Chapter 32, Orthopedic Injuries

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1. Introduction to Orthopedic Injuries and the Musculoskeletal System

- orthopedic injuries are a common reason for seeking medical attention [7].
- These injuries often cause pain, swelling, and deformity [8].
- While rarely fatal, musculoskeletal injuries can result in short or long-term disability [9].
- The musculoskeletal system provides form, upright posture, and movement [5].
- It also protects vital internal organs [6].
  - The body has three types of muscles: skeletal, smooth, and cardiac [12].
  - **Skeletal muscles** are also called striated muscle due to their stripes [13].
    - They attach to bones and usually cross at least one joint [13].

    - They are voluntary muscles under direct control of the voluntary system [14].
    - Skeletal muscles make up the largest portion of the body's muscle mass [16].
    - They are supplied with arteries, veins, and nerves [17].
    - Skeletal muscle tissue attaches directly to bone by **tendons** [18].
- **Smooth muscle** is involuntary and performs much of the body's autonomic work [19].
    - Found in the walls of most tubular structures, they control the movement of contents within these structures by contracting and relaxing [20].
- **Cardiac muscle** is a specially adapted involuntary muscle with its own regulatory system [22].
- The **skeleton** gives recognizable human form, protects vital internal organs, and allows movement [24].
- It consists of approximately 206 bones [25].
- Bones produce red blood cells in the bone marrow [26].
- They also serve as a reservoir for important minerals and electrolytes [26].

System Component	Key Function	Associated Structure/Example
Skeletal Muscle	Movement, Posture, Form	Attaches to bones by tendons, largest muscle mass
Smooth Muscle	Autonomic work, Movement of contents	Walls of tubular structures (e.g., blood vessels)
Cardiac Muscle	Involuntary muscle with regulatory system	Heart
Skeletal System	Form, Protection, Movement, Blood Production	Approximately 206 bones, produces red blood cells

2. Anatomy of the Skeletal System

- The **skull** is a solid, vault-like structure protecting the brain [28].
- The **thoracic cage** protects the heart, lungs, and great vessels [29].
- The **lower ribs** protect the liver and spleen [30].
- The **bony spinal canal** encases and protects the spinal cord [30].
- The **pectoral or shoulder girdle** consists of two scapula and two clavicles [30].
  - The **scapula** (shoulder blade) is a flat, triangular bone held to the rib cage by powerful muscles [31].
  - The **clavicle** (collarbone) is a slender s-shaped bone attached to the sternum and acromion process by ligaments [31].
  - The clavicle is vulnerable to injury because it is slender and exposed [33].
- The **upper extremities** extend from the shoulder to the fingertips [35].
  - They are composed of the upper arm (humerus), elbow, and forearm (radius and ulna) [35].
  - The humerus joins the shoulder girdle at the joint [36].
  - The humerus connects to the forearm bones to form a hinged elbow joint [36].
  - The **hand** contains three sets of bones: carpals (wrist bones), metacarpals (hand bones), and phalanges (finger bones) [37].
- The **pelvis** supports body weight and protects structures like the bladder, rectum, and female reproductive organs [38].
  - The **pelvic girdle** is three fused bones (ilium, ischium, and pubis) forming the hip joint [39].
- The **lower extremities** consist of bones of the thigh, leg, and foot [40].
  - The **femur** (thigh bone) is a long, powerful bone [41].
  - It connects to the pelvis in a ball and socket joint and to the knees in a hinged joint [42].
  - The **lower leg** consists of two bones: the tibia and fibula [42].
  - The **foot** consists of three classes of bones: tarsals (ankle joints), metatarsals (foot bones), and phalanges (toe bones) [43].

3. Joints and Mechanisms of Injury

- A **joint** is formed where two bones come into contact [46].
- Joints are held together by a tough fibrous **capsule** [46].

- The capsule is supported and strengthened by bands of fibrous tissues called **ligaments** [47].
- In moving joints, bone ends are covered with **articular cartilage** [48].
- Joints are bathed and lubricated by **synovial fluid** [49].
- Joints allow different motions:
  - Circular motion (e.g., shoulder joint) [49].
  - Hinge motion (e.g., elbow and knee) [49].
  - Minimal motion (e.g., sternoclavicular joints) [49].
  - No motion (e.g., sutures in the skull) [49].
- Significant force is generally required to cause fractures and dislocations [51].
- Forces can include direct blows, indirect forces, twisting forces, or high energy forces [51].
- A slight force can fracture a bone weakened by a tumor, infection, or osteoporosis [52].
- Suspect a fracture in an older patient reporting pain after a mild injury [53].

Type of Joint	Example	Motion Allowed	Supporting Structure
Ball and Socket	Shoulder, Hip	Circular motion	Capsule, Ligaments
Hinge	Elbow, Knee	Hinge motion (bending and straightening)	Capsule, Ligaments
Minimal Motion	Sternoclavicular	Limited movement	Ligaments
No Motion	Sutures (Skull)	No movement	Capsule

4. Types of Musculoskeletal Injuries: Fractures

- A **fracture** is a break in the continuity of the bone [54].
- fractures often occur due to an external force [54].
- fractures are classified as either **open or closed** [55].

- An **open fracture** has an external wound [55].
  - The wound can be caused by the initial blow or by the broken bone lacerating the skin [55].
  - Treat any injury that breaks the skin as a possible open fracture [56].
  - Complications of open fractures include increased blood loss and a higher likelihood of infection [57].
- fractures are also described by whether the bone has moved from its normal position [58].
  - A **non-displaced fracture**, or hairline fracture, is a simple crack [59].
  - It can be difficult to distinguish from a sprain or contusion [59].
  - A **displaced fracture** produces deformity by shortening, rotating, or angulating the limb [60].
- Specific types of fractures include:
  - **Greenstick fracture:** Incomplete fracture passing partly through the bone shaft [61].
  - **Oblique fracture:** Bone broken at an angle across the bone [61].
  - **Pathologic fracture:** Fracture of a weakened or diseased bone by minimal force [61].
  - **Incomplete fracture:** Does not run completely through the bone [61].
  - **Comminuted fracture:** Bone broken into more than two fragments [62].
  - **Epiphyseal fracture:** Occurs in the growth section of a child's bone, potentially leading to growth abnormalities [63].
  - **Spiral fracture:** Caused by twisting force, creating an oblique fracture around and through the bone [66].
  - **Transverse fracture:** Occurs straight across the bone [66].
- Suspect a fracture if these signs and symptoms are present [67]:
  - Deformity or tenderness [68].
  - Guarding or swelling [68].
  - Bruising [68].
  - crepitus (grating sound or sensation) [68].
  - false motion (movement where there shouldn't be) [68].
  - Exposed fragments [68].
  - Pain [68].
  - A locked joint [68].

5. Types of Musculoskeletal Injuries: Dislocations, Sprains, Strains, and Amputations

- A **dislocation** is a disruption of a joint where bone ends are no longer in contact [70].
- Supporting ligaments are often torn, allowing bone ends to separate [71].
- A **fracture dislocation** is a combination injury with a dislocated joint and a fracture of bone ends [72].
- Some dislocated joints may spontaneously reduce before assessment [73].
- History taking can help confirm a spontaneously reduced dislocation [74].
- A dislocation that doesn't reduce is a serious problem [75].
- Commonly dislocated joints include fingers, shoulders, elbows, and knees [76].
- Signs and symptoms of a dislocated joint are similar to fractures [77]:
  - Marked deformity [77].
  - Swelling [77].
  - Pain aggravated by movement attempts [77].
  - Tenderness on palpation [77].
  - Virtually complete loss of normal joint motion (locked joint) [77].
  - Numbness or impaired circulation [77].
- A **sprain** occurs when a joint is twisted or stretched beyond its normal range of motion [78].
- Supporting capsular and ligaments are stretched or torn [78].
- sprains range from mild to severe [79].
- The most vulnerable joints are knees, shoulders, and ankles [79].
- After injury, alignment generally returns to near normal [80].
- Signs and symptoms of sprains include guarding, swelling, ecchymosis, pain, or joint instability [81].
- A **strain** is basically a pulled muscle [82].
- It involves stretching or tearing of the muscle [82].
- Strains cause pain, swelling, and bruising of soft tissues [83].
- Unlike a sprain, typically no ligament or joint damage occurs [84].
- Often, no deformity is present, and only minor swelling is noted [85].
- Most patients will have extreme point tenderness with a strain [86].

- An **amputation** is an injury where an extremity is completely severed [88].
- Amputations can damage every aspect of the musculoskeletal system [89].

Injury Type	Definition	Key Characteristics	Associated Signs/Symptoms
Dislocation	Disruption of a joint, bone ends lose contact	Supporting ligaments often torn, potential for spontaneous reduction	Marked deformity, swelling, pain, tenderness, locked joint
Sprain	Joint twisted/stretched beyond normal range of motion	Supporting ligaments stretched/torn, range from mild to severe	Guarding, swelling, bruising, pain, joint instability
Strain	Stretching or tearing of a muscle (pulled muscle)	No ligament/joint damage typical, minor swelling	Pain, swelling, bruising, extreme point tenderness
Amputation	Complete severance of an extremity	Damages bone, ligament, and muscle	Severe bleeding, shock, absence of a limb (obvious)

6. Complications of Musculoskeletal Injuries

- orthopedic injuries can lead to numerous complications [91].
- Complications are not limited to the musculoskeletal system [91].
- Systematic changes or illness can occur [91].
- The likelihood of complications is related to the force of injury, location, and patient's overall health [92].
- To prevent contamination in open fractures, brush away obvious debris on the skin [94].
- Do not enter or probe an open fractured site before applying a dressing [96].
- Preventing further injury helps reduce the risk of long-term disability [97].

- Reducing the risk of wound infection also helps reduce long-term disability [97].
- Transporting patients to the appropriate medical facility contributes to reducing long-term disability [97].

7. Assessing the Severity of Injury and Patient Assessment

- The "golden period" is critical for preserving limb viability in extremities with less than complete circulation [99].
- Prolonged hypoperfusion can cause significant damage [100].
- Any suspected open fracture or vascular injury is considered a critical emergency [101].
- Most injuries are not critical [102].
- Always look at the big picture when assessing patients [105].
- Evaluate the overall situation to determine and treat any life threats [105].
- Distinguish mild injuries from severe injuries [106].
- Some severe injuries may compromise neurovascular function, threatening long-term function [106].
- **Scene size-up** is crucial [109].
  - Scene safety is the number one priority [109].
  - Identify forces associated with the mechanism of injury [109].
  - Standard precautions like gloves may be needed [110].
  - A mask and gown may be necessary [110].
  - Consider the possibility of hidden bleeding [111].
  - Evaluate the need for law enforcement, advanced life support, or additional ambulances [112].
- Be alert for primary and secondary injuries based on the mechanism of injury [113].
- The **primary assessment** focuses on identifying and managing life threats [114].
  - Treat the patient according to their level of consciousness [114].
  - Ex-ABCs are always a priority (Exsanguination, Airway, Breathing, Circulation) [114].
  - Check for responsiveness using the AVPU scale [115].
  - Consider high flow oxygen for patients with less than alert and oriented

consciousness [115].

    - Musculoskeletal injuries may be lower priority if significant trauma affects multiple body systems [116].
    - fractures and sprains usually don't cause airway or breathing problems [117].
    - Focus on determining if the patient has a pulse, adequate perfusion, or is bleeding [118].
- Treat the patient for shock immediately if skin is pale, cool, or clammy, or capillary refill is slow [119].
- Maintain a normal body temperature [120].
- Stabilize extremity injuries before moving the patient [120].
- **Transport decisions** depend on the patient's condition and mechanism of injury [121].
    - Provide rapid transport for patients with airway/breathing problems or significant bleeding [121].
    - Patients with a significant mechanism of injury, but otherwise stable, should be transported promptly [122].
    - For rapid transport with a significant mechanism, a backboard can splint the whole body [123].
    - Patients with a simple mechanism can be assessed and stabilized on scene if no other problems exist [124].

Assessment Step	Focus	Key Actions
Scene Size-Up	Safety, Mechanism of Injury	Scene safety, identify forces, consider standard precautions, hidden bleeding
Primary Assessment	Identifying/Managing Life Threats	Ex-ABCs priority, check responsiveness, consider oxygen, evaluate circulation
Shock Management	Treating inadequate perfusion	Treat immediately if signs present, maintain temperature

Stabilization (Extremities)	Preparing for transport	Stabilize injuries before moving the patient
Transport Decision	Determining urgency and method of transport	Rapid transport for life threats/significant MOI, backboard for whole body splint

8. History Taking and Secondary Assessment

- Obtain a **medical history** and be alert for injury-specific signs, symptoms, and pertinent negatives [128].
- Obtain a sample history for all trauma patients [129].
- The detail of the history depends on the patient's condition and transport urgency [130].
- OPQRST can be of limited use and too lengthy in severe injury cases [131].
- Rapid transport requires immediate attention to airway, breathing, or circulation [133].
- The **secondary assessment** involves a physical exam [135].
- If significant trauma affects multiple systems, perform a head-to-toe assessment [135].
- Work systematically from head to feet, checking the head, chest, abdomen, extremities, and back [136].
- The goal is to identify hidden and potentially life-threatening injuries [137].
- Use the **DCAP-BTLS** approach to assess the musculoskeletal system [137].
- Consider an open fracture when lacerations are present in an extremity [138].
- Bleeding control and dressings must be applied [139].
- Injury or deformity of a bone may be associated with vessel or nerve injury [140].
- Obtain a **baseline neurovascular assessment** [141].
- Always recheck neurovascular function before splinting or manipulating a limb [141].
- Examination of an injured limb should include the **Six P's** of musculoskeletal assessment [142]:
  - Pain [143].
  - Paralysis [143].

    - paresthesia (numbness or tingling) [143].
    - Pulselessness [143].
    - Pallor (not power) [143].
    - Pressure [143].
- Determine a baseline set of vital signs [143].

9. Reassessment and Documentation

- **Reassessment** is crucial to ensure interventions are working [144].
- Perform reassessment every five minutes for unstable patients [145].
- Perform reassessment every fifteen minutes for stable patients [145].
- During reassessment, assess the patient's overall condition [146].
- Stabilize the XABCs [146].
- Control any serious bleeding in critically injured patients [147].
- Secure critically injured patients to a long backboard for prompt transport to a trauma center [148].
- In critical situations, a secondary assessment may be a waste of valuable time [149].
- Reassess the patient en route to the emergency department [150].
- If the patient has no life-threatening injuries, take time on scene to stabilize their condition [150].
- Apply a secure splint after assessing the extremity for non-life-threatening injuries [151].
- Splinting should be done prior to transport [152].
- **Communication and documentation** are vital [152].
- Document complete descriptions of injuries and associated mechanisms of injury [152].
- Document the presence or absence of circulation, motor function, or sensation distal to the injured extremity [153].
- Document neurovascular status after manipulation or splinting [153].
- Document neurovascular status on arrival at the hospital [153].

Patient Stability	Reassessment Frequency	Key Actions During Reassessment

Unstable	Every 5 minutes	Assess overall condition, stabilize XABCs, control bleeding
Stable	Every 15 minutes	Assess overall condition, stabilize XABCs, control bleeding

10. Emergency Medical Care and Splinting Principles

- **Emergency care** for musculoskeletal injuries involves performing a primary assessment [155].
- Stabilize the patient's ABCs if needed [155].
- Perform a secondary assessment of the entire body or specific injured area [156].
- Be alert for signs and symptoms of internal bleeding [157].
- Follow specific skill drill steps when caring for these patients [157].
- A **splint** is a flexible or rigid device protecting and maintaining the position of an injured extremity [158].
- Splint fractures, dislocations, and sprains before moving the patient, unless life is in immediate danger [159].
- Splinting reduces pain and makes transport easier [160].
- **Splinting helps prevent** [161]:
  - Further damage to muscles, spinal cord, nerves, and blood vessels from broken bone ends [161].
  - Laceration of skin by broken bones [162].
  - Restriction of blood vessel flow from pressure of bone ends [162].
  - Excessive bleeding from tissues at the injury site [162].
  - Increased pain from bone movement [162].
  - Paralysis of extremities [162].
- **General principles of splinting** [163]:
  - Remove clothing from the suspected fracture/dislocation area to inspect for DCAP-BTLS [163].
  - Note and record neurovascular status distal to the injury (pulse, sensation, movement) [164].
  - Cover open wounds with dry, sterile dressings before splinting [165].

- Do not move the patient before splinting unless there's immediate danger or uncorrected life threats [166].
- For a suspected fracture of a bone shaft, stabilize the joints above and below the fracture [167].
- For injuries in and around a joint, stabilize the bones above and below the injured joint [167].
- Pad all rigid splints to prevent local pressure and discomfort [168].
- Maintain manual stabilization while applying the splint to minimize limb movement [169].
- Support the injury site [169].
- Use constant gentle manual traction to align a severely deformed long bone shaft fracture for splinting [170].
- If encountering resistance or pain during alignment, splint the limb in its deformed position [171].
- Immobilize suspected spinal injuries in a neutral inline position on a backboard [172].
- If the patient shows signs of shock, align the limb in the normal atomic position and transport [172].
- When in doubt, splint [173].

11. Types of Splints and Hazards of Improper Splinting

- **Rigid splints** are non-formable and made of firm material [174].
  - They are applied to the sides, front, and back of an injured extremity to prevent motion [175].
  - Splint a limb in the position of deformity if the deformity is severe or if you encounter resistance/pain during gentle traction of a shaft fracture [176].
- **Formable splints** include SAM splints and vacuum splints [177].
  - SAM splint stands for structural aluminum manual splint [177].
  - Other examples are air splints, pillow splints, and sling and swathe splints [179].
  - A vacuum splint can be shaped around a deformed limb [180].
  - Air is pulled out of a vacuum splint using a hand pump [181].
- **Pelvic binders** are used to splint the bony pelvis [183].
  - They reduce hemorrhage from bone ends and venous disruption [184].
  - Pelvic binders also help reduce pain [184].

- **Hazards of improper splinting** [186]:
  - Compression can injure nerves, tissues, and blood vessels [186].
  - Improper splinting can delay transport for patients with life-threatening injuries [187].
  - It can reduce distal circulation [187].
  - Improper splinting can aggravate the injury [187].
  - Excessive movement of the bone or joint can injure tissues, nerves, blood vessels, or muscles [187].

Splint Type	Characteristics	Common Use Cases	Potential Hazards of Improper Use
Rigid Splint	Non-formable, firm material, prevents motion	Applied to sides/front/back of extremity	Compression, nerve/tissue/vessel injury
Formable Splint	Flexible, can be molded (SAM, vacuum, air, pillow)	Around deformed limbs, various extremity injuries	Reduced circulation, aggravated injury
Pelvic Binder	Secures bony pelvis	Pelvic fractures	Delayed transport, further injury

12. Transportation Considerations

- Very few musculoskeletal injuries justify excessive speed during transport [189].
- A patient with a pulseless limb must be given high priority [190].
- If the treatment facility is an hour or more away, transport a patient with a pulseless limb by helicopter or immediate ground transport [190].

13. Specific Musculoskeletal Injuries: Upper Extremities

- **clavicle (collar bone) fractures** are among the most common bone fractures [191].
  - Common in children falling with an outstretched hand [192].

    - Patients report pain in the shoulder and hold the arm across the body [192].
    - Swelling and point tenderness occur over the clavicle [193].
    - clavicle fractures may lead to neurovascular compromise due to nearby vessels and nerves [194].
- **scapula (shoulder blade) fractures** are less frequent due to muscle protection [195].
    - Almost always result from forceful direct blows to the back over the scapula [195].
    - Associated chest injuries pose the greatest threat, not the fracture itself [196].
    - Abrasions, contusions, and significant pain occur [198].
    - Patients limit arm use due to pain [198].
- **Acromioclavicular (AC) joint separation** occurs at the joint below the clavicle and scapula's acromion process [199].
    - Frequently separated during sports when falling on the point of the shoulder [200].
- clavicle and scapula fractures can be splinted with a sling and swath [201].
- **Shoulder dislocations** most commonly occur anteriorly [203].
    - Result from forceful adduction and external rotation [203].
    - Shoulder dislocations are extremely painful [204].
    - Patients may report hand numbness due to nervous or circulatory compromise [204].
    - Stabilizing an anterior shoulder dislocation is difficult as moving the arm towards the chest wall causes pain [205].
    - Splint the joint in the position most comfortable for the patient [205].
    - Sling the forearm and wrist to support the arm's weight [206].
    - Secure the arm in a sling to a pillow and chest with a swath [206].
    - Transport the patient seated or semi-seated [207].
- **humerus fractures** occur proximally, mid-shaft, or distally at the elbow [209].
    - Consider applying traction to realign severely angulated fractures before splinting [210].
    - Support the fracture site and gently pull the humeral condyles in line with the limb's normal axis [211].
    - Splint the arm with a sling and swath and a padded board splint on the lateral aspect [213].

- **Elbow injuries** (fractures and dislocations) are often difficult to distinguish without X-rays [214].
  - They produce similar deformities and require the same emergency care [215].
  - **Distal humerus fractures** (supracondylar/intracondylar) are common in children [216].
    - Fracture fragments often rotate, injuring vessels and nerves [217].
    - Swelling occurs rapidly and is severe [218].
  - **Elbow dislocations** occur in athletes and rarely young children [219].
    - The ulna and radius are often displaced posteriorly relative to the humerus [219].
    - There is swelling and potential for vessel/nerve injuries [220].
  - **Fracture of the olecranon process of the ulna** results from direct or indirect forces [221].
    - Often associated with lacerations and abrasions [221].
    - Patients cannot actively extend the elbow [221].
  - **fractures of the radial head** are often missed [222].
    - Generally occur from a fall on an outstretched arm or direct blow to the lateral elbow [222].
    - Attempting to rotate the elbow or wrist causes discomfort [223].
  - **Care for elbow injuries** requires careful management [224].
    - Assess distal neurovascular function periodically [225].
    - If pulses and cap refill are good, splint the elbow in the position found, adding a wrist sling if helpful [226].
    - A cold, pale hand, weak/absent pulse, or poor cap refill indicates likely blood vessel injury [227].
    - If the limb is pulseless and severely deformed at the elbow, apply gentle manual traction to decrease deformity and provide prompt transport [229].
- **Forearm fractures** are seen most often in children and older people [230].
  - Usually, both radius and ulna break from a fall on an outstretched hand [230].
  - Isolated ulna shaft fractures can occur from a direct blow (nightstick fracture) [232].
  - Distal radius fractures (Colles' fracture) are common in elderly patients with osteoporosis [233].

    - Stabilize forearm and wrist fractures with padded board, air vacuum, or pillow splints [234].
- **Wrist and hand injuries** often involve dislocations associated with fractures (fracture dislocation) [236].
    - An isolated, non-displaced carpal bone fracture (scaphoid) is also common [237].
    - Improper treatment can lead to permanent disability and deformity due to intricate function [238].
    - Follow skill drill steps to splint the hand and wrist [239].

Upper Extremity Area	Common Injuries	Key Characteristics	Management Considerations
Clavicle	Fracture	Very common, pain in shoulder, holds arm across body, potential neurovascular compromise	Splint with sling and swath
Scapula	Fracture	Less common, forceful direct blow, associated chest injuries more threatening	Splint with sling and swath
AC Joint	Separation	Common in sports (fall on shoulder point)	Splint with sling and swath
Shoulder	Dislocation (mostly anterior)	Extremely painful, numbness possible, resistance to movement towards chest	Splint in position found, sling/swath, seated/semi-seated transport

Humerus	Fracture (proximal, mid-shaft, distal)	Severe angulation possible, potential for vessel/nerve injury	Traction for severe deformity, sling/swath, padded board splint
Elbow	Fractures/Dislocations	Difficult to distinguish, similar deformities, potential vessel/nerve injury	Assess neurovascular function, splint in position found (or traction if pulseless/deformed)
Forearm/Wrist	Fractures (radius, ulna, carpal)	Common (children/elderly), bilateral common from fall (forearm), Colles' fracture (wrist)	Padded board, air, vacuum, pillow splints
Wrist/Hand	Dislocations, Fractures	Often associated fracture (fracture dislocation), permanent disability risk	Splinting according to skill drills

14. Specific Musculoskeletal Injuries: Pelvis and Lower Extremities

- **Pelvis fractures** often result from direct compression (heavy blow) [240].
  - May be accompanied by life-threatening blood loss from lacerated vessels [242].
  - Several liters of blood can drain into the pelvic and retroperitoneal space [243].
  - Can result in significant hypotension, shock, and death [246].
  - Pelvic fractures can lacerate the rectum, vagina, and bladder [248].
  - Suspect in patients with high velocity injury and lower back or abdomen discomfort [249].

    - Deformity or swelling may be hard to see [252].
    - The most reliable sign is tenderness or instability on compression and palpation [253].
    - Stabilize isolated pelvic fractures in stable patients with a long backboard or scoop stretcher [255].
- **Hip dislocations** involve a very stable ball and socket joint [257].
    - Dislocate only after significant injury [258].
    - Most are posterior, often from a motor vehicle crash driving the femur posteriorly [259].
    - Associated with distinctive signs: severe pain, resistance to movement, tenderness, palpation of femoral head in buttocks [260].
    - Do not attempt to reduce a dislocated hip in the field unless directed by medical control [261].
    - Splint the dislocation in the position of deformity [262].
    - Place the patient supine on a long backboard [262].
    - Support the affected limb with pillows/blankets to secure it to the backboard [263].
- **Proximal femur fractures** are common, especially in older people and those with osteoporosis [264].
    - The break goes through the neck or proximal shaft of the femur [264].
    - Patients have characteristic deformity: externally rotated leg, injured limb shorter than the uninjured [266].
    - Unable to walk or move the leg [267].
    - Hip region is tender on palpation [267].
    - Gentle rolling causes pain but no further damage [267].
    - Assess the pelvis for soft tissue injury [268].
    - Bandage, splint the lower extremity, and transport [268].
    - Significant blood loss is possible; treat with high flow oxygen, monitor vital signs, and watch for shock [270].
- **Femoral shaft fractures** can occur anywhere from the hip to the knee [271].
    - Large thigh muscles spasm, attempting to splint the unstable limb [272].
    - Muscle spasm produces significant limb deformity [272].
    - fractures may be open, with significant blood loss [273].
    - Hypovolemic shock is not unusual due to severe deformity [273].

    - Bone fragments may penetrate or press on nerves and vessels, causing damage [274].
    - Carefully and periodically assess distal neurovascular function [274].
    - Cover wounds with a dry, sterile dressing [275].
    - Best stabilized with a **traction splint** (e.g., Sager splint) [275].
    - Traction splints secure femur shaft fractures characterized by pain, swelling, and mid-thigh deformity [278].
    - Excessive traction can harm an uninjured limb [279].
    - Goals of inline traction: stabilize fragments, prevent excessive movement, align limb for splinting, avoid neurovascular compromise [280].
    - Do NOT use a traction splint for upper extremity injuries, injuries near/involving the knee, pelvic injuries, partial amputations with bone separation, or lower leg/foot/ankle injuries [282].
- **Knee ligament injuries** are common as the knee is vulnerable [286].
    - Range from mild sprains to complete dislocations [287].
    - Occur when abnormal bending and twisting forces are applied [288].
    - Patient reports joint pain and cannot use the extremity normally [289].
    - Swelling, bruising, tenderness, and fluid in the joint are generally present [289].
    - Splint all suspected knee ligament injuries [290].
    - The splint should extend from the hip joint to the foot [291].
    - Stabilize the bone with the injured joint and the bone below it [292].
    - Various splints can be used, including padded rigid long leg splints or two padded board splints [293].
- **Knee dislocations** are true emergencies that may threaten the limb [294].
    - Ligaments providing support may be damaged or torn [295].
    - Always check distal circulation carefully before other steps [296].
    - Direction of dislocation refers to the tibia's position relative to the femur [297].
    - Posterior knee dislocations are most common [298].
    - Medial dislocations result from a direct blow to the lateral leg [299].
    - Patients complain of knee pain and report the knee "gave out" [300].
    - Complications include limb-threatening popliteal artery disruption, nerve injuries, and joint instability [301].

    - If adequate distal pulses are present, splint the knee in the position found and transport promptly [302].
    - Medical control may instruct you to attempt realigning a deformed, pulseless limb to reduce popliteal artery compression and restore circulation [303].
- **fractures about the knee** occur at the distal femur, proximal tibia, or patella [305].
    - If adequate distal pulses are present and no significant deformity, splint the limb with the knee straight [306].
    - If an adequate pulse is present with significant deformity, splint the knee in the position of deformity [307].
    - If the pulse is absent below the injury, suspect vascular/nerve damage and contact medical control [308].
    - Never use a traction splint if a knee fracture is suspected [309].
- **Dislocation of the patella** usually displaces to the lateral side [310].
    - Produces significant deformity: knee held moderately flexed, patella displaced laterally [312].
    - Splint the knee in the position found (often moderately flexed) [313].
    - Apply padded board splints to medial and lateral aspects, extending from hip to ankle [314].
- **tibia and fibula injuries** involve fractures of the shaft between the knee and ankle [316].
    - Often both bones are fractured simultaneously [316].
    - Even a single fracture can cause severe deformity (angulation or rotation) [316].
    - tibial fractures are relatively common [317].
    - Stabilize with padded rigid long leg splints or an air splint from foot to upper thigh [317].
    - Correct severe deformity with gentle longitudinal traction before splinting [319].
- **Ankle injuries** are common [320].
    - Range from simple sprains to severe fracture dislocations [320].
    - Injuries causing pain, swelling, localized tenderness, or inability to bear weight require physician evaluation [321].
    - The most frequent mechanism is twisting, stretching or tearing ligaments [322].

    - Manage ankle injuries: dress open wounds, assess distal neurovascular function, correct gross deformity with gentle longitudinal traction to the heel, then apply splint [324].
- **Foot injuries** can result in dislocation or fracture of tarsals, metatarsals, or phalanges [325].
    - Force of injury can transmit up the leg, causing a lumbar spine fracture [325].
    - If foot dislocation is suspected, immediately assess pulses, motor, and sensory functions [326].
    - If a pulse is present, immobilize the extremity with a splint, leaving toes exposed for neurovascular assessment [327].
    - If pulses are absent, contact medical control [328].
    - Foot injuries are associated with significant swelling but rarely gross deformity [329].
    - Splint the foot using a rigid padded board, air, or pillow splint, stabilizing the ankle joint and foot [330].
    - Leave toes exposed [331].
    - Elevate the foot about six inches to minimize swelling [333].

15. Management of Sprains, Strains, Amputations, and Compartment Syndrome

- Treat every severe sprain as if it's a fracture [335].
- General treatment for sprains and strains includes the **RICE** protocol [336]:
    - Rest [337].
    - Ice [337].
    - Compression [337].
    - Elevation [337].
    - Splinting [337].
- **Management of amputations** [338]:
    - Control bleeding and treat for shock [338].
    - Surgeons can sometimes reattach amputated parts [339].
    - For partial amputations, immobilize the part with a bulky dressing and splint [340].
    - Do not sever any partial amputations [340].

    - Control bleeding from the stump; apply a tourniquet if severe [341].
    - For complete amputations, wrap the clean part in a sterile dressing and place it in a plastic bag [342].
    - Follow local protocols for preserving amputated parts [343].
    - Keep the part cool without freezing or causing frostbite [344].
    - Transport the amputated part with the patient to the appropriate hospital [345].
- **Compartment syndrome** is a limb-threatening condition [346].
    - Characterized by local tissue swelling within a compartment [347].
    - Blood flow decreases inside the muscle compartment, leading to ischemia [348].
    - Tissues become damaged and can die [350].
    - Definitive treatment is a surgical fasciotomy allowing swollen muscle to expand [351].
    - Typically develops 6-12 hours after injury from excessive bleeding, crushed extremity, or rapid return of pulse to an ischemic limb [352].
    - Signs and symptoms include pain out of proportion to the injury, pain on passive stretch, and altered sensation [353].
    - Additional signs may be pallor and decreased power [354].
    - If compartment syndrome is suspected, splint the affected limb level with the heart [355].
    - Provide immediate transport [355].
    - Reassess neurovascular status frequently during transport [356].

Injury Type	Management Protocol/Key Actions
Sprains and Strains	RICE (Rest, Ice, Compression, Elevation, Splinting), treat severe sprains as fractures
Amputations	Control bleeding, treat for shock, immobilize partial amputations, preserve complete amputations
Compartment Syndrome	Suspect based on pain out of proportion, splint limb level with heart, immediate transport

16. Review of Key Concepts

- Skeletal muscle is also referred to as striated muscle [357].
- A strain is stretching or tearing of the muscle, not ligaments with joint dislocation [358].
- In an unresponsive patient with a musculoskeletal injury, you will not be able to assess sensory function (can you feel this?) [359].
- The purpose of splinting a fracture is to prevent movement of bony fragments and reduce further injury [361].
- For a conscious, restless patient with closed deformities to both mid-shaft femurs, cool/clammy skin, and weak/rapid radial pulses, the most appropriate splinting technique is securing him to a long backboard to act as a splint [362].
- To effectively immobilize a fractured clavicle, you should use a sling and swath to minimize movement [364].
- When treating a patient with severe pain and obvious deformity to their elbow after a fall, the very first thing to do is manually stabilize the injury and assess for PMS (Pulse, Motor, Sensation) [366].
- When treating an open fracture, you should cover the wound to prevent further infection [369].
- Of the musculoskeletal injuries listed, pelvic fractures have the greatest risk for shock due to blood loss because large vessels can be lacerated [370].
- For an injured patient with a severely painful and deformed left knee that is flexed, but distal pulses are present and strong, the most appropriate treatment is to splint the leg in the position it is found [373].