Anatomy and Physiology of the Musculoskeletal System

Cardiac muscle
Skeletal muscle
Smooth muscle
Peripheral nerve from spinal cord to muscle
Artery from heart
Vein to heart
Skeletal muscle
Skeletal System

- Skull
- Clavicle
- Shoulder Girdle
- Sternum
- Thorax (rib cage)
- Humerus (arm)
- Vertebra
- Radius (forearm)
- Ulna (forearm)
- Pelvis
- Femur
- Patella
- Fibula (leg)
- Tibia (leg)

Joints:
- Sutures
- No motion
- Shoulder joint
- Circular motion
- Sacroiliac joint
- Minimal motion
- Sternoclavicular joint
- Elbow joint
- Knee joint
- Hinge motion
Types of Musculoskeletal Injuries

- Fracture
  - Broken bone
- Dislocation
  - Disruption of a joint
- Sprain
  - Joint injury with tearing of ligaments
- Strain
  - Stretching or tearing of a muscle
Mechanism of Injury

• Force may be applied in several ways:
  - Direct blow
  - Indirect force
  - Twisting force
  - High-energy injury
Fractures

- Closed fracture
  - A fracture that does not break the skin
- Open fracture
  - External wound associated with fracture
- Nondisplaced fracture
  - Simple crack of the bone
- Displaced fracture
  - Fracture in which there is actual deformity
Greenstick Fracture

• is a fracture in a young, soft bone in which the bone bends and partially breaks
Comminuted Fracture

- A fracture in which bone is broken, splintered or crushed into a number of places
Pathologic Fracture

- is a broken bone that occurs in an area of weakened bone
Epiphyseal Fracture

- fracture involving the epiphyseal plate of a long bone, which causes separation or fragmentation of the plate
Signs and Symptoms of a Fracture

- Deformity
- Tenderness
- Guarding
- Swelling
- Bruising
- Crepitus
- False motion
- Exposed fragments
- Pain
- Locked joint
Signs and Symptoms of a Dislocation

- Marked deformity
- Swelling
- Pain
- Tenderness on palpation
- Virtually complete loss of joint function
- Numbness or impaired circulation to the limb and digit
Signs and Symptoms of a Sprain

- Point tenderness can be elicited over injured ligaments.
- Swelling and ecchymosis appear at the point of injury to the ligaments.
- Pain
- Instability of the joint is indicated by increased motion
Compartment Syndrome

- Most commonly occurs in a fractured tibia or forearm of children
- Elevated pressure within a fascial compartment
- Develops within 6 to 12 hours after injury
- Pain out of proportion with injury
- Splint affected limb, keeping it at the level of the heart
- Provide immediate transport
Severity of Injury

- **Severity of Injury**
  - Critical injuries can be identified using musculoskeletal injury grading system
- **Minor Injuries**
  - Minor sprains
  - Fractures or dislocations of digits
- **Moderate Injuries**
  - Open fractures of the digits
  - Nondisplaced long bone fractures
  - Nondisplaced pelvic fractures
  - Major sprains of a major joint

- **Serious Injuries**
  - Displaced long bone fractures
  - Multiple hand and foot fractures
  - Open long bone fractures
  - Displaced pelvic fractures
  - Dislocations of major joints
  - Multiple digit amputations
  - Laceration of major nerves or blood vessels
Severe Life-Threatening Injuries
(Survival Is Probable)

- Multiple closed fractures
- Limb amputations
- Fractures of both long bones on the leg (bilateral femur fractures)
Critical Injuries
(Survival Is Uncertain)

- Multiple open fracture of the limbs
- Suspected pelvic fractures with hemodynamic instability
Rapid Physical Exam for Significant Trauma

• If you find no external signs of injury, ask patient to move each limb carefully, stopping immediately if this causes pain.
• Skip this step if the patient reports neck or back pain
• Slight movement could cause permanent damage to spinal cord
Focused Physical Exam for Nonsignificant Trauma

• Evaluate circulation, motor function, sensation.
• If two or more extremities are injured, transport.
  – Severe injuries more likely if two or more bones have been broken
• Recheck neurovascular function before and after splinting.
• Impaired circulation can lead to death of the limb
• If anything causes pain, do not continue that portion of exam.

• Pulse
  – Palpate the radial, posterior tibial, and dorsalis pedis pulses
Assessing Neurovascular Status 2

- Capillary refill
  - Note and record skin color.
  - Press the tip of the fingernail to make the skin blanch.
  - If normal color does not return within 2 seconds, you can assume that circulation is impaired.
Assessing Neurovascular Status 3

• Sensation
  – Check feeling on the flesh near the tip of the index finger
  – In the foot, check the feeling on the flesh of the big toe and on the lateral side of the foot
Assessing Neurovascular Status 4

• Motor function
  – Evaluate muscular activity when the injury is near the patient’s hand or foot
  – Ask the patient to open and close his or her fist
  – Ask the patient to wiggle his or her toes
Emergency Medical Care

- Completely cover open wounds
- Apply the appropriate splint
- If swelling is present, apply ice or cold packs
- Prepare the patient for transport
- Always inform hospital personnel about wounds that have been dressed and splinted
Ongoing assessment

- Repeat initial assessment and vital signs
- Reassess interventions
- Reassess neurovascular function and color of splinted injured extremity distal to injury site
- Communication and documentation
  - Report problems with ABCs, type of fracture, and if circulation was compromised before or after splinting.
  - Document complete descriptions of injuries and MOIs
Splinting

- Flexible or rigid device used to protect extremity
- Injuries should be splinted prior to moving patient, unless the patient is critical
- Splinting helps prevent further injury
- Improvise splinting materials when needed
General Principles 1

- Remove clothing from the area
- Note and record the patient’s neurovascular status
- Cover all wounds with a dry, sterile dressing
- Do not move the patient before splinting
General Principles 2

- Immobilize the joints above and below the injured joint
- Pad all rigid splints
- Apply cold packs if swelling is present
- Maintain manual immobilization
- Use constant, gentle, manual traction if needed
- If you find resistance to limb alignment, splint the limb as is
• Immobilize all suspected spinal injuries in a neutral in-line position
• If the patient has signs of shock, align limb in normal anatomic position and transport
• When in doubt, splint
In-line Traction Splinting

- Act of exerting a pulling force on a bony structure in the direction of its normal alignment
- Realigns fracture of the shaft of a long bone
- Use the least amount of force necessary
- If resistance is met or pain increases, splint in deformed position
Applying a Rigid Splint

• Provide gentle support and in- traction of the limb
• Another EMT-B places the rigid splint alongside or under the limb
• Place padding between the limb and splint as needed
• Secure the splint to the limb with bindings
• Assess and record distal neurovascular function
Applying a Vacuum Splint

• Stabilize and support the injury
• Place the splint and wrap it around the limb
• Draw the air out of the splint and seal the valve
• Check and record distal neurovascular function
Traction Splints

• Do not use a traction splint under the following conditions:
  – Upper extremity injuries
  – Injuries close to or involving the knee
  – Pelvis and hip injuries
  – Partial amputation or avulsions with bone separation
  – Lower leg, foot, or ankle injuries
Applying a Hare Traction Splint

- Expose the injured limb and check pulse, motor, and sensory function
- Place splint beside the uninjured limb, adjust to proper length, and prepare straps
- Support the injured limb as your partner fastens the ankle hitch
- Continue to support the limb as your partner applies gentle in-line traction to the ankle hitch and foot
- Slide the splint into position under the injured limb

- Pad the groin and fasten the ischial strap
- Connect loops of ankle hitch to end of splint as your partner continues traction.
- Carefully tighten ratchet to the point that splint holds adequate traction.
- Secure and check support straps
- Assess distal neurovascular function
- Secure the patient and splint to long board for transport
Hazards of Improper Splinting

- Compression of nerves, tissues, and blood vessels
- Delay in transport of a patient with a life-threatening condition
- Reduction of distal circulation
- Aggravation of the injury
- Injury to tissue, nerves, blood vessels, or muscle
Clavicle and Scapula Injuries

- Clavicle is one of the most fractured bones in the body
- Scapula is well protected
- Joint between clavicle and scapula is the acromioclavicular (A/C) joint
- Splint with a sling and swathe
Shoulder injuries

- **A/C Separation**
  - The distal end of the clavicle usually sticks out

- **Dislocation of the Shoulder**
  - Most commonly dislocated large joint
  - Usually dislocates anteriorly
  - Is difficult to immobilize
Dislocation of the Shoulder

- A patient with a dislocated shoulder will guard the shoulder, trying to protect it by holding the arm in a fixed position away from the chest wall.
- Splint the joint with a pillow or towel between the arm and the chest wall.
- Apply a sling and a swathe.
Fractures of the Humerus

- Occurs either proximally, in the midshaft, or distally at the elbow
- Consider applying traction to realign a severely angulated humerus, according to local protocols
- Splint with sling and swathe, supplemented with a padded board splint
Elbow Injuries

• Fractures and dislocations often occur around the elbow
• Injuries to nerves and blood vessels common
• Assess neurovascular function carefully
  – Realignment may be needed to improve circulation
Fractures of the Forearm

- Usually involves both radius and ulna
- Use a padded board, air, vacuum, or pillow splint
- A fracture of the distal radius produces a characteristic silver fork deformity
Injuries to the Wrist and Hand

- Follow BSI precautions
- Cover all wounds
- Form hand into the position of function
- Place a roller bandage in palm of hand
- Apply padded board splint
- Secure entire length of splint
- Apply a sling and swathe
Fractures of the Pelvis

- May involve life-threatening internal bleeding
- Assess pelvis for tenderness
- Stable patients can be secured to a long backboard or scoop stretcher to immobilize isolated fractures of the pelvis
Assessment of Pelvic Fractures

- If there is injury to the bladder or urethra, the patient may have lower abdominal tenderness.
- They may have blood in the urine (hematuria) or at the urethral opening.
A stable patient with a pelvic fracture may be placed on a long board.

If the patient is unstable, consider using a PAGS with the patient stabilized on the long board (consult your local protocols).
Dislocation of the Hip

- Hip dislocation requires significant mechanism of injury
- Posterior dislocations lie with hip joint flexed and thigh rotated inward
- Anterior dislocations lie with leg extended straight out, and rotated, pointing away from midline
- Splint in position of deformity and transport
Injuries of Knee Ligaments

- Knee is very vulnerable to injury.
- Patient will complain of pain in the joint and be unable to use the extremity normally.
- Splint from hip joint to foot.
- Monitor distal neurovascular function
Knee injury

• Dislocation of the Knee:
  – Produces significant deformity
  – More urgent injury is to the popliteal artery, which is often lacerated or compressed
  – Always check distal circulation

• Fractures Around the Knee:
  – If there is adequate distal pulse and no significant deformity, splint limb with knee straight.
  – If there is adequate distal pulse and significant deformity, splint joint in position of deformity.
  – If pulse is absent below level of injury, contact medical control immediately
Dislocation of the Patella

- Usually dislocates to lateral side
- Produces significant deformity
- Splint in position found
- Support with pillows
Injuries to the Tibia and Fibula

- Usually, both bones fracture at the same time.
- Open fracture of tibia common.
- Stabilize with a padded rigid long leg splint or an air splint that extends from the foot to upper thigh.
- Because the tibia is so close to the skin, open fractures are quite common.
Ankle Injuries

- Most commonly injured joint
- Dress all open wounds
- Assess distal neurovascular function
- Correct any gross deformity by applying gentle longitudinal traction to the heel
- Before releasing traction, apply a splint
Foot Injuries

• Usually occur after a patient falls or jumps
• Immobilize ankle joint and foot
• Leave toes exposed to assess neurovascular function
• Elevate foot 6”
• Also consider possibility of spinal injury from a fall
• A pillow splint can provide excellent stabilization of the foot
Injuries from Falls

• Frequently after a fall, the force of the injury is transmitted up the legs to the spine, sometimes resulting in a fracture of the lumbar spine