinal, Genitourinary injuries
  - Open pelvis fracture 50% mortality

Dislocations

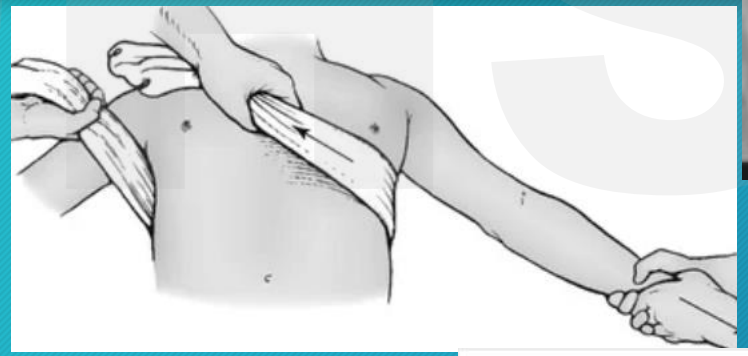
1-General 2-History 3-Inspect 4-Exam 5-HIRICE 6-Immobilize 7-Evacuate 8-Monitor

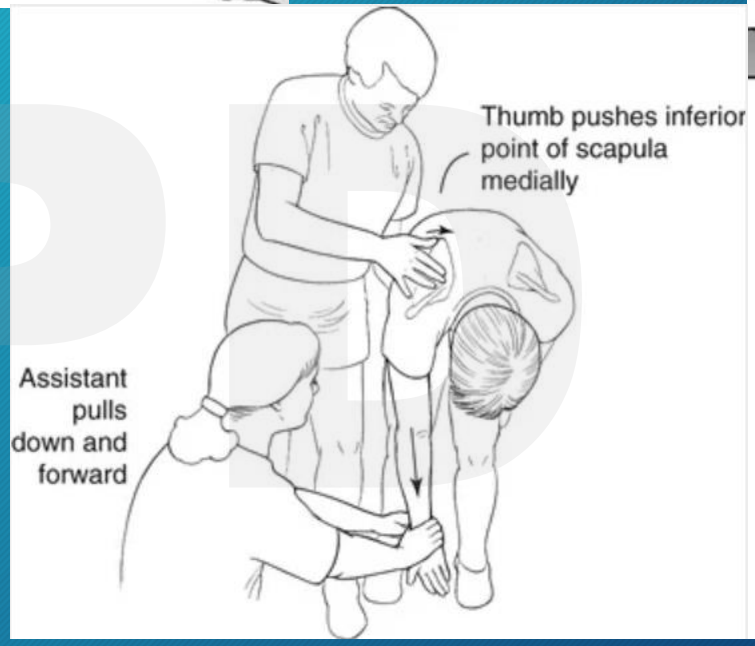
- Upper Extremity
  - Sternoclavicular Joint
  - Acromioclavicular Separation
  - Glenohumeral Joint (Anterior/Inferior)
  - Glenohumeral Joint (Posterior)
  - Shoulder Fracture/Dislocation
  - Elbow
  - Wrist
  - Metacarpophalangeal Joint
  - Interphalangeal Joints
- Lower Extremity
  - Hip
  - Knee
  - Patella
  - Ankle
  - Calcaneus
  - Lisfranc
  - Metatarsophalangeal
  - Interphalangeal

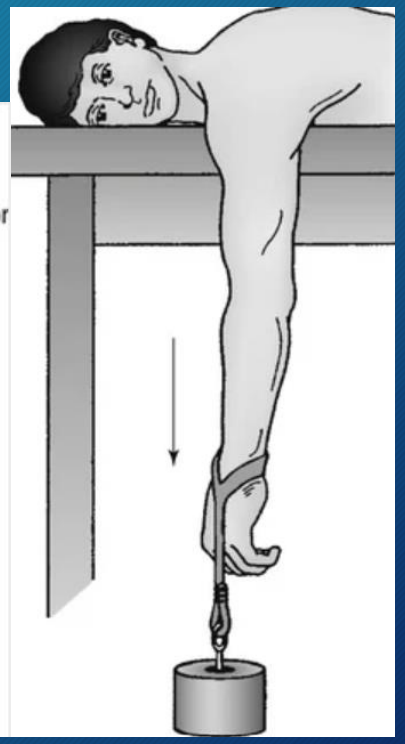
Dislocation: Anterior Shoulder

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

- Mechanism
  - Force to abducted arm
  - Anterior most common
  - ‘Square Shoulder’
  - Posterior dislocation
- Evaluation
  - No crepitus, decreased ROM, CSM
- Treatment
  - Consider reduction if not fracture dislocation
  - Sling, Shoulder spica wrap
- Complications
  - Axillary, Musculocutaneous nerve injury







Dislocation: Anterior Shoulder

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

- Mechanism
  - Force to abducted arm
  - Anterior most common
  - 'Square Shoulder'
    - Anterior with medial and inferior displacement
  - Posterior dislocation
- Evaluation
  - No crepitus, decreased ROM
- Treatment
  - Splint
  - Consider reduction, multiple techniques
- Complications
  - Axillary, Musculocutaneous nerve injury

Reduction of Acute Shoulder Dislocations in a Remote Environment: A Prospective Multicenter Observational Study

Therezia Bokor-Billmann, MD; Hryhoryi Lapshyn, MD; Erhard Kiffner, Prof MD; Matthias F. Goos, MD; Ulrich T. Hopt, Prof MD; Franck G. Billmann, MD, PhD

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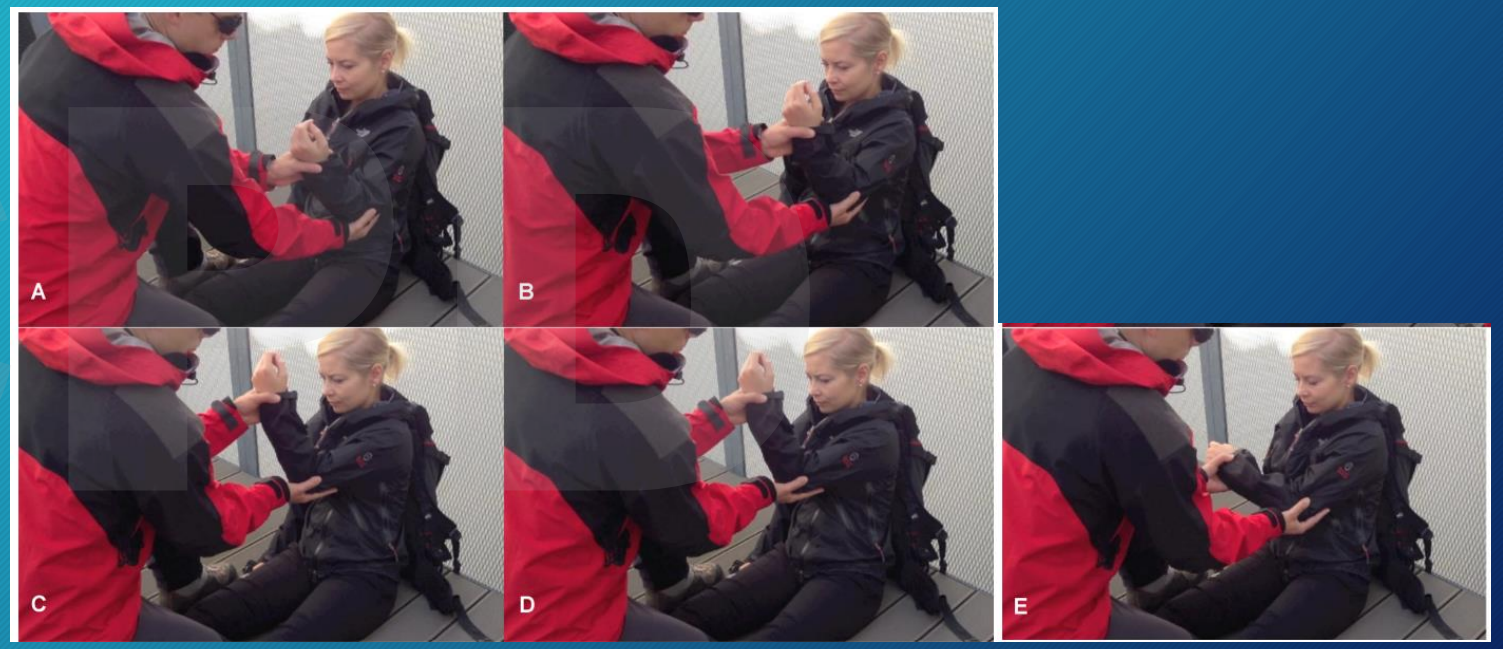
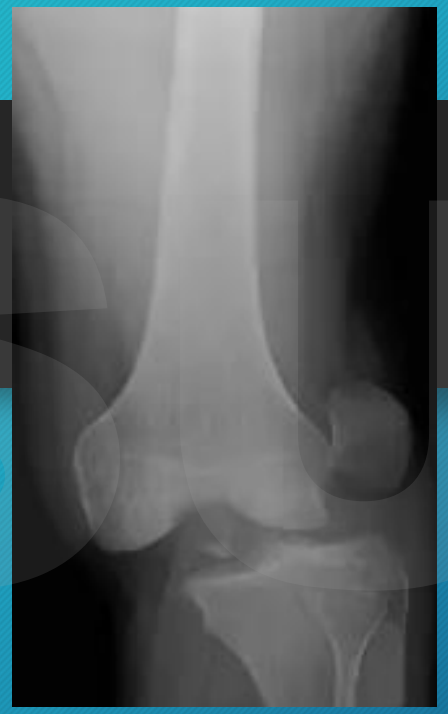


Dislocations: Knee

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



EMERGENCY!

- Most common is anterior dislocation
- Spontaneous reduction may occur and not be recognized
  - Can still have arterial injury
- Evaluation
  - CSM, intact pulses do not rule out vascular injury
- Treatment
  - Linear traction and splint
  - Immediate evacuation
- Complications
  - High association of vascular injury
  - Compartment syndrome

Dislocations: Ankle Fracture/Dislocation

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

- Rotational forces, fall
- Routinely accompanied by malleoli fracture
- Evaluation
  - Swelling, pain, deformity
- Treatment
  - Align foot with knee bent
    - Neutralizes Gastrocnemius
  - Posterior or Wrap splint
  - Elevate
  - Monitor CSM

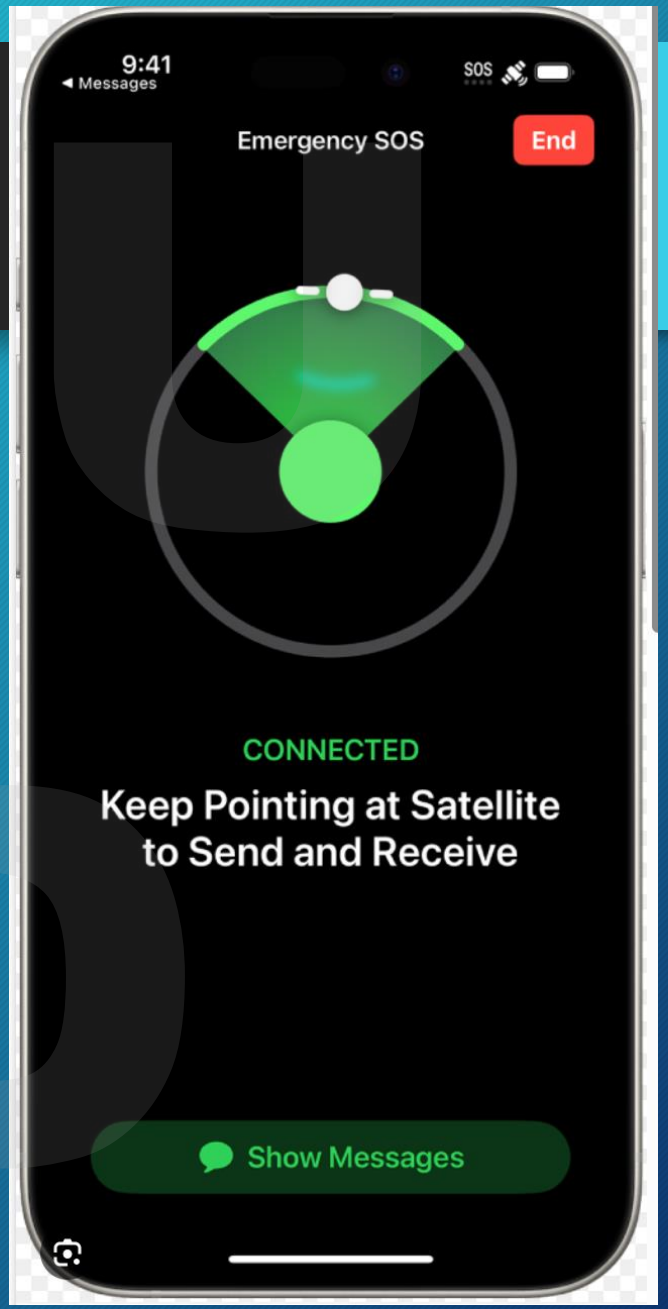
Evacuating the Patient

- Immediate Evacuation
  - Fractures
    - Spine, Pelvis, Femur
  - Open Fractures
  - Dislocations
    - Hip, Knee
  - Compartment Syndrome
  - Vascular Injury/Compromise
  - Tendon/Nerve Laceration
  - Uncertain Severity

Evacuating the Patient

- Evacuating Patient
  - Can patient walk out?
  - Can you assist patient out?
  - Do you need help to get the patient out?

Getting Help



Getting Help: iPhone SOS

- Uses Globalstar Satellite Network (not everywhere)
- Need Clear Line of Sight to sky
- Only available in certain regions (US, Canada, parts of Europe)
- Local regulations may affect availability
- Limited to text messages to emergency services
- Valuable but not replacement for dedicated satellite communicators
  - Garmin, SPOT, etc.
  - More robust, broader coverage

What to Bring

- Essentials
  - Day hike
  - Overnight
- First Aid Kit
- Splint Kit
- Survival Kit
- Modern Resources
- Be Creative
  - Use what you have

The Ten Essentials

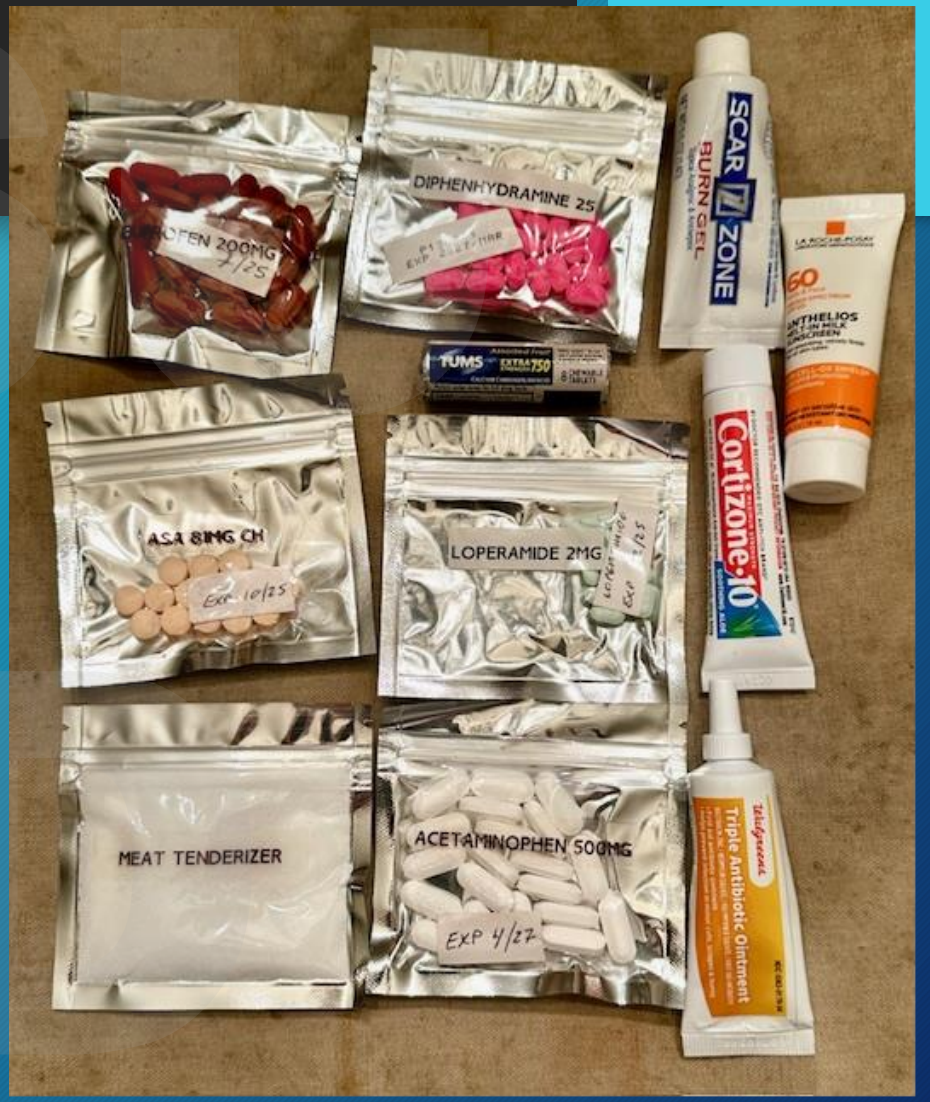
- First aid kit
- Flashlight
- Trail food
- Fire starter/matches
- Sun protection
- Whistle
- Rain gear
- Water (and purification)
- Map and compass
- Knife (or multitool)

Additional Essentials

Be Prepared!

- Garbage bags
- Rope (nylon cord)
- Multitool with saw
- Day pack

First Aid Kit



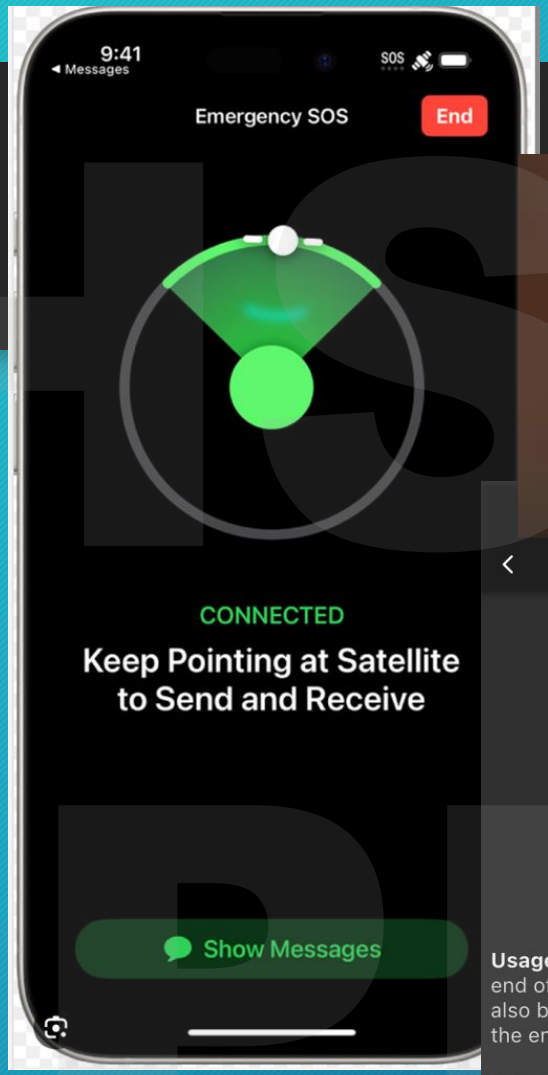
Splint Kit

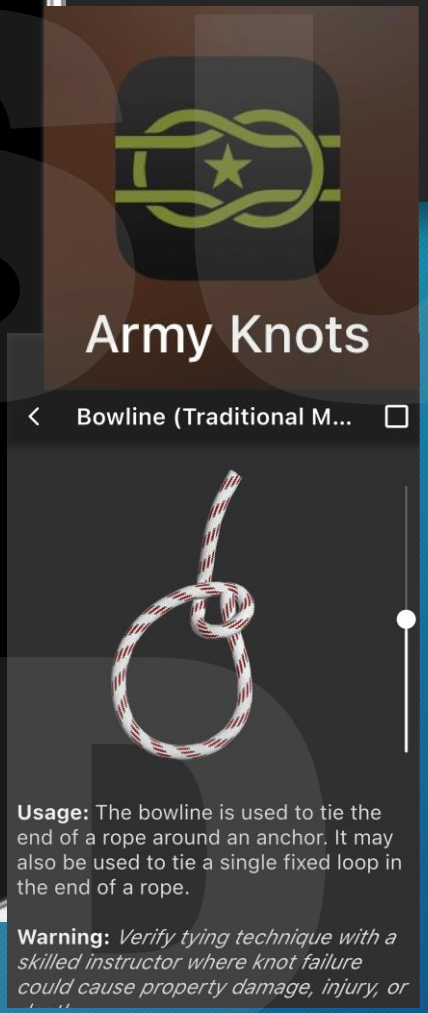

eOgecreek

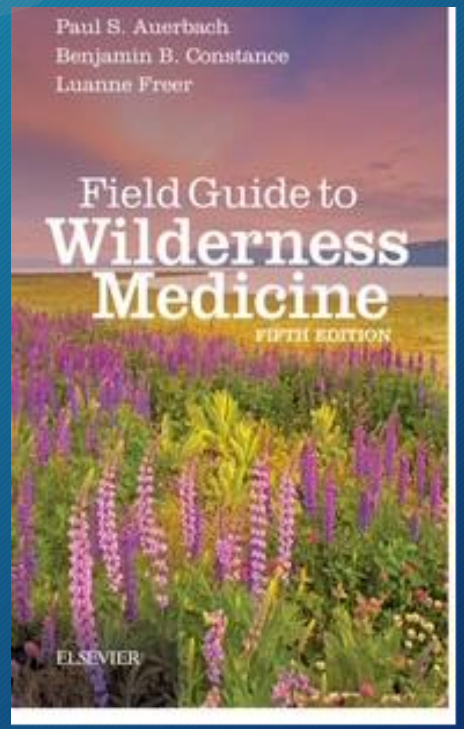

SAM SPLINT
RADIOLUCENT
SAM
SAM SPLINT
RADIOLUCENT
SAWYER +
SAM

Emergency Kit

Modern Resources







Be Creative~

Use What You Have

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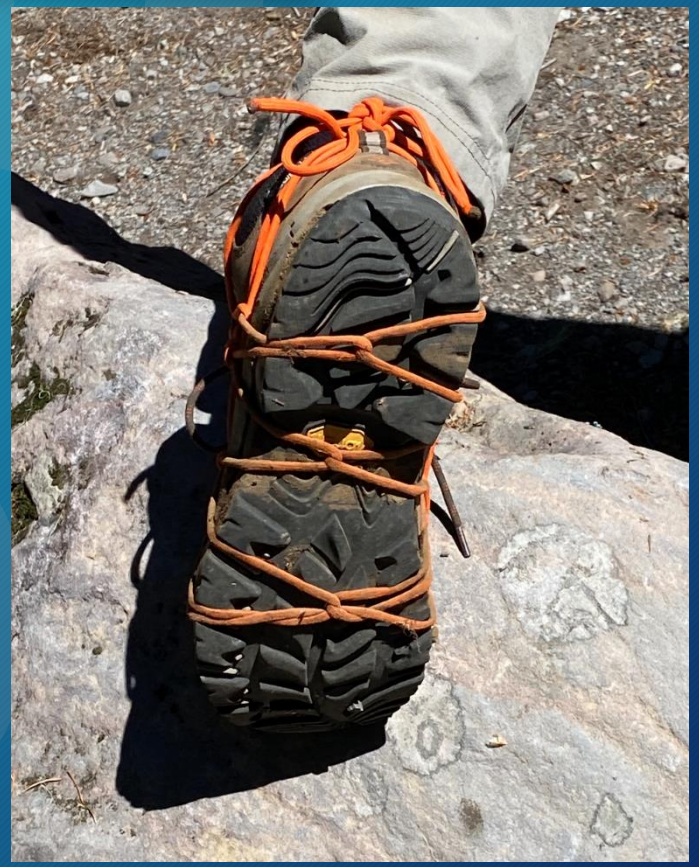

Thank you!

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