



Chapter 29

Orthopaedic Injuries

National EMS Education Standard Competencies (1 of 6)

Trauma

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely injured patient.

National EMS Education Standard Competencies (2 of 6)

Orthopaedic Trauma

- Recognition and management of:
 - Open fractures
 - Closed fractures
 - Dislocations
 - Amputations

National EMS Education Standard Competencies (3 of 6)

- Pathophysiology, assessment, and management of:
 - Upper and lower extremity orthopaedic trauma
 - Open fractures
 - Closed fractures
 - Dislocations
 - Sprains/strains

National EMS Education Standard Competencies (4 of 6)

- Pathophysiology, assessment, and management of (cont'd):
 - Pelvic fractures
 - Amputations/replantation

National EMS Education Standard Competencies (5 of 6)

Medicine

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely ill patient.

National EMS Education Standard Competencies (6 of 6)

Nontraumatic Musculoskeletal Disorders

- Anatomy, physiology, pathophysiology, assessment, and management of:
 - Nontraumatic fractures

Introduction (1 of 2)

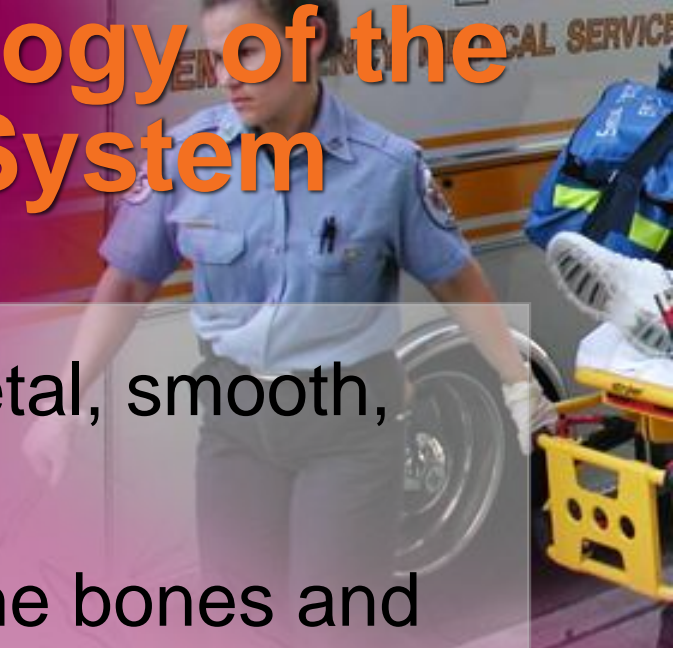
- The musculoskeletal system provides:
 - Form
 - Upright posture
 - Movement
- System also protects vital internal organs
 - Bones, muscles, tendons, joints, and ligaments are still at risk

Introduction (2 of 2)

- Musculoskeletal injuries are among the most common reasons why patients seek medical attention.
 - Often easily identified because of associated pain, swelling, and deformity
 - Often result in short- or long-term disability

Anatomy and Physiology of the Musculoskeletal System

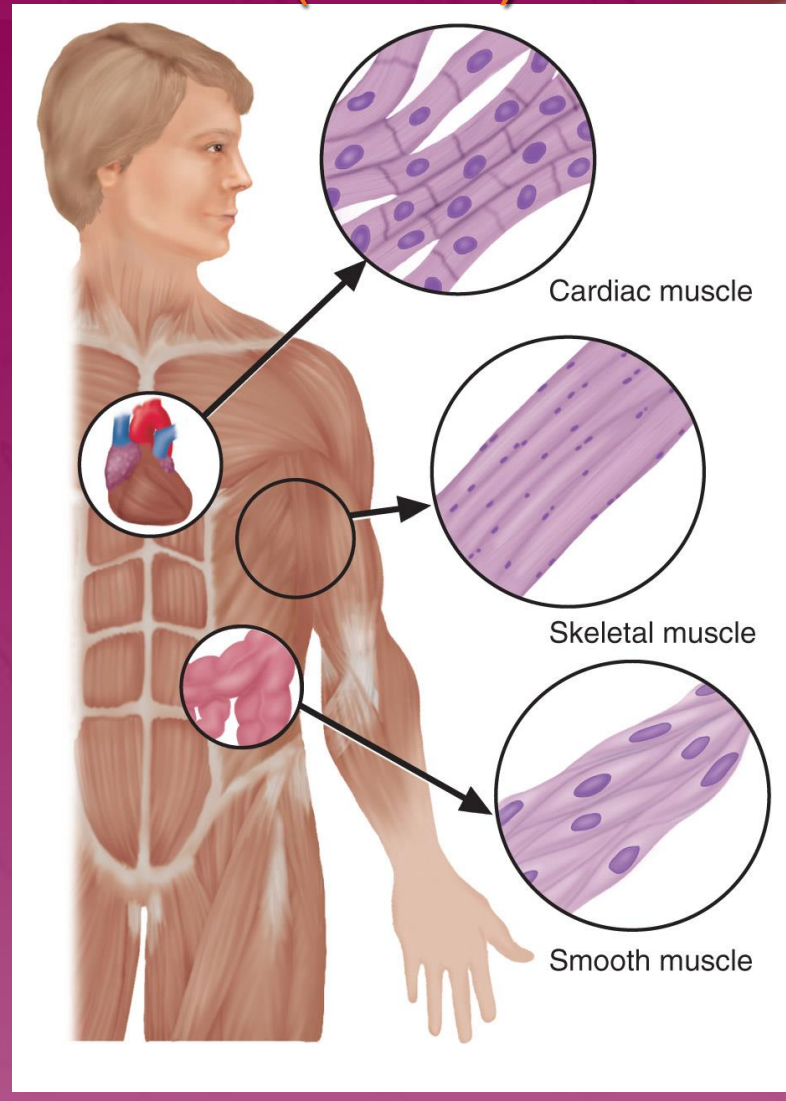
(1 of 5)

A paramedic in a light blue uniform is standing next to an ambulance. The ambulance has "EMERGENCY MEDICAL SERVICES" written on its side. The paramedic is wearing white gloves and is looking down at something in their hands.

- Three types of muscles: skeletal, smooth, and cardiac
- Skeletal muscle attaches to the bones and usually crosses at least one joint.
 - Forms the major muscle mass of the body
 - Called voluntary muscle because it is under direct voluntary control of the brain

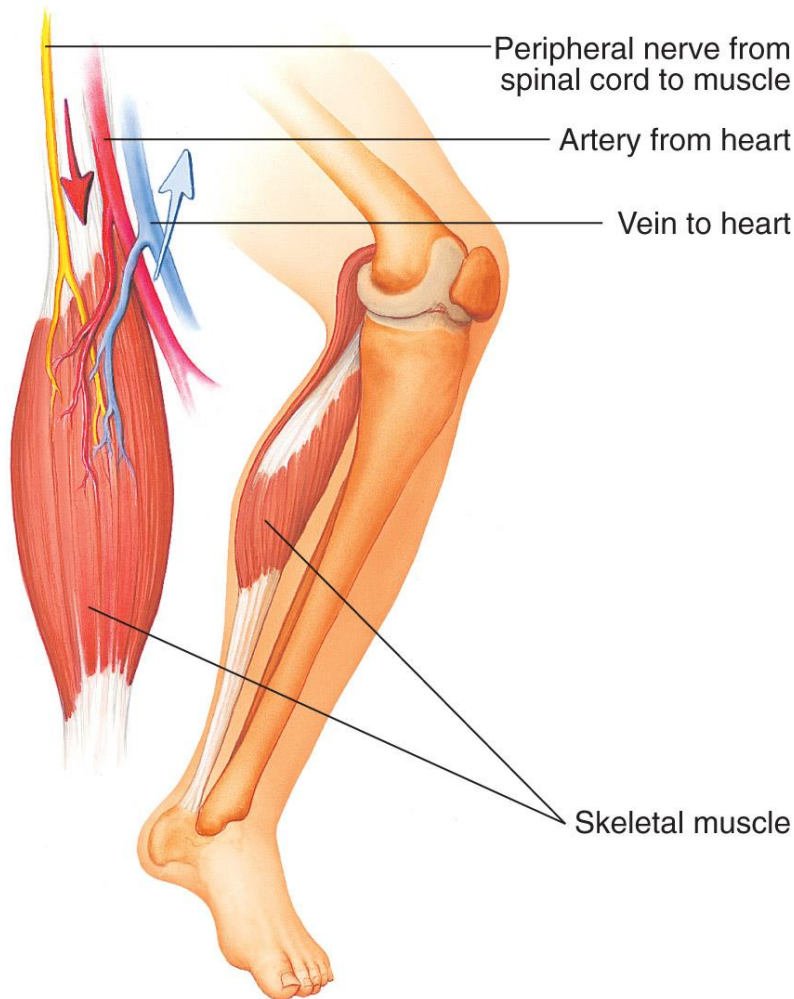
Anatomy and Physiology of the Musculoskeletal System

(2 of 5)



Anatomy and Physiology of the Musculoskeletal System

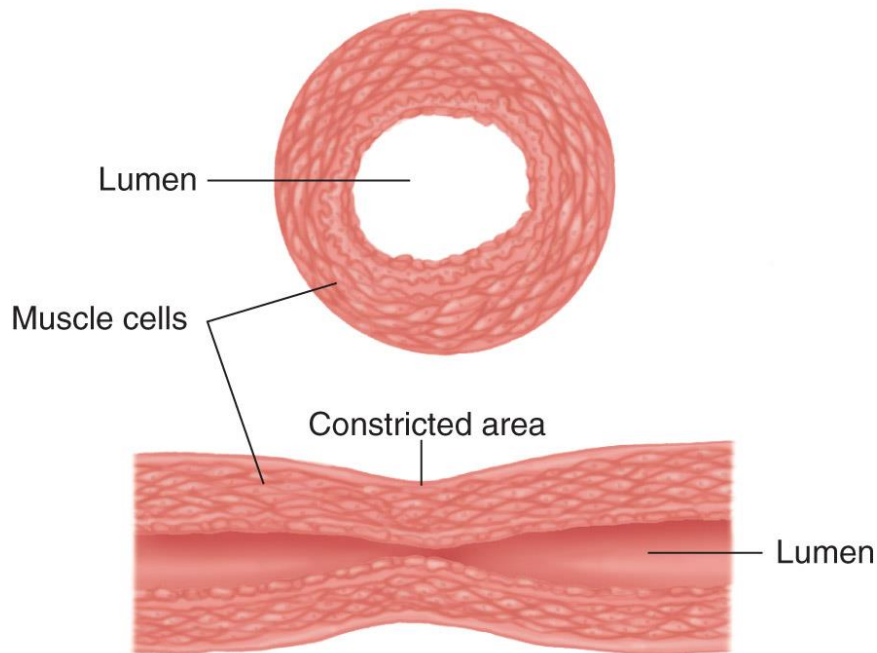
(3 of 5)



- All skeletal muscles are supplied with arteries, veins, and nerves.
- Skeletal muscle tissue is directly attached to the bone by tendons.

Anatomy and Physiology of the Musculoskeletal System

(4 of 5)



- Smooth muscle performs much of the automatic work of the body.
 - Not under voluntary control of the brain
 - Contracts and relaxes to control the movement of the contents within tubular structures

Anatomy and Physiology of the Musculoskeletal System

(5 of 5)

- Cardiac muscle is a specially adapted involuntary muscle with its own regulatory system.

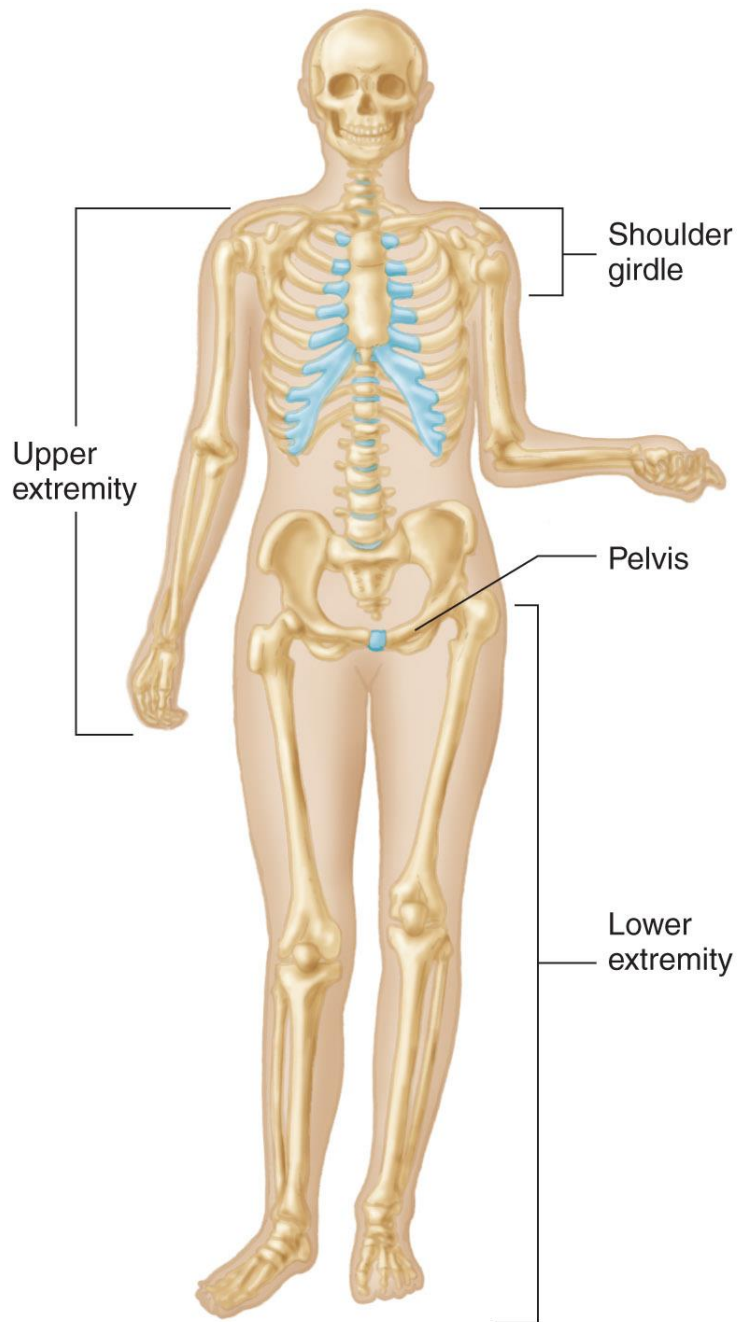
The Skeleton (1 of 11)



- Gives us our recognizable human form
- Protects our vital organs
- Allows us to move
- Produces blood cells
- Made up of approximately 206 bones

The Skeleton

(2 of 11)

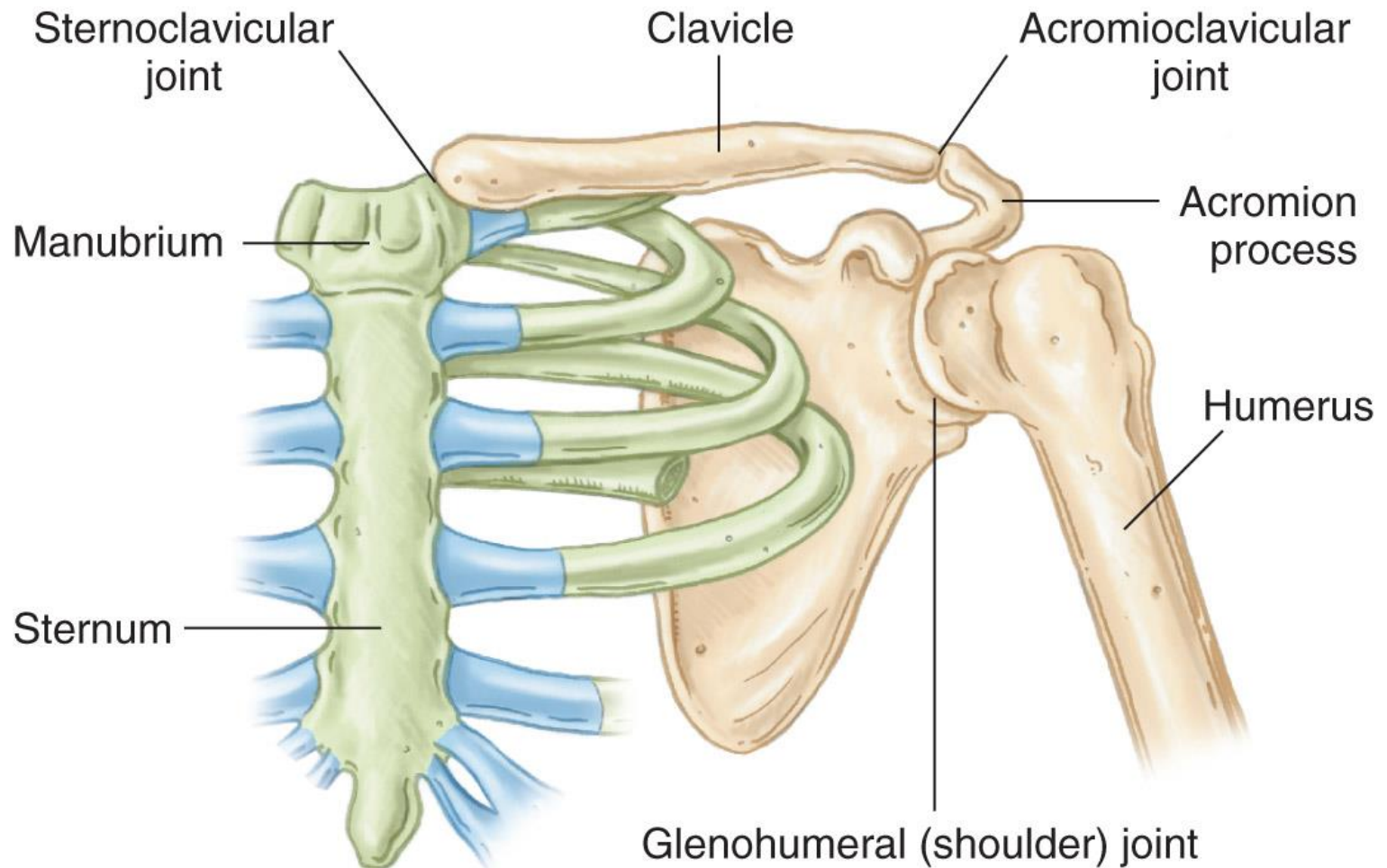


The Skeleton (3 of 11)

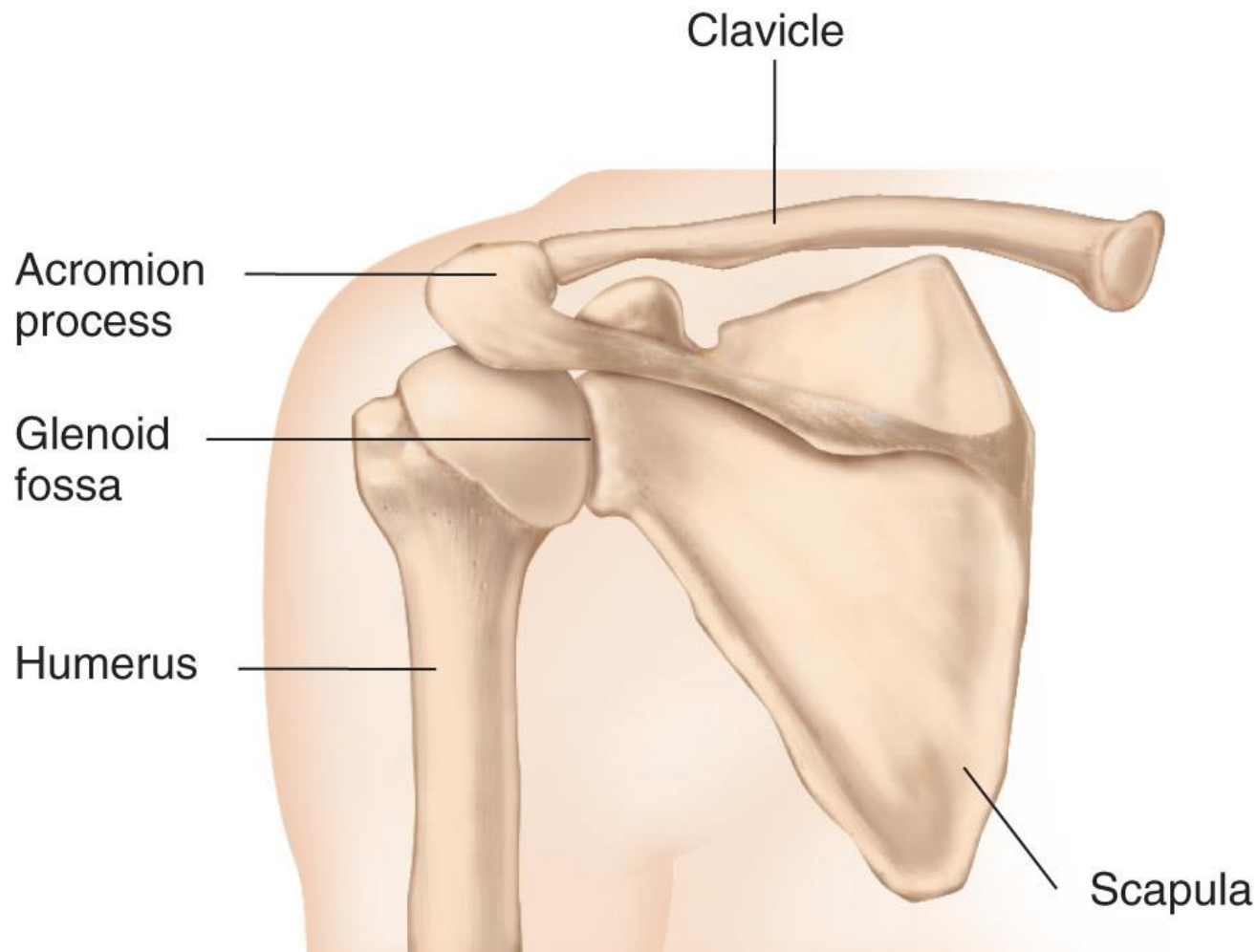


- The skull protects the brain.
- The thoracic cage protects the heart, lungs, and great vessels.
- The pectoral girdle consists of two scapulae and two clavicles.

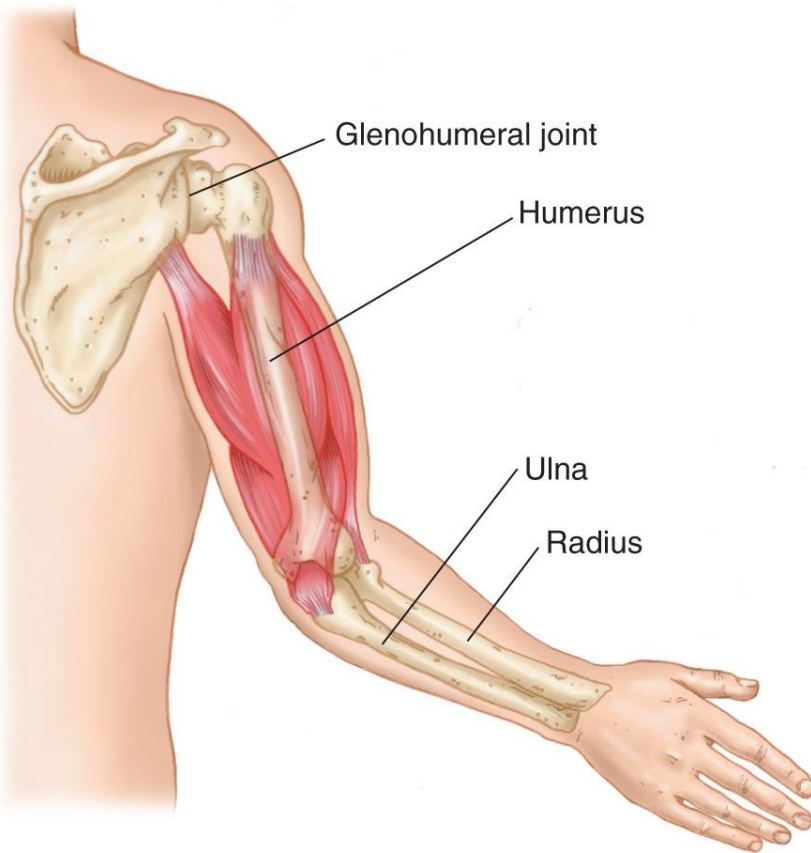
The Skeleton (4 of 11)



The Skeleton (5 of 11)

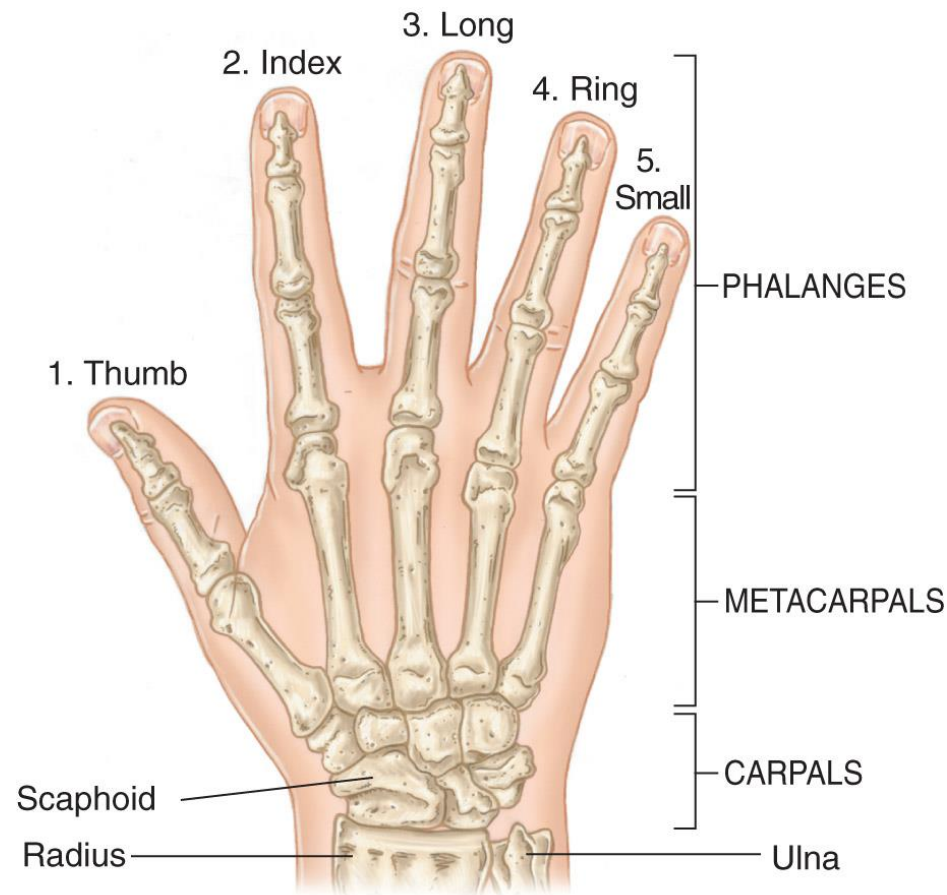


The Skeleton (6 of 11)



- The upper extremity extends from the shoulder to the fingertips.
 - Composed of the arm (humerus), elbow, forearm (radius and ulna), wrist, hand, and fingers

The Skeleton (7 of 11)



- The hand contains three sets of bones:

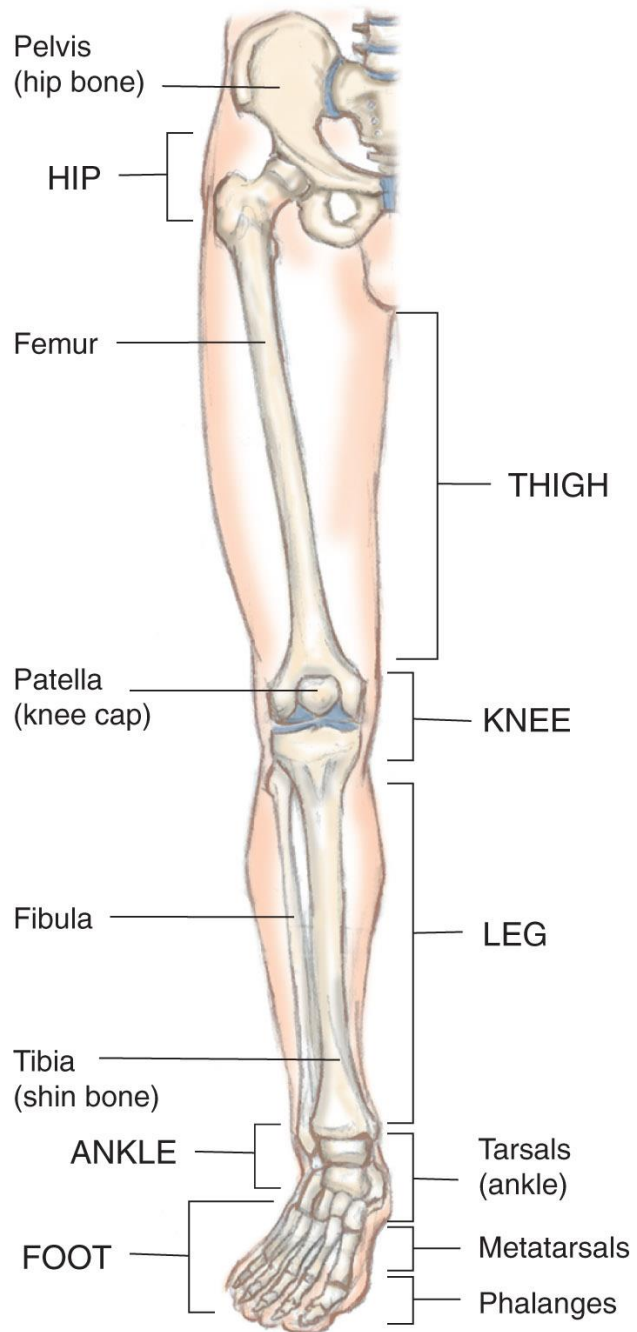
- Wrist bones (carpals)
- Hand bones (metacarpals)
- Finger bones (phalanges)

The Skeleton (8 of 11)

- The pelvis supports the body weight and protects the structures within the pelvis: the bladder, rectum, and female reproductive organs.
- The lower extremity consists of the bones of the thigh, leg, and foot.

The Skeleton

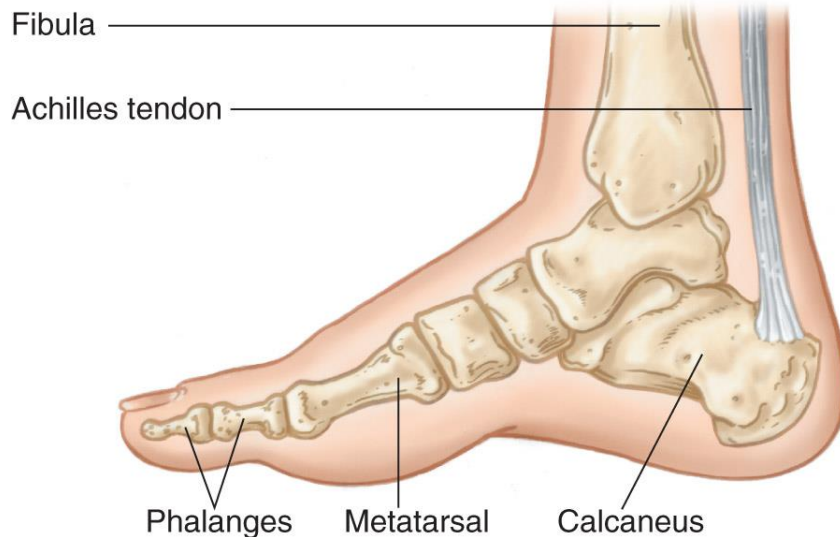
(9 of 11)



The Skeleton (10 of 11)

- The foot consists of three classes of bones:

- Ankle bones (tarsals)
- Foot bones (metatarsals)
- Toe bones (phalanges)



The Skeleton (11 of 11)

- The bones of the skeleton provide a framework to which the muscles and tendons are attached.
- A joint is formed wherever two bones come into contact.
 - Joints are held together in a capsule.
 - Joints are lubricated by synovial fluid.

Musculoskeletal Injuries (1 of 5)

- A fracture is a broken bone.
 - A potential complication is compartment syndrome.
- A dislocation is a disruption of a joint in which the bone ends are no longer in contact.



Musculoskeletal Injuries (2 of 5)



- A subluxation is similar except the disruption of the joints is not complete.
- A fracture-dislocation is a combination injury at the joint.

Musculoskeletal Injuries (3 of 5)

- A sprain is an injury to ligaments, articular capsule, synovial membrane, and tendons crossing the joint.
- A strain is a stretching or tearing of the muscle, causing:
 - Pain
 - Swelling
 - Bruising

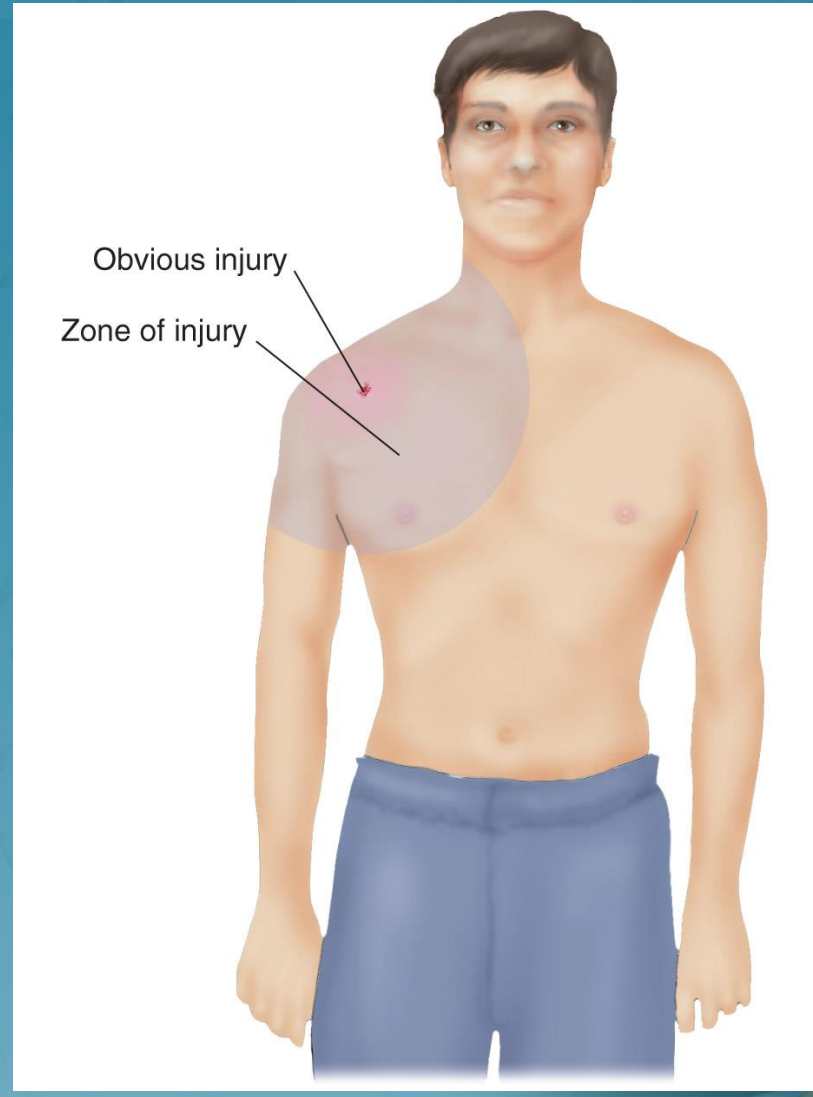


Musculoskeletal Injuries (4 of 5)

- An amputation is an injury in which an extremity is completely severed from the body.
- Injury to bones and joints is often associated with injury to the surrounding tissues.
 - Entire area is known as the zone of injury



Musculoskeletal Injuries (5 of 5)



Mechanism of Injury

- Significant force is generally required to cause fractures and dislocations.
 - Direct blows
 - Indirect forces
 - Twisting forces
 - High-energy forces





Fractures (1 of 8)

- Classified as either closed or open
- Your first priority is to determine whether the overlying skin is damaged.
 - Treat any injury that breaks the skin as a possible open fracture.



Fractures (2 of 8)

- Fractures are described by whether the bone is moved from its normal position.
 - A nondisplaced fracture is a simple crack of the bone.
 - A displaced fracture produces actual deformity, or distortion, of the limb by shortening, rotating, or angulating it.

Fractures (3 of 8)



- Medical personnel often use the following special terms to describe particular types of fractures.



Fractures (4 of 8)

- **Greenstick**
 - An incomplete fracture that passes only partway through the shaft of a bone
- **Comminuted**
 - A fracture in which the bone is broken into more than two fragments
- **Pathologic**
 - A fracture of weakened or diseased bone



Fractures (5 of 8)

- Oblique
 - A fracture in which the bone is broken at an angle across the bone
- Transverse
 - A fracture that occurs straight across the bone



Fractures (6 of 8)

- **Spiral**
 - A fracture caused by a twisting force, causing an oblique fracture around the bone and through the bone
- **Incomplete**
 - A fracture that does not run completely through the bone

Fractures (7 of 8)



- Suspect a fracture if one or more of the following signs are present:
 - Deformity
 - Tenderness
 - Guarding
 - Swelling

Fractures (8 of 8)



- Signs of fractures (cont'd)
 - Bruising
 - Crepitus
 - False motion
 - Exposed fragments
 - Pain
 - Locked joint

Dislocations (1 of 3)

- Sometimes a dislocated joint will spontaneously reduce before your assessment.
 - Confirm the dislocation by taking a patient history.
 - A dislocation that does not reduce is a serious problem.



Dislocations (2 of 3)

- Signs and symptoms
 - Marked deformity
 - Swelling
 - Pain that is aggravated by any attempt at movement
 - Tenderness on palpation



Dislocations (3 of 3)



Source: © Dr. P. Marazzi/Photo Researchers, Inc.

- Signs and symptoms (cont'd)
 - Virtually complete loss of normal joint motion
 - Numbness or impaired circulation to the limb or digit



Sprains (1 of 3)



- A sprain occurs when a joint is twisted or stretched beyond its normal range of motion.
 - Alignment generally returns to a fairly normal position, although there may be some displacement.
 - Severe deformity does not typically occur.

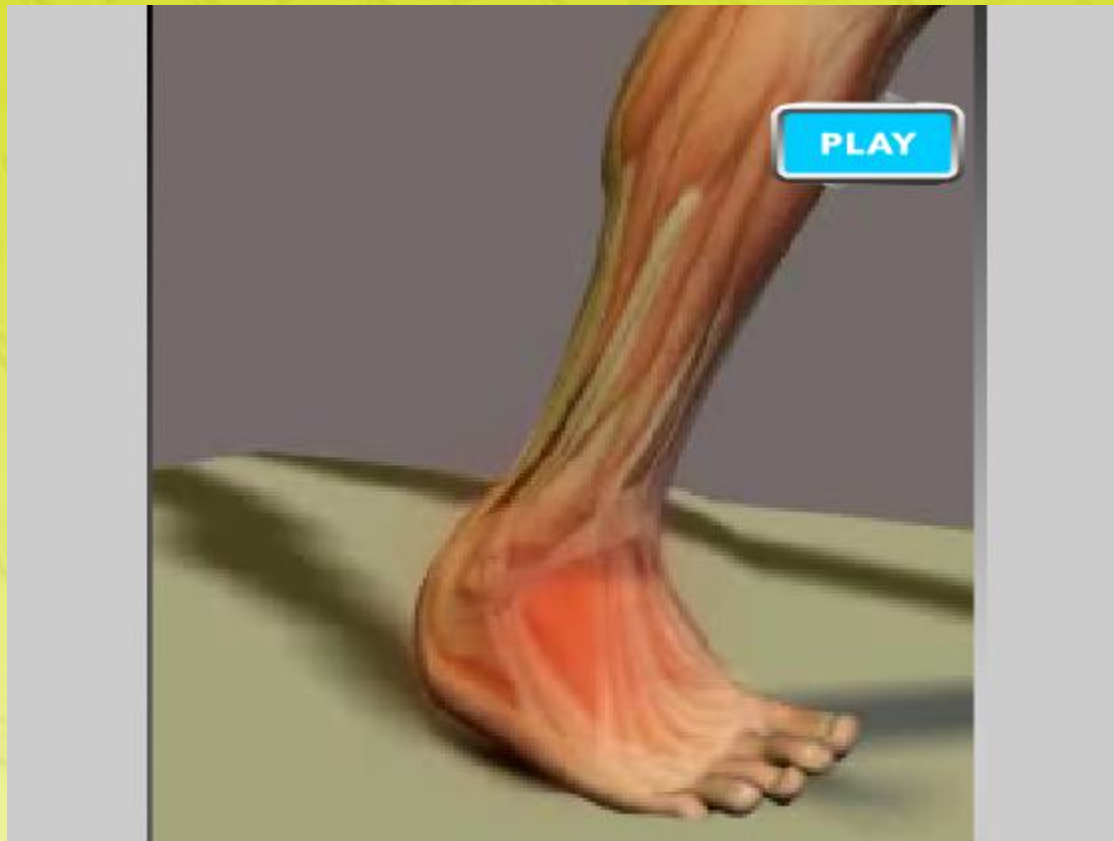
Sprains (2 of 3)



Source: © Sean Gladwell/Dreamstime.com

- Signs and symptoms
 - Point tenderness
 - Swelling and ecchymosis
 - Pain
 - Instability of the joint

Sprains (3 of 3)



Strain



- A strain is an injury to a muscle and/or tendon that results from a violent muscle contraction or from excessive stretching.
 - Often no deformity is present and only minor swelling is noted at the site of the injury.

Compartment Syndrome (1 of 2)

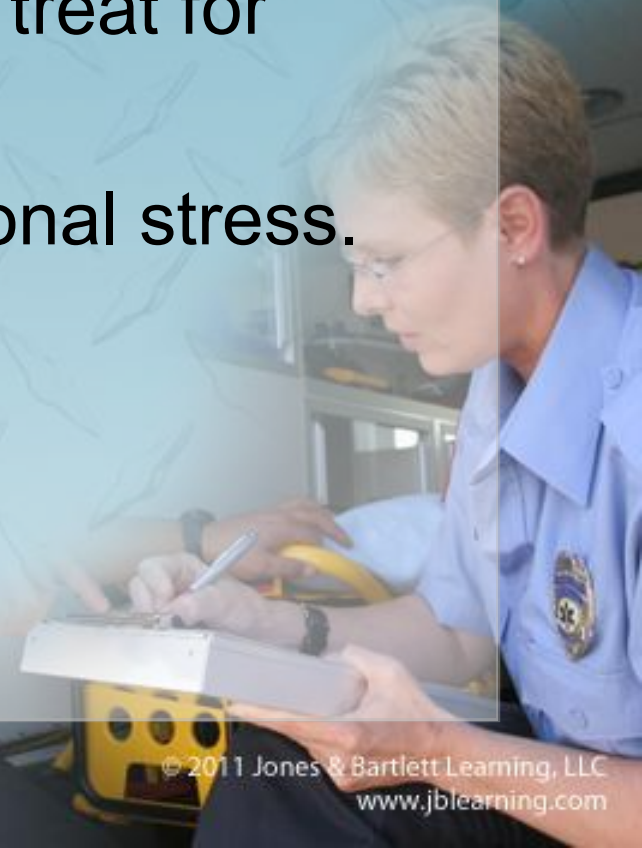
- Most often occurs with a fractured tibia or forearm of children
- Typically develops within 6 to 12 hours after injury, as a result of:
 - Excessive bleeding
 - A severely crushed extremity
 - The rapid return of blood to an ischemic limb

Compartment Syndrome (2 of 2)

- This syndrome is characterized by:
 - Pain that is out of proportion to the injury
 - Pain on passive stretching of muscles within the compartment
 - Pallor
 - Decreased sensation
 - Decreased power

Amputations

- Can occur as a result of trauma or a surgical intervention
- You must control bleeding and treat for shock.
- Be aware of the victim's emotional stress.



Complications (1 of 3)

- Orthopaedic injuries can also lead to systemic changes or illnesses.
- The likelihood of having a complication is often related to the:
 - Strength of the force that caused the injury
 - Injury's location
 - Patient's overall health



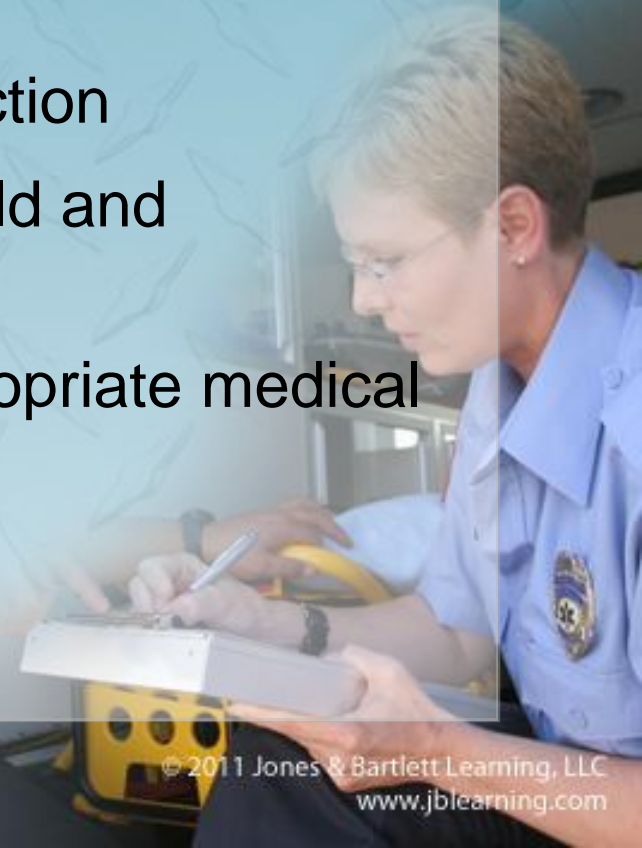
Complications (2 of 3)


- To prevent contamination following an open fracture:
 - Brush away any debris on the skin
 - Do not enter or probe the site
- Long-term disability is one of the most devastating consequences of an orthopaedic injury.



Complications (3 of 3)

- You can help reduce the risk or duration of long-term disability by:
 - Preventing further injury
 - Reducing the risk of wound infection
 - Minimizing pain by the use of cold and analgesia
 - Transporting patients to an appropriate medical facility





Assessing the Severity of Injury (1 of 2)

- The Golden Period is critical for life and for preserving limb viability.
 - Prolonged hypoperfusion can cause significant damage.
 - Any suspected open fracture or vascular injury is a medical emergency.
- Most injuries are not critical.
 - Use a grading system.

Table 29-1 Musculoskeletal Injury Grading System

Minor Injuries

- Minor sprains
- Fractures or dislocations of digits

Moderate Injuries

- Open fractures of 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 of the legs (bilateral femur fractures)

Critical Injuries (survival is uncertain)

- Multiple open fractures of the limbs
- Suspected pelvic fractures with hemodynamic instability

Assessing the Severity of Injury

(2 of 2)



Patient Assessment (1 of 2)

- Patient assessment steps
 - Scene size-up
 - Primary assessment
 - History taking
 - Secondary assessment
 - Reassessment

Patient Assessment (2 of 2)

- Always look at the big picture.
 - Distinguish mild injuries from severe injuries.
 - Severe injuries may compromise neurovascular function, which could be limb threatening.



Scene Size-up (1 of 2)

- Scene safety
 - Observe the scene for any hazards.
 - Identify the forces associated with the MOI.
 - Standard precautions involve gloves, a mask, and a gown.
 - Consider that there may be hidden bleeding.
 - Evaluate the need for additional support.



Scene Size-up (2 of 2)

- Mechanism of injury/nature of illness
 - Look for indicators of the MOI.
 - Be alert for both primary and secondary injuries.
 - Consider how the MOI produced the injuries expected.

Primary Assessment (1 of 5)

- Focus on identifying and managing life threats.
- Form a general impression.
 - Introduce yourself.
 - Check for responsiveness using the AVPU scale.
 - Ask about the chief complaint.



Primary Assessment (2 of 5)

- Form a general impression (cont'd).
 - Administer high-flow oxygen to all patients whose LOC is less than alert and oriented.
 - Perform a rapid scan and ask about the MOI.
 - If there was significant trauma, the musculoskeletal injuries may be a lower priority.

Primary Assessment (3 of 5)

- Airway and breathing
 - Evaluate the chief complaint and MOI.
 - If a spinal injury is suspected, take the appropriate precautions and prepare for stabilization.
 - Oxygen may be given to relieve anxiety and improve perfusion.



Primary Assessment (4 of 5)

- Circulation

- Determine whether the patient has a pulse, has adequate perfusion, or is bleeding.
- If the skin is pale, cool, or clammy and capillary refill time is slow, treat for shock.
- Maintain a normal body temperature and improve perfusion with oxygen.
- Fractures can break through the skin and cause external bleeding.



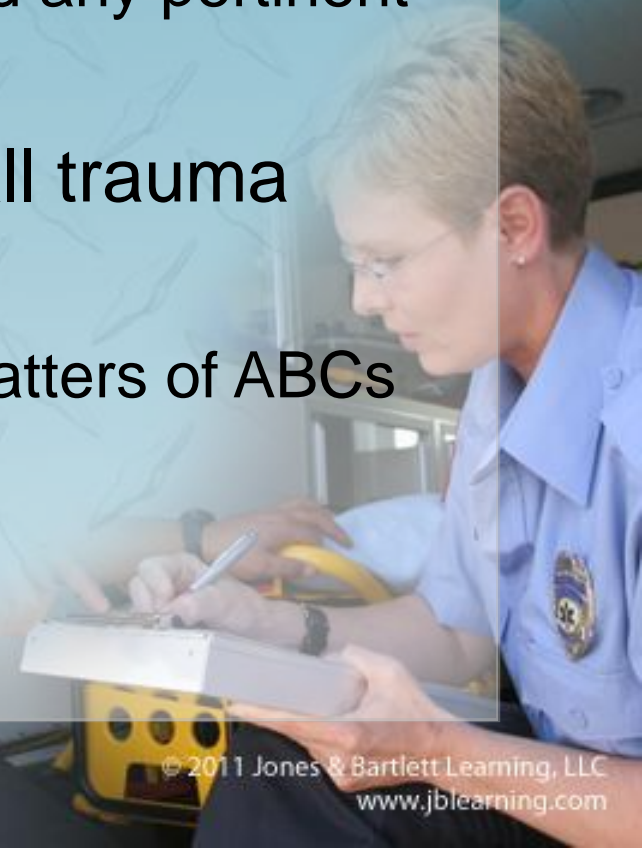
Primary Assessment (5 of 5)

- Transport decision
 - Provide rapid transport if the patient has an airway or breathing problem, or significant bleeding.
 - A patient who has a significant MOI but whose condition appears otherwise stable should also be transported promptly.
 - Patients with a simple MOI may be further assessed.



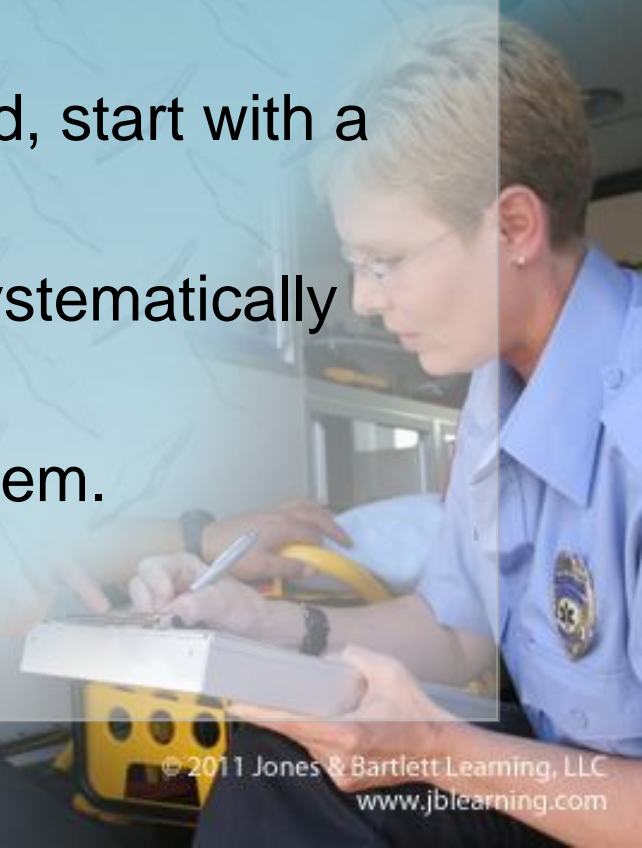
History Taking

- Investigate the chief complaint.
 - Obtain a medical history and be alert for injury-specific signs and symptoms and any pertinent negatives.
- Obtain a SAMPLE history for all trauma patients.
 - OPQRST is too lengthy when matters of ABCs require immediate attention.



Secondary Assessment (1 of 4)

- More detailed examination of the patient to reveal hidden injuries
- Physical examinations
 - If significant trauma has occurred, start with a full-body scan
 - Begin with the head and work systematically toward the feet.
 - Assess the musculoskeletal system.

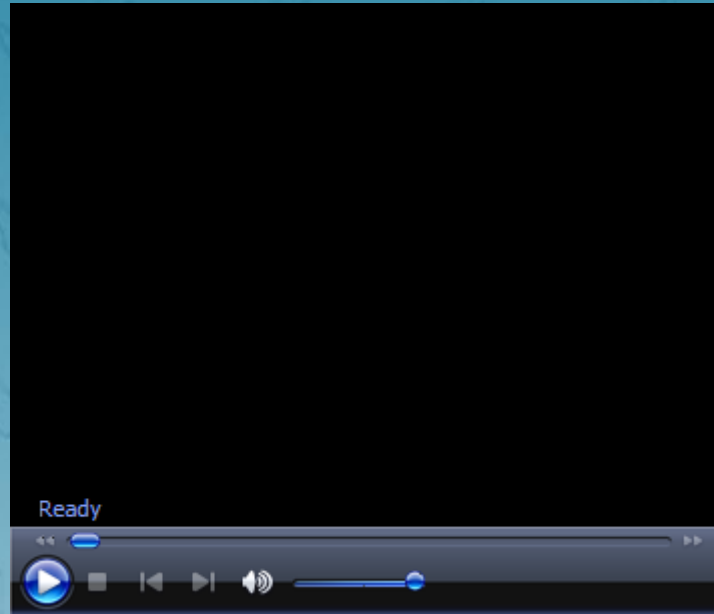


Secondary Assessment (2 of 4)

- Physical examinations (cont'd)
 - When lacerations are present in an extremity, consider an open fracture.
 - Any injury or deformity of the bone may be associated with vessel or nerve injury.
 - To assess neurovascular status, follow the steps in **Skill Drill 29-1**.



Secondary Assessment (3 of 4)



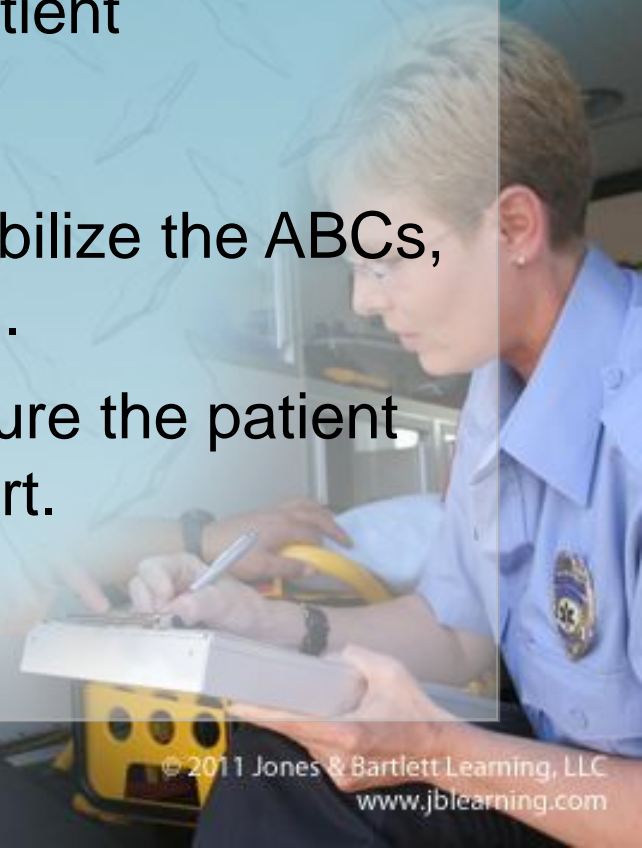
Secondary Assessment (4 of 4)

- Vital signs
 - Determine a baseline set of vital signs, including:
 - Pulse rate, rhythm, and quality
 - Respiratory rate, rhythm, and quality
 - Blood pressure
 - Skin condition
 - Pupil size and reaction to light



Reassessment (1 of 3)

- Repeat the primary assessment.
 - Every 5 minutes for an unstable patient
 - Every 15 minutes for a stable patient
- Interventions
 - Assess the overall condition, stabilize the ABCs, and control any serious bleeding.
 - In a critically injured patient, secure the patient to a long backboard and transport.



Reassessment (2 of 3)

- Interventions (cont'd)
 - If the patient has no life-threatening injuries, take extra time at the scene to stabilize his or her condition.
 - The main goal is stabilization in the most comfortable position that allows for maintenance of good circulation distal to the injury.



Reassessment (3 of 3)

- Communication and documentation
 - Include a description of the problems found during your assessment.
 - Report problems with the ABCs, open fractures, and compromised circulation.
 - Document complete description of injuries and the MOIs associated with them.



A man in a light blue shirt is looking down at a clipboard held by a person whose back is to the camera. The background is a blurred outdoor setting with trees.

Emergency Medical Care

- Perform a primary assessment.
- Stabilize the patient's ABCs.
- Perform a rapid scan or focus on a specific injury.
- Follow standard precautions.
- Suspect internal bleeding.
- Follow the steps in **Skill Drill 29-2.**

A man in a light blue shirt is looking down at a patient's arm, which is being held by a woman with long blonde hair. The background is a blurred outdoor setting with greenery.

Splinting (1 of 7)

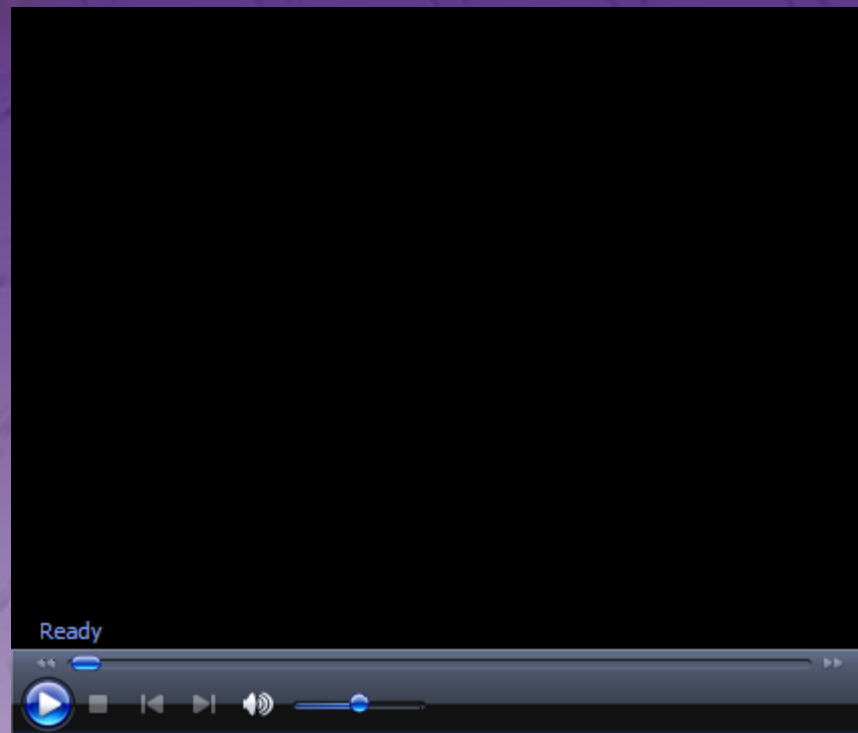
- A splint is a flexible or rigid device that is used to protect and maintain the position of an injured extremity.
 - Splint all fractures, dislocations, and sprains before moving the patient, unless he or she is in immediate danger.
 - Splinting reduces pain and makes it easier to transfer and transport the patient.



Splinting (2 of 7)

- Splinting will help to prevent:
 - Further damage to muscles, the spinal cord, peripheral nerves, and blood vessels
 - Laceration of the skin
 - Restriction of distal blood flow
 - Excessive bleeding of the tissues
 - Increased pain
 - Paralysis of extremities

Splinting (3 of 7)



A man in a light blue shirt is looking down at a patient's arm, which is being held by a person with long blonde hair. The background is a blurred outdoor setting with greenery.

Splinting (4 of 7)

- General principles of splinting
 - 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 an extremity, unless there is danger.

A man in a light blue shirt is looking down at a patient's arm, which is being splinted. The background is a blurred outdoor setting with trees.

Splinting (5 of 7)

- General principles of splinting (cont'd)
 - Pad all rigid splints.
 - Maintain manual stabilization.
 - If you encounter resistance, splint the limb in its deformed position.
 - Stabilize all suspected spinal injuries in a neutral, in-line position.
 - When in doubt, splint.



Splinting (6 of 7)

- General principles of in-line traction splinting
 - Act of pulling on a body structure in the direction of its normal alignment
 - Goals of in-line traction:
 - To stabilize the fracture fragments
 - To align the limb sufficiently
 - To avoid potential neurovascular compromise

Splinting (7 of 7)



- In-line traction splinting (cont'd)
 - Imagine where the uninjured limb would lie, and pull gently along the line of that imaginary limb until the injured limb is in approximately that position.

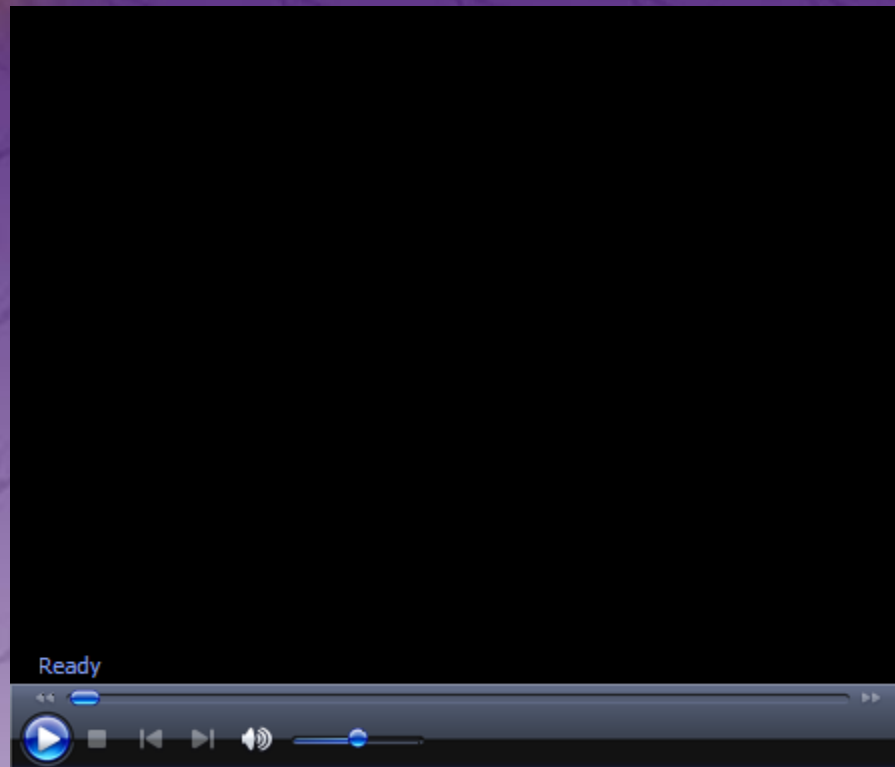




Rigid Splints (1 of 4)

- Made from firm material
- Applied to the sides, front, and/or back of an injured extremity
- Prevent motion at the injury site
- Takes two EMTs to apply
- Follow the steps in **Skill Drill 29-3.**

Rigid Splints (2 of 4)



Rigid Splints (3 of 4)





Rigid Splints (4 of 4)

- Two situations in which you must splint the limb in the position of deformity:
 - When the deformity is severe
 - When you encounter resistance or extreme pain when applying gentle traction to the fracture of a shaft of a long bone



Formable Splints (1 of 2)

- Most commonly used formable splint is the precontoured, inflatable, clear plastic air splint
 - Comfortable
 - Provides uniform contact
 - Applies firm pressure to a bleeding wound
 - Used to stabilize injuries below the elbow or knee



Formable Splints (2 of 2)

- Drawbacks:
 - The zipper can stick, clog with dirt, or freeze.
 - Significant changes in the weather affect the pressure of the air in the splint.
- Follow the steps in **Skill Drills 29-4, 29-5, and 29-6.**



Traction Splints (1 of 4)

- Used primarily to secure fractures of the shaft of the femur
- Several different types:
 - Hare splint
 - Sager splint
 - Reel splint
 - Kendrick splint

A man in a light blue shirt is looking at a white splint. The background is a purple gradient with a faint, repeating pattern of white splints.

Traction Splints (2 of 4)

- Do not use for any of these conditions:
 - Injuries of the upper extremity
 - Injuries close to or involving the knee
 - Injuries of the hip
 - Injuries of the pelvis
 - Partial amputations or avulsions with bone separation
 - Lower leg, foot, or ankle injury



Traction Splints (3 of 4)

- Proper application requires two well-trained EMTs.
- To apply a Hare splint, follow the steps in **Skill Drill 29-7.**
- To apply a Sager splint, follow the steps in **Skill Drill 29-8.**

Traction Splints (4 of 4)



Pelvic Binder



- Used to splint the bony pelvis to reduce hemorrhage from bone ends, venous disruption, and pain
- Meant to provide temporary stabilization
 - Should be light, made of soft material, easily applied by one person, and should allow access to the abdomen, perineum, anus, and groin

Pneumatic Antishock Garments (1 of 3)



- Use as a splinting device if a patient has injuries to the lower extremities/pelvis.
- Do not use the PASG if any of the following conditions exist:
 - Pregnancy
 - Pulmonary edema
 - Acute heart failure

Pneumatic Antishock Garments (2 of 3)



- Do not use the PASG if (cont'd):
 - Penetrating chest injuries
 - Groin injuries
 - Major head injuries
 - A transport time of less than 30 minutes
- Follow the steps in **Skill Drill 29-9.**

Pneumatic Antishock Garments (3 of 3)



Hazards of Improper Splinting

A person in a blue shirt is shown in the upper right corner, working on a splint. The background is a yellow gradient with a faint, repeating pattern of the word "HAZARD" in a diamond shape.

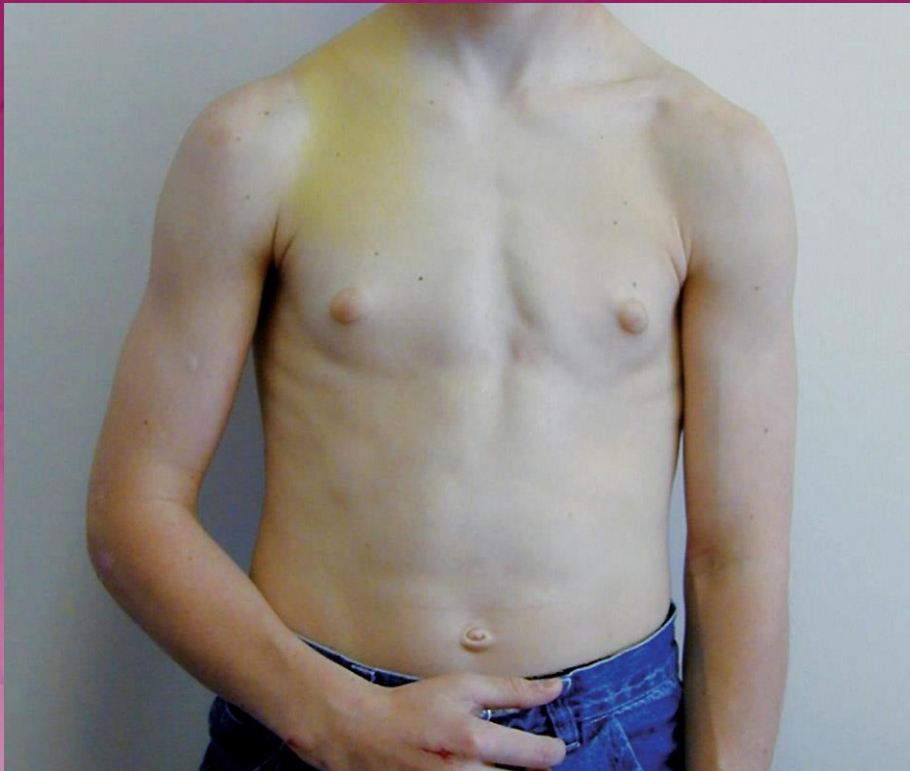
- Compressions of nerves, tissues, and blood vessels
- Delay in transport of a patient with a life-threatening injury
- Reduction of distal circulation
- Aggravation of the injury
- Injury to tissue, nerves, blood vessels, or muscles

Transportation



- Very few, if any, musculoskeletal injuries justify the use of excessive speed during transport.
 - A patient with a pulseless limb must be given a higher priority.
 - If the treatment facility is an hour or more away, transport by helicopter or immediate ground transportation.

Injuries of the Clavicle and Scapula (1 of 3)



Source: © Shea, MD/Custom Medical Stock Photo

- The clavicle is one of the most commonly fractured bones in the body.
 - Occur most often in children
 - A patient will report pain in the shoulder and will hold the arm across the front of the body.

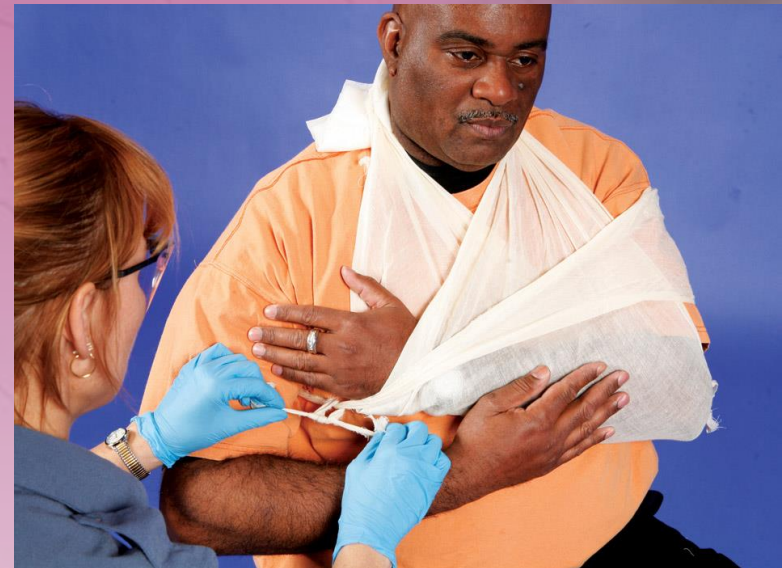
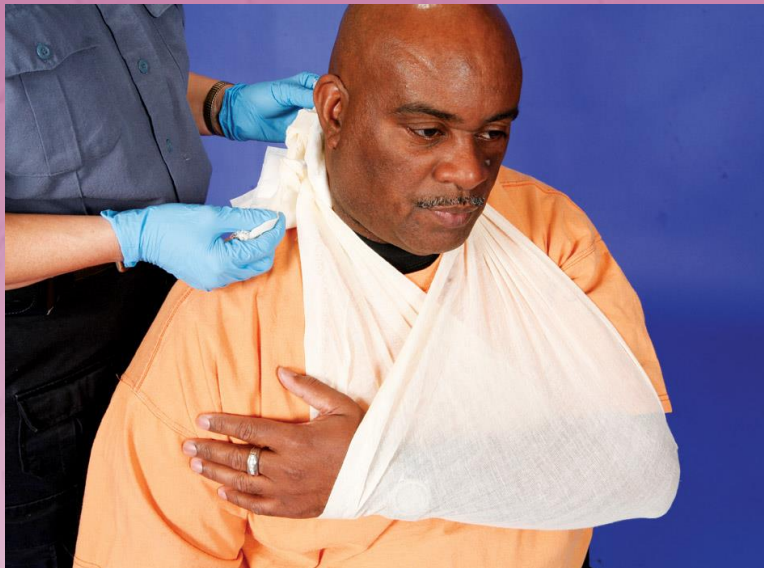


Injuries of the Clavicle and Scapula (2 of 3)

- Fractures of the scapula occur much less frequently because the bone is well protected by many large muscles.
 - Almost always the result of a forceful, direct blow to the back
 - The associated chest injuries pose the greatest threat of long-term disability.

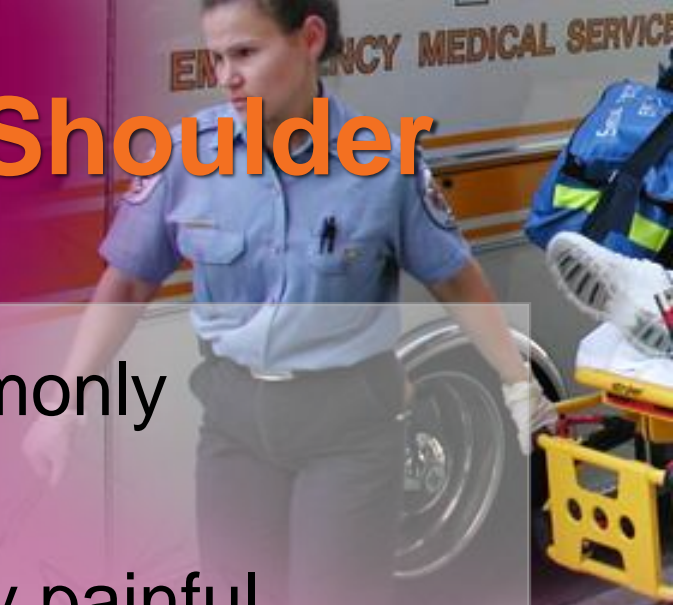
Injuries of the Clavicle and Scapula (3 of 3)

- These fractures can be splinted effectively with a sling and swathe.



Dislocations of the Shoulder

- The humeral head most commonly dislocates anteriorly.
- Shoulder dislocations are very painful.
 - Stabilization is difficult because any attempt to bring the arm in toward the chest wall produces pain.
 - Splint the joint in whatever position is more comfortable for the patient.



Fractures of the Humerus (1 of 2)

- Occur either proximally, in the midshaft, or distally at the elbow
- Consider applying traction to realign the fracture fragments before splinting them.
 - Splint the arm with a sling and swathe.



Fractures of the Humerus (2 of 2)

Table 29-2 Characteristics and Treatment of Fractures of the Humerus

Type	Characteristics	Treatment
Proximal humeral fractures	<ul style="list-style-type: none">■ Significant swelling, but no deformity of the upper arm■ Neurovascular compromise■ Any or all of the brachial plexus affected, depending on the degree of displacement■ Concurrent soft-tissue injuries■ Possible rotator cuff injury (If x-ray films show no fracture, a tear of the rotator cuff is possible, especially if the patient cannot move the arm toward the medial plane.)	<ul style="list-style-type: none">■ Stabilize in a sling and swathe or a shoulder stabilizer.■ Use the chest wall as a splint, and secure the injured arm to the chest wall.■ Place a short, padded board splint on the lateral side of the arm under the sling and swathe for additional support.
Midshaft fractures	<ul style="list-style-type: none">■ Gross angulation of the arm■ Marked instability and crepitus of fracture fragments■ Possible neurovascular compromise■ Possible entrapment of the radial nerve (The patient cannot extend or dorsiflex the wrist or fingers and may report numbness on the dorsum of the hand; classic "wrist drop.")	<ul style="list-style-type: none">■ Stabilize with a sling and swathe or a shoulder stabilizer.■ Use the chest wall as a splint, and secure the injured arm to the chest wall.■ Place a short, padded board splint on the lateral side of the arm under the sling and swathe for additional support.
Distal humeral fractures	<ul style="list-style-type: none">■ Significant swelling at the elbow■ Possible neurovascular compromise■ Possible injury to the ulnar or median nerve (Document nerve status before and after any attempt to reduce the fracture.)	<ul style="list-style-type: none">■ Stabilize in a splint, in addition to a sling and swathe or a shoulder stabilizer.

Elbow Injuries (1 of 5)

- Different types of injuries are difficult to distinguish without x-ray examinations.
- Fracture of the distal humerus
 - Common in children
 - Fracture fragments rotate significantly, producing deformity and causing injuries to nearby vessels and nerves.

Elbow Injuries (2 of 5)



- Dislocation of the elbow
 - Typically occurs in athletes
 - The ulna and radius are most often displaced posteriorly.



Elbow Injuries (3 of 5)

- Elbow joint sprain
 - This diagnosis is often mistakenly applied to an occult, nondisplaced fracture.
- Fracture of olecranon process of ulna
 - Can result from direct or indirect forces
 - Often associated with lacerations and abrasions
 - Patient will be unable to extend the elbow.



Elbow Injuries (4 of 5)

- Fractures of the radial head
 - Often missed during diagnosis
 - Generally occurs as a result of a fall on an outstretched arm or a direct blow to the lateral aspect of the elbow
 - Attempts to rotate the elbow or wrist cause discomfort.



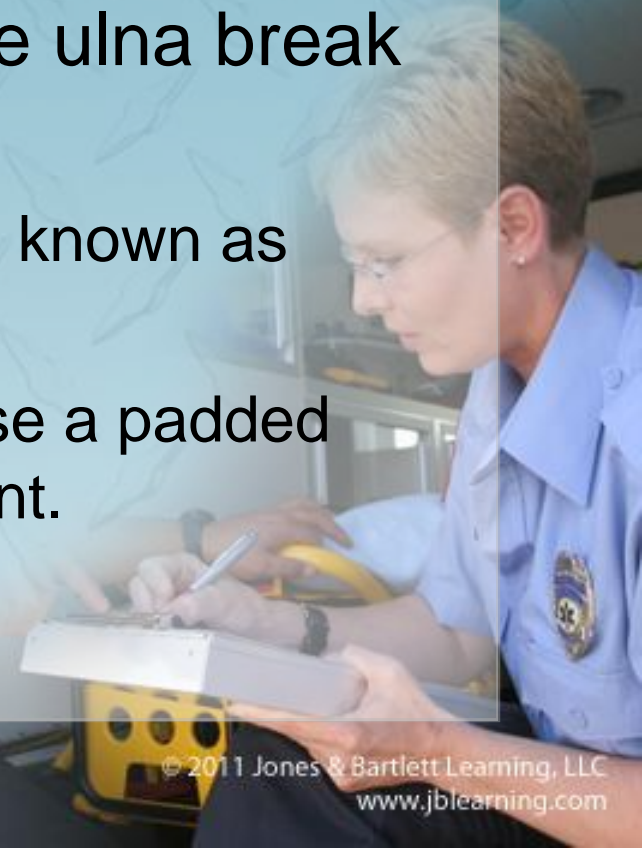
Elbow Injuries (5 of 5)

- Care of elbow injuries
 - All elbow injuries are potentially serious and require careful management.
 - Always assess distal neurovascular functions periodically.
 - Provide prompt transport for all patients with impaired distal circulation.



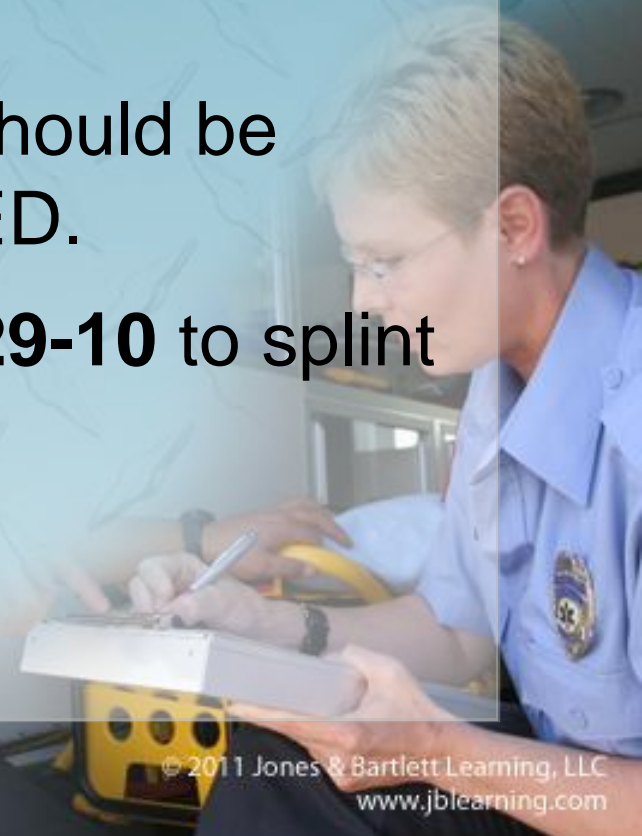
Fractures of the Forearm

- Common in people of all age groups
- Seen most often in children and elderly
- Usually, both the radius and the ulna break at the same time.
 - Fractures of the distal radius are known as Colles fractures.
 - To stabilize fractures, you can use a padded board, air, vacuum, or pillow splint.



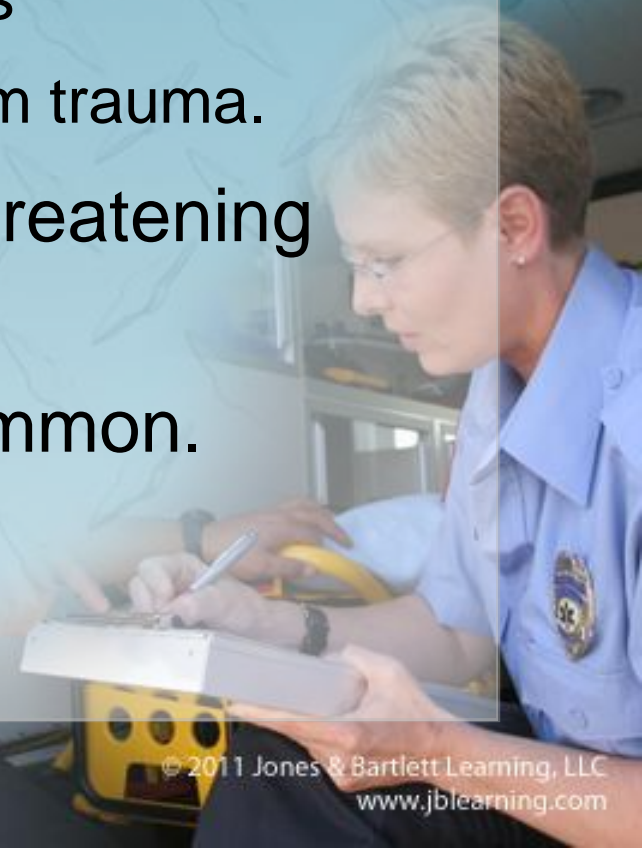
Injuries of the Wrist and Hand

- Must be confirmed by x-ray exams
- Dislocations are usually associated with a fracture.
- Any questionable wrist injury should be splinted and evaluated in the ED.
- Follow the steps in **Skill Drill 29-10** to splint the hand and wrist.



Fractures of the Pelvis (1 of 3)

- Often results from direct compression in the form of a heavy blow
 - Can be caused by indirect forces
 - Not all pelvis fractures result from trauma.
- May be accompanied by life-threatening loss of blood
- Open fractures are quite uncommon.

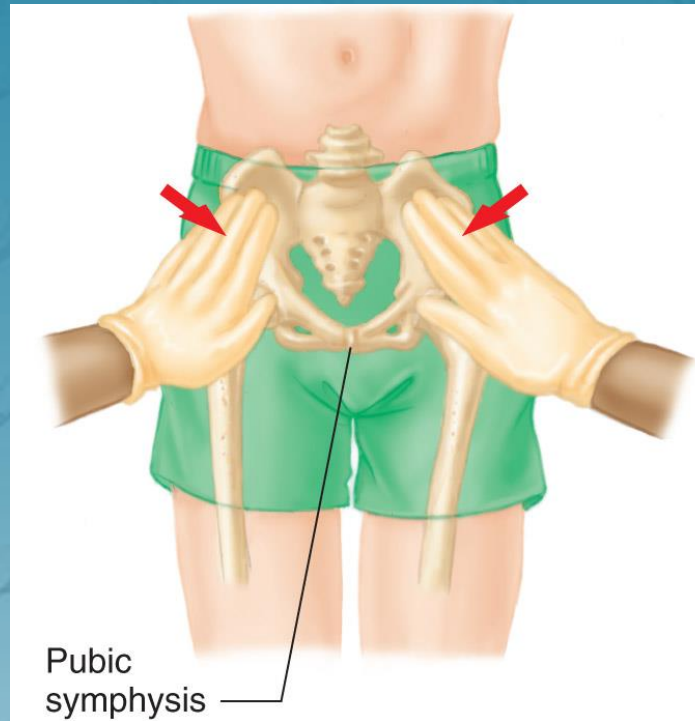
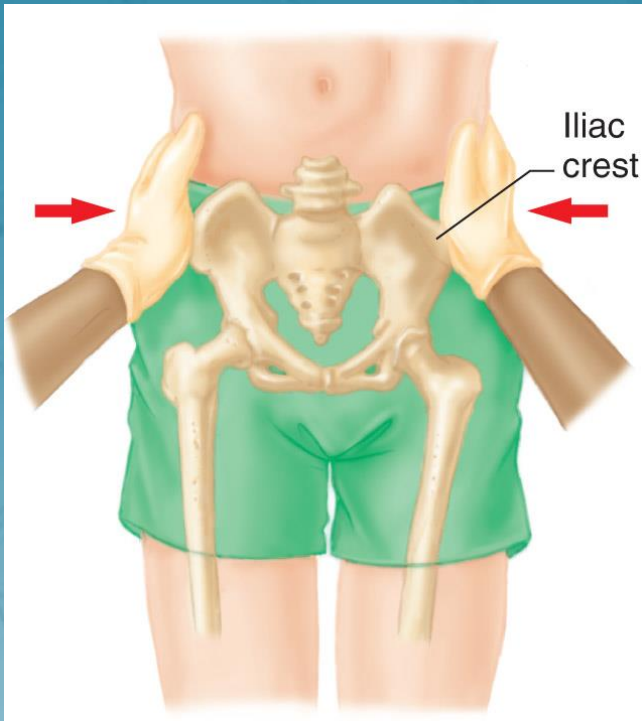


Fractures of the Pelvis (2 of 3)

- Suspect a fracture of the pelvis in any patient who has sustained a high-velocity injury and complains of discomfort in the lower back or abdomen.
- Assess for tenderness.



Fractures of the Pelvis (3 of 3)



Dislocation of the Hip (1 of 3)

- Dislocates only after significant injury
- Most dislocations are posterior.
- Suspect a dislocation in any patient who has been in an automobile crash and has a contusion, laceration, or obvious fracture in the knee region.

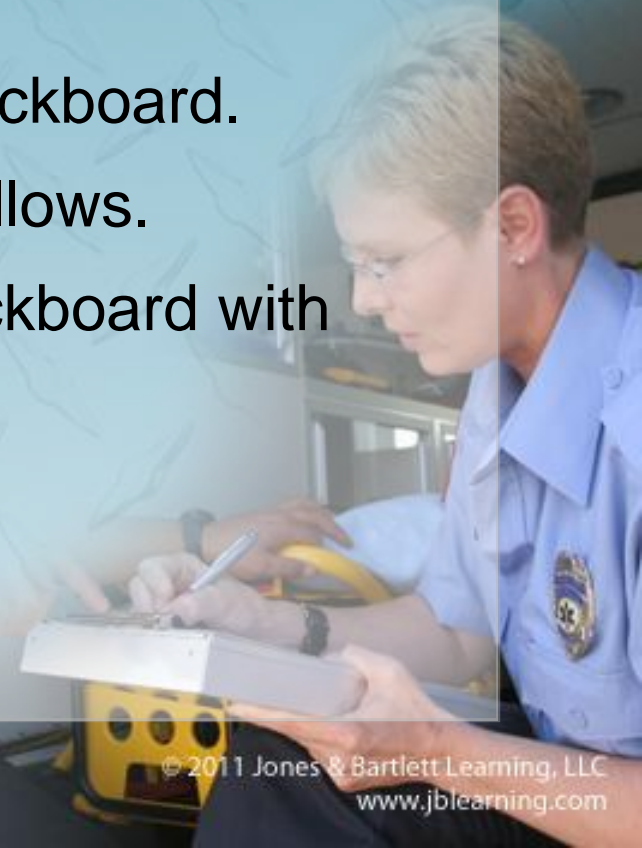
Dislocation of the Hip (2 of 3)


- Posterior dislocation is frequently complicated by injury to the sciatic nerve.
- Distinctive signs
 - Severe pain in the hip
 - Strong resistance to movement of the joint
 - Tenderness on palpation



Dislocation of the Hip (3 of 3)

- Make no attempt to reduce the dislocated hip in the field.
 - Splint the dislocation.
 - Place the patient supine on a backboard.
 - Support the affected limb with pillows.
 - Secure the entire limb to the backboard with long straps.
 - Provide prompt transport.





Fractures of the Proximal Femur (1 of 2)

- Common fractures, especially in elderly
- Break goes through the neck of the femur, the intertrochanteric region, or across the proximal shaft of the femur
- Patients display a certain deformity.
 - They lie with the leg externally rotated, and the injured limb is usually shorter than the opposite, uninjured limb.



Fractures of the Proximal Femur (2 of 2)

- Assess the pelvis for any soft-tissue injury and bandage appropriately.
- Assess pulses and motor and sensory functions.
- Splint the lower extremity and transport to the emergency department.



Femoral Shaft Fractures (1 of 2)

- Can occur in any part of the shaft, from the hip region to the femoral condyles just above the knee joint
- Large muscles of the thigh spasm in an attempt to “splint” the unstable limb.
- Fractures may be open.
- There is often significant blood loss.



Femoral Shaft Fractures (2 of 2)

- Bone fragments may penetrate or press on important nerves and vessels.
 - Carefully and periodically assess the distal neurovascular function.
- Cover any wound with a dry, sterile dressing.
- These fractures are best stabilized with a traction splint.



Injuries of Knee Ligaments

(1 of 2)

- Many different types of injuries occur in this region.
 - Ligament injuries
 - Patella can dislocate.
 - Bony elements can fracture.



Injuries of Knee Ligaments

(2 of 2)

- When you examine the patient, you will generally find:
 - Swelling
 - Occasional ecchymosis
 - Point tenderness at the injury site
 - A joint effusion
- Splint all suspected knee ligament injuries.



Dislocation of the Knee (1 of 2)

- These are true emergencies that may threaten the limb.
- Ligaments may be damaged or torn.
- Direction of dislocation is the position of the tibia with respect to the femur.
 - Anterior dislocations
 - Posterior dislocations
 - Medial dislocations



Dislocation of the Knee (2 of 2)

- Complications may include:
 - Limb-threatening popliteal artery disruption
 - Injuries to the nerves
 - Joint instability
- If adequate distal pulses are present, splint the knee and transport promptly.

Fractures About the Knee (1 of 2)

- May occur at the distal end of the femur, at the proximal end of the tibia, or in the patella
- Management
 - If there is an adequate distal pulse and no significant deformity, splint the limb with the knee straight.

Fractures About the Knee (2 of 2)

- Management (cont'd)
 - If there is an adequate pulse and significant deformity, splint the joint in the position of deformity.
 - If the pulse is absent below the level of injury, contact medical control.
 - Never use a traction splint.

Dislocation of the Patella

- Most commonly occurs in teenagers and young adults in athletic activities
- Usually, the dislocated patella displaces to the lateral side and exhibits a significant deformity.
- Splint the knee in the position in which you find it.

Injuries of the Tibia and Fibula



- Tibia (shinbone) is the larger of the two leg bones, and the fibula is the smaller.
- Fracture may occur at any place between the knee joint and the ankle joint.
 - Usually, both fracture at the same time.
- Stabilize with a padded, rigid long leg splint or an air splint.

Ankle Injuries (1 of 2)

- The ankle is a very commonly injured joint.
 - Range from a simple sprain to severe fracture-dislocations
- Any ankle injury that produces pain, swelling, localized tenderness, or the inability to bear weight must be evaluated by a physician.

Ankle Injuries (2 of 2)



- Management
 - Dress all open wounds.
 - Assess distal neurovascular function.
 - Correct any gross deformity by applying traction.
 - Before releasing traction, apply a splint.

Foot Injuries (1 of 2)



- Can result in the dislocation or fracture of one or more of the tarsals, metatarsals, or phalanges of the toes
- Frequently, the force of injury is transmitted up the legs to the spine.
- If you suspect a foot dislocation, assess for pulses and motor and sensory functions.

Foot Injuries (2 of 2)



- Injuries of the foot are associated with significant swelling but rarely with gross deformity.
- To splint the foot, apply a rigid padded board splint, an air splint, or a pillow splint.
 - Leave the toes exposed.

Compartment Syndrome (1 of 2)

- If you have a pediatric patient with a fracture below the elbow or knee, be on the lookout for these signs/symptoms:
 - Extreme pain
 - Decreased pain sensation
 - Pain on stretching of affected muscles
 - Decreased power

Compartment Syndrome (2 of 2)

- If you suspect the patient has compartment syndrome, splint the affected limb and transport immediately.
 - Reassess neurovascular status frequently during transport.
- Compartment syndrome must be managed surgically.

Amputations (1 of 2)

- Surgeons can occasionally reattach amputated parts.
- Make sure to immobilize the part with bulky compression dressings.
 - Do not sever any partial amputations.
 - Control any bleeding to the stump.
 - If bleeding cannot be controlled, apply a tourniquet.



Amputations (2 of 2)

- With a complete amputation, wrap the clean part in a sterile dressing and place it in a plastic bag.
 - Put the bag in a cool container filled with ice.
 - The goal is to keep the part cool without allowing it to freeze or develop frostbite.

Strains and Sprains (1 of 4)

- Strains
 - Often no deformity is present and only minor swelling is noted.
 - Patients may complain of:
 - Increased sharp pain with passive movement
 - Severe weakness of the muscle
 - Extreme point tenderness



Strains and Sprains (2 of 4)

- Strains (cont'd)
 - General treatment is similar to that of fractures and includes the following:
 - Rest; immobilize or splint injured area
 - Ice or cold pack over the injury
 - Compression with an elastic bandage
 - Elevation
 - Reduced or protected weight bearing
 - Pain management as soon as practical



Strains and Sprains (3 of 4)

- Sprains
 - Usually result from a sudden twisting of a joint beyond its normal range of motion
 - Majority involve the ankle or the knee
 - Err on the side of caution and treat every sprain as if it is a fracture.



Strains and Sprains (4 of 4)

- Sprains (cont'd)
 - Sprains are typically characterized by:
 - Pain
 - Swelling at the joint
 - Discoloration over the injured joint
 - Unwillingness to use the limb
 - Point tenderness
 - General treatment is the same for strains.



Summary (1 of 6)

- Skeletal or voluntary muscle attaches to bone and forms the major muscle mass of the body. This muscle contains veins, arteries, and nerves.
- There are 206 bones in the human body.
- A joint is a junction where two bones come into contact.

Summary (2 of 6)

- A fracture is a broken bone, a dislocation is a disruption of a joint, a sprain is a stretching injury to the ligaments around a joint, and a strain is a stretching of the muscle.
- Fractures of the bones are classified as open or closed.

Summary (3 of 6)

- Fractures and dislocations are often difficult to diagnose without an x-ray examination.
- Signs of fractures and dislocations include pain, deformity, point tenderness, false movement, crepitus, swelling, and bruising.

Summary (4 of 6)

- Signs of sprain include bruising, swelling, and an unstable joint.
- Compare the unaffected extremity with the injured extremity for differences whenever possible.
- There are three main types of splints used by EMTs: rigid splints, traction splints, and formable splints.

Summary (5 of 6)

- A sling and swathe is used commonly to treat shoulder dislocations and to secure injured upper extremities to the body. Lower extremities can be secured to the unaffected limb or to a long backboard.

Summary (6 of 6)

- The most common life-threatening musculoskeletal injuries are multiple fractures, open fractures with arterial bleeding, pelvic fractures, bilateral femur fractures, and limb amputations.

Review



1. Skeletal muscle is also referred to as:
 - A. smooth muscle.
 - B. striated muscle.
 - C. autonomic muscle.
 - D. involuntary muscle.

Review

Answer: B

Rationale: Skeletal muscle, also called striated muscle because of its characteristic stripes (striations), attaches to the bones and usually crosses at least one joint, forming the major muscle mass of the body. This type of muscle is also called voluntary muscle because it is under direct voluntary control of the brain.

Review (1 of 2)

1. Skeletal muscle is also referred to as:

A. smooth muscle.

Rationale: This is found in the walls of most tubular structures, internal organs, and the cardiovascular system.

B. striated muscle.

Rationale: Correct answer

Review (2 of 2)

1. Skeletal muscle is also referred to as:

C. autonomic muscle.

Rationale: This is not a term associated with the muscles.

D. involuntary muscle.

Rationale: Involuntary muscle is also called smooth muscle. It is not under voluntary control of the brain.

Review



2. You respond to a soccer game for a 16-year-old male with severe ankle pain. When you deliver him to the hospital, the physician tells you that he suspects a sprain. This means that:
- A. there is a disruption of the joint and the bone ends are no longer in contact.
 - B. the patient has an incomplete fracture that passes only partway through the bone.
 - C. stretching or tearing of the ligaments with partial or temporary dislocation of the bone ends has occurred.
 - D. the muscles of the ankle have been severely stretched, resulting in displacement of the bones from the joint.

Review

Answer: C

Rationale: A sprain is a joint injury in which there is both partial or temporary dislocation of the bone ends and partial stretching or tearing of the supporting ligaments. Sprains are typically marked by swelling, pain, and ecchymosis.

Review (1 of 2)

2. You respond to a soccer game for a 16-year-old male with severe ankle pain. When you deliver him to the hospital, the physician tells you that he suspects a sprain. This means that:

A. there is a disruption of the joint and the bone ends are no longer in contact.

Rationale: With a sprain, there will be a partial or temporary dislocation of the bone ends.

B. the patient has an incomplete fracture that passes only partway through the bone.

Rationale: With a sprain, there is no fracture associated with the injury.

Review (2 of 2)

2. You respond to a soccer game for a 16-year-old male with severe ankle pain. When you deliver him to the hospital, the physician tells you that he suspects a sprain. This means that:

- C. stretching or tearing of the ligaments with partial or temporary dislocation of the bone ends has occurred.

Rationale: Correct answer

- D. the muscles of the ankle have been severely stretched, resulting in displacement of the bones from the joint.

Rationale: A sprain is not an injury to the muscles.

Review



3. A young male has a musculoskeletal injury and is unresponsive. You will NOT be able to assess:
- A. false motion.
 - B. distal pulses.
 - C. capillary refill.
 - D. sensory and motor functions.

Review

Answer: D

Rationale: In order to assess sensory and motor functions (eg, Can you feel? Can you move?), the patient must be conscious, alert, and able to follow commands. False motion, distal pulses, and capillary refill are objective findings; therefore, they can be assessed in unresponsive patients.

Review

3. A young male has a musculoskeletal injury and is unresponsive. You will NOT be able to assess:

A. false motion.

Rationale: This is an objective finding.

B. distal pulses.

Rationale: This is an objective finding.

C. capillary refill.

Rationale: This is an objective finding.

D. sensory and motor functions.

Rationale: Correct answer

Review



4. The purpose of splinting a fracture is to:
- A. reduce the fracture if possible.
 - B. prevent motion of bony fragments.
 - C. reduce swelling in adjacent soft tissues.
 - D. force the bony fragments back into anatomic alignment.

Review

Answer: B

Rationale: The purpose of splinting a fracture is to prevent motion of the bony fragments, thus minimizing the possibility of neurovascular damage. Splinting is not intended to force bony fragments into anatomic alignment, nor will it reduce swelling (ice reduces swelling). You should never try to reduce a fracture.

Review (1 of 2)

4. The purpose of splinting a fracture is to:

A. reduce the fracture if possible.

Rationale: Reduction of a suspected fracture is a medical procedure to be performed in the hospital.

B. prevent motion of bony fragments.

Rationale: Correct answer

Review (2 of 2)

4. The purpose of splinting a fracture is to:

C. reduce swelling in adjacent soft tissues.

Rationale: Splinting will not reduce swelling, but cold application will.

D. force the bony fragments back into anatomic alignment.

Rationale: Splinting to immobilize a fracture site is not intended to force bony fragments back into alignment.

Review



5. A motorcyclist crashed his bike and has closed deformities to both of his midshaft femurs. He is conscious, but restless; his skin is cool and clammy; and his radial pulses are rapid and weak. The MOST appropriate splinting technique for this patient involves:
- A. applying rigid board splints.
 - B. applying two traction splints.
 - C. securing him to a long backboard.
 - D. immobilizing his femurs with air splints.

Review

Answer: C

Rationale: In this particular case, it is more practical—and less time-consuming—to secure the patient to a long backboard. He is in shock and requires rapid transport. Taking the time to apply traction splints, air splints, or board splints will only delay transport.

Review (1 of 2)

5. A motorcyclist crashed his bike and has closed deformities to both of his midshaft femurs. He is conscious, but restless; his skin is cool and clammy; and his radial pulses are rapid and weak. The MOST appropriate splinting technique for this patient involves:

A. applying rigid board splints.

Rationale: This causes undue delays in the transport of the patient.

B. applying two traction splints.

Rationale: This causes undue delays in the transport of the patient.

Review (2 of 2)

5. A motorcyclist crashed his bike and has closed deformities to both of his midshaft femurs. He is conscious, but restless; his skin is cool and clammy; and his radial pulses are rapid and weak. The MOST appropriate splinting technique for this patient involves:

C. securing him to a long backboard.

Rationale: Correct answer

D. immobilizing his femurs with air splints.

Rationale: This causes undue delays in the transport of the patient.

Review



6. To effectively immobilize a fractured clavicle, you should apply a(n):
- A. sling and swathe.
 - B. air splint over the entire arm.
 - C. rigid splint to the upper arm, then a sling.
 - D. traction splint to the arm of the injured side.

Review

Answer: A

Rationale: The quickest and most effective way to immobilize a fractured clavicle (collarbone) is to apply a sling and swathe. The sling will help minimize movement of the clavicle itself, while the swath will minimize movement of the arm on the affected side.

Review (1 of 2)

6. To effectively immobilize a fractured clavicle, you should apply a(n):

A. sling and swathe.

Rationale: Correct answer

B. air splint over the entire arm.

Rationale: An air splint is not effective on a joint.

Review (2 of 2)

6. To effectively immobilize a fractured clavicle, you should apply a(n):
- C. rigid splint to the upper arm, then a sling.
Rationale: A sling will not prevent the movement of the shoulder.
 - D. traction splint to the arm of the injured side.
Rationale: There is no traction splint for the arm.

Review



7. A patient tripped, fell, and landed on her elbow. She is in severe pain and has obvious deformity to her elbow. You should:
- A. assess distal pulses.
 - B. manually stabilize her injury.
 - C. assess her elbow for crepitus.
 - D. apply rigid board splints to her arm.

Review

Answer: B

Rationale: When caring for a patient with an orthopaedic injury, you should *first* manually stabilize the injury site; this will prevent further injury. Then assess pulse, motor functions, and sensory functions distal to the injury. Splint the injury using the appropriate technique, and then reassess pulse, motor functions, and sensory functions. Do not intentionally assess for crepitus; this is a coincidental finding that you may encounter during your assessment and *should not be elicited*.

Review (1 of 2)

7. A patient tripped, fell, and landed on her elbow. She is in severe pain and has obvious deformity to her elbow. You should:

A. assess distal pulses.

Rationale: This is completed after the manual stabilization of the injury.

B. manually stabilize her injury.

Rationale: Correct answer

Review (2 of 2)

7. A patient tripped, fell, and landed on her elbow. She is in severe pain and has obvious deformity to her elbow. You should:

C. assess her elbow for crepitus.

Rationale: Do not intentionally assess for crepitus; this is a coincidental finding.

D. apply rigid board splints to her arm.

Rationale: This is completed after manual stabilization of the injury.

Review



8. When treating an open extremity fracture, you should:
- A. apply a splint and then dress the wound.
 - B. dress the wound before applying a splint.
 - C. irrigate the wound before applying a dressing.
 - D. allow the material that secures the splint to serve as the dressing.

Review

Answer: B

Rationale: Prior to splinting an open extremity fracture, you should cover the wound with a dry, sterile dressing. This will help control any bleeding and decreases the risk of infection. Irrigating an open fracture should be avoided in the field; this also increases the risk of infection—especially if foreign material is flushed into the wound.

Review (1 of 2)

8. When treating an open extremity fracture, you should:

A. apply a splint and then dress the wound.

Rationale: The dressing must come before the splint.

B. dress the wound before applying a splint.

Rationale: Correct answer

Review (2 of 2)

8. When treating an open extremity fracture, you should:

C. irrigate the wound before applying a dressing.

Rationale: Irrigation of an open fracture in the prehospital setting may increase the chance of infection.

D. allow the material that secures the splint to serve as the dressing.

Rationale: The wound must be dressed separately from the splint and before splinting is done.

Review



9. Which of the following musculoskeletal injuries has the **GREATEST** risk for shock due to blood loss?
- A. pelvic fracture
 - B. posterior hip dislocation
 - C. unilateral femur fracture
 - D. proximal humerus fracture

Review

Answer: A

Rationale: The pelvic cavity can accommodate a large volume of blood. Shock in a patient with a pelvic injury is usually due to injury to femoral veins or arteries. Bilateral femur fractures can also cause severe blood loss (up to 1 liter per femur).

Review (1 of 2)

9. Which of the following musculoskeletal injuries has the GREATEST risk for shock due to blood loss?

A. Pelvic fracture

Rationale: Correct answer

B. Posterior hip dislocation

Rationale: Unless the dislocation has injured the vascular system, bleeding will be contained and minimal.

Review (2 of 2)

9. Which of the following musculoskeletal injuries has the GREATEST risk for shock due to blood loss?

C. Unilateral femur fracture

Rationale: A unilateral femur fracture can lose 500 to 1,500 mL of blood.

D. Proximal humerus fracture

Rationale: Nerves and blood vessels can be injured, and the blood loss could be 500 mL.

Review



10. A patient injured her knee while riding a bicycle. She is lying on the ground, has her left leg flexed, is in severe pain, and cannot move her leg. Your assessment reveals obvious deformity to her left knee. Distal pulses are present and strong. The MOST appropriate treatment for her injury involves:
- A. wrapping her entire knee area with a pillow.
 - B. splinting the leg in the position in which it was found.
 - C. straightening her leg and applying two rigid board splints.
 - D. straightening her leg and applying and inflating an air splint.

Review

Answer: B

Rationale: The patient likely has a dislocated knee. You should immobilize any joint injury in the position in which it was found—especially if distal pulses are present and strong.

Attempting to straighten a dislocated joint may cause damage to the nerves and/or vasculature.

Review (1 of 2)

10. A patient injured her knee while riding a bicycle. She is lying on the ground, has her left leg flexed, is in severe pain, and cannot move her leg. Your assessment reveals obvious deformity to her left knee. Distal pulses are present and strong. The MOST appropriate treatment for her injury involves:

A. wrapping her entire knee area with a pillow.

Rationale: Providers can wrap the knee with a pillow to splint it. It is most important to splint the joint in the position it was found.

B. splinting the leg in the position in which it was found.

Rationale: Correct answer

Review (2 of 2)

10. A patient injured her knee while riding a bicycle. She is lying on the ground, has her left leg flexed, is in severe pain, and cannot move her leg. Your assessment reveals obvious deformity to her left knee. Distal pulses are present and strong. The MOST appropriate treatment for her injury involves:

C. straightening her leg and applying two rigid board splints.

Rationale: The straightening of a joint injury is contraindicated if the pulses are intact.

D. straightening her leg and applying and inflating an air splint.

Rationale: Air splints are not effective on joint injuries that are flexed.

Credits

- Chapter opener: © Chuck Stewart, MD.
- Background slide images: © Jones & Bartlett Learning. Courtesy of MIEMSS.