Activity: Orthopaedic Emergencies Booklet

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Target Audience: Orthopaedic Surgery, ER, Primary care

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No Planner/Author/Co-Author has any financial interest or other relationship with any manufacturer of commercial product or service to disclose.

Activity Objectives:
- Describe orthopaedic emergencies
- Review treatment options for orthopaedic emergencies
- Describe physical examinations of orthopaedic emergencies
- Identify symptoms of orthopaedic emergencies
- Diagnose orthopaedic emergencies
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Open Fractures: Gustilo Anderson Classification

Introduction

- Open fractures are injuries where the fracture and the fracture hematoma communicate with the external environment through a traumatic defect in the surrounding soft tissues and overlying skin.
- The goal of treatment of an open fracture is to prevent infection and provide stabilization of the bony injury.

Etiology

- The most commonly fractured bone resulting in an open injury is tibia (49.6%), followed by forearm, (12.6%) and ankle (9.7%).

1. Gustilo Type I Injury (Fig. 1a)

   a. Low energy injury
   b. Clean wound
   c. Wound size < 1 cm (poke hole)
   d. Minimal soft tissue injury
   e. Minimal bone comminution

2. Gustilo Type II Injury (Fig. 1b)

   a. Moderate energy injury
   b. Moderately contaminated wound
   c. Wound size > 1 cm
   d. Moderate soft tissue injury
   e. Moderate bone comminution

3. Gustilo Type III Injury (Fig. 1c)

   a. High energy injury
   b. Highly contaminated wound
   c. Wound size > 10 cm
      a. Even if wound size is less than 10 cm, high energy injuries (high degrees of comminution, segmental fractures, etc.) are automatically Gustilo Type III.
         A. Grade IIIA (Fig. 1d)
            - Soft tissue coverage of bone is possible
         B. Grade IIIB (Fig. 1e)
            - Requires soft tissue reconstructive surgery in the form of local or distant flap.
         C. Grade IIIC (Fig. 1f)
            - Vascular injury that requires repair

Treatment

- Initial management in emergency department:
  o Antibiotic administration.
- Antibiotic administered within 3 hours has been shown to reduce the incidence of infection after open fractures.
  - Local irrigation and debridement.
  - Reduction and stabilization of bony injury with splint or brace as needed.
  - Tetanus booster if not up to date.

- Operative management:
  - Formal irrigation and debridement to be done within 24 hours of injury.
  - Bony stabilization may come in the way of temporary fixation with an external fixator or immediate definitive fixation.

Figure 1a: Grade I Injury

Figure 1b: Grade II Injury
Figure 1c: Grade III Injury

Injury of the femoral artery from the posteriorly displaced proximal fragment of a grade IIIC open supracondylar fracture of femur.
Femoral Neck Fractures in Young Adults (Fig. 2)

Introduction
- Femoral neck fractures in young patients are typically the result of a high-energy trauma.
- The increased magnitude of trauma may result in marked soft tissue injury.
- Without urgent reduction and fixation, the blood supply to the femoral head is at risk.

Complications
- Osteonecrosis is the most prevalent complication.
  - Main blood supply to the femoral head is the medial femoral circumflex artery.
  - Pressure from intracapsular hematoma may also affect blood supply.
- High reported rates of nonunion have been reported regardless of patient age.

Stress Fractures
- Stress fractures may be seen in young patients, commonly military recruits and runners.
- They should be considered in any young patient presenting with hip pain.

Diagnosis
- AP and lateral radiographs.
- MRI may be needed to diagnose occult fracture.
- Characteristic position of the fractured hip on physical exam is flexion and external rotation.

Treatment
- Displaced fractures must be anatomically reduced.
- Open procedures are often necessary to obtain reduction.
- Reduction and fixation should occur within 12 hours.
- Fracture is commonly stabilized with multiple cancellous screws or intramedullary nail.
Pelvic Fractures with Bleeding (Fig. 3)

Introduction
- Pelvic fractures may be associated with life-threatening hemorrhage.

Etiology
- The superior gluteal artery is responsible for the majority of bleeding in pelvic fractures with arterial injury.
- Most of the bleeding, however, comes from venous bleeding and the fracture itself.
- Patients with pelvic trauma are often multiply traumatized and may have other injuries that contribute to blood loss.

Risk Factors
- Patients older than 55 years of age are more likely to have bleeding from a pelvic fracture that requires transfusion and angiography.
- Fracture patterns that are highly unstable to both rotational and vertical stress, usually anteroposterior compression (APC) or vertical shear injuries are consistently associated with a higher risk of mortality from bleeding.

Complications
- Hemorrhage is the most life-threatening complication associated with pelvic fractures.
- Mortality rate is directly related to shock at the time of presentation.
- Anteroposterior compression or vertical shear injuries are consistently associated with a higher risk of mortality from bleeding.

Diagnosis
- Clinical examination includes palpation at the anterior superior iliac spines, examination of the skin for laceration and lesions, scrotal or labial hematomas, digital rectal examination, and examination of urethral meatus for gross blood
- Radiographic studies MRI, CT scan, X-ray

Treatment
- Management always begins with ABCs:
  A. Airway
  B. Breathing
  C. Circulation
- In a hemodynamically unstable patient with a pelvic fracture, a pelvic binder should be applied immediately.
  a. Contraindicated in patient with a ruptured diaphragm.
- If stable, abdominal and pelvic CT scans will clearly define the bony injury and the extent of bleeding.
- Initial pelvic stabilization may be achieved with application of an external fixator:
  - Tamponade bleeding by decreasing pelvic volume
  - Used in the ER in cases of open book injury
- Angiography and embolization may be useful to control arterial bleeding if patient is hemodynamically unstable after receiving 4 units of blood.
- Laparotomy may be required for fractures associated with abdominal visceral injury.
- Observe the patient for disseminated intravascular coagulation and hypothermia.

Figure 3: Pelvic fracture and sacroiliac dislocation with massive hemorrhage from injury to superior gluteal artery
Hip Dislocation (Fig. 4)

Introduction
- During a hip dislocation, the femoral head is pushed translated backward relative to the acetabulum (posterior dislocation), or forward (anterior dislocation).

Etiology
- MVA (typically a dashboard injury).
- Fall from height.

Presentation
1. Posterior dislocation (most common)
   - Limb will be flexed, adducted, internally rotated.
2. Anterior dislocation (rare)
   - Limb will be extended, abducted, externally rotated.

Diagnosis
- Clinical exam involves looking at position of legs
- Pelvic and hip radiographs will show dislocation.

Treatment
- Emergent reduction of hip is needed within 6 hours to prevent avascular necrosis.
- CT scan should be obtained after reduction to evaluate the presence of entrapped fragments in the joint, associated fracture of the femoral head or the acetabulum, and stability of the hip.
- Open reduction is required for irreducible dislocations and incongruent reductions.

Complications
- Avascular necrosis
- Sciatic nerve palsy (foot drop)
  - Patient is unable to dorsiflex the ankle.
Hip Fracture in an Elderly Patient (Fig. 5)

Introduction
- Geriatric hip fractures are among the most common orthopedic injuries.
- Categorized into femoral neck, intertrochanteric, or subtrochanteric fractures.

Etiology
- Low energy falls

Diagnosis
- Short, externally-rotated position of affected extremity on exam.
- Pelvic and hip x-rays.
- MRI may be used to identify occult stress fractures.

Complications
- Mortality rate of 20-30% within the first year following fracture.
- Surgical treatment within 48 hours decreases 1 year mortality.
- Femoral neck fractures have a high rate of AVN.

**Treatment**

- **Femoral neck fracture**
  - Closed-reduction with percutaneous screw fixation in nondisplaced fractures.
  - Prosthesis (bipolar or total hip arthroplasty) in displaced fractures.

- **Intertrochanteric fracture**
  - Compression hip screw
    - Compression hip screw contraindicated in reverse oblique fracture pattern.
  - Cephalomedullary nail

- **Subtrochanteric fracture**
  - Cephalomedullary nail

**Figure 5: Intertrochanteric Hip Fracture**
Fractures with Vascular Injury (Fig. 6)

Introduction

- Arterial injuries can be associated with fractures where the arteries are held close to bone.

Etiology

- Both high and low energy trauma may result in an arterial injury.
- Fractures involving the femoral condyles or tibial plateau carry a high risk of vascular injury because of the relatively fixed position of the popliteal artery.
  - Fractures involving the medial tibial plateau are associated with knee dislocation and increased incidence of vascular injury.
- If vascular injury is not promptly recognized and treated it can lead to amputation.
- Presence of concomitant shock with vascular injury may result in early soft tissue necrosis due to hypotension and ischemia.

Diagnosis

- Physical exam will show absent, reduced, or asymmetrical pulses.
- Ankle-brachial index may be used to evaluate perfusion of the lower extremities in causes of suspected vascular injury.
- Angiography may be used to definitively diagnose a vascular injury.

Treatment

- The single most important factor determining the outcome of the limb with vascular compromise is the duration of warm ischemia.
  - Warm ischemia time of less than 6 hours is associated with a lower rate of amputation.
- Skeletal stabilization with simultaneous vascular exploration or repair offers the best chances of limb survival.
- Prophylactic fasciotomy is necessary in all cases of vascular injury with repair to prevent compartment syndrome that would result from the swelling associated with reperfusion.
Figure 6: Comminuted femoral shaft fracture with injury to femoral artery
Compartment Syndrome

Introduction
- A condition in which increased pressure within an osseofascial compartment compromises the circulation to the tissue contained within this space.
- Without urgent decompression, tissue ischemia, necrosis, and irreversible damage will occur within 6-8 hours.

Etiology
- Any source of increased pressure within an osseofascial compartment may cause compartment syndrome.
  - Trauma (fractures, crush injuries, gunshot wounds), tight casts or dressings, infiltration of arterial or IV lines, burns, reperfusion edema, arterial injury.
- Locations:
  - Leg (most common), forearm, hand, foot, thigh

Risk Factors
- Tibia fracture is the most common fracture associated with compartment syndrome.
- Bleeding disorders.
- Male gender.
- Young age.

Diagnosis
- Compartment syndrome may be diagnosed on clinical exam alone.
  - Symptoms include the “5 P’s”
    - Pain (out of proportion, and with passive stretch of the muscles contained within the compartment).
    - Pallor
    - Paresthesia
    - Pulses
    - Paralysis
  - Intra-compartmental pressure with an absolute value of 30 mmHg
  - Intra-compartmental pressure within 30 mmHg of DBP ($\Delta < 30$ mmHg)

Treatment
- Emergent fasciotomy.
- Bedside fasciotomy is an acceptable method of treatment.
Knee Dislocation (Fig. 8)

Introduction
- Dislocation of the knee is a true orthopedic emergency due to the high incidence of neurovascular injury.

Etiology
- Knee dislocations result from high-energy trauma.
- Most common mechanism is a dashboard injury resulting in a posterior dislocation.

Concomitant Injuries
- Peroneal nerve injury occurs as it is tethered at the fibular neck.
  - Incidence of nerve injury ranges from 14 percent to 35 percent.
- The popliteal artery is tethered by the adductor hiatus proximally and the soleus arch distally, resulting in a high incidence of arterial injury.
  - Arterial injury occurs in 20-40% of all knee dislocations.
- High incidence of multi-ligamentous knee injuries occur as a result of a dislocation.
  - At least 3 of the 4 stabilizing ligaments of the knee must be torn for a dislocation to occur (ACL, PCL, MCL, LCL).

Diagnosis
- Posterior tibialis and dorsalis pedis pulses should be carefully evaluated in any patient with a knee dislocation and compared to the contralateral side.
- Look for any evidence of ischemia, diminished blood flow, or compartment syndrome.

Treatment
- Urgent reduction of the knee is mandatory.
  - Beware of spontaneously reduced knee dislocations and its associated pathology.
- Reevaluate circulation after reduction:
  - If normal, serial clinical exam and noninvasive studies (ankle-brachial index) may be used to monitor the circulation.
  - If abnormal, arteriography must be done.
  - If pulses are absent, emergent exploration must be done in the operating room.
- With an established popliteal artery injury and resultant ischemia, blood flow must be restored within 6-8 hours.
- Arterial injury is treated with excision of the damaged segment and re-anastomosis with a reverse saphenous vein graft and prophylactic fasciotomy.
Figure 8: Posterior knee dislocation resulting in injury to the popliteal artery
Posterior Sternoclavicular Joint Dislocation (Fig. 9)

Introduction

- Occurs when the clavicle dislocates from the sternum and is pushed posteriorly, potentially causing compression of the structures within the mediastinum.
  - The trachea, esophagus, or great vessels of the neck are at risk.

Etiology

- Posterior dislocations are the result of trauma.
- Atraumatic dislocations (chronic subluxations) are typically anterior and treated conservatively.

Diagnosis

- Patients may present with dyspnea, stridor, dysphagia, or tachypnea.
- If there is compression of the great vessels, asymmetric pulses in the upper extremity may be seen.
- May be difficult to diagnose on x-ray.
  - Serendipity view (40° cephalic tilt) is the recommended view.
- CT scan is the study of choice for diagnosis.

Treatment

- Urgent reduction under general anesthesia.
  - Reduction occurs by abduction and extension of the shoulder.
  - Towel clip may be percutaneously used on the medial end of the clavicle for manipulation.
  - Must have thoracic surgeon backup.

Figure 9: Posterior Dislocation
Scapulothoracic Dissociation (Fig. 10, 11)

Introduction

- Rare entity that results from a high-energy disruption of the scapulo-thoracic articulation.
- Closed, traumatic forequarter amputation.

Etiology

- High-energy lateral traction injury.

Concomitant Injuries

- High incidence of brachial plexus injuries.
  - Complete loss of motor and sensory function resulting in a “flail extremity”.
- Scapula fractures, clavicle fractures, proximal humerus fractures, AC separations and sternoclavicular dislocations may all be seen.
- Vascular injury (subclavian artery most commonly injured).
  - Patients may present with reduced or absent pulses in the upper extremity.

Diagnosis

- Chest xray will show significant lateral displacement of the scapula.
- Angiography should be performed to diagnose vascular injury in cases of reduced or absent pulses.

Treatment

- Advanced trauma life support (airway, breathing, circulation).
- Angiography for the evaluation of vascular injury and repair of the arterial injury, if possible.
- Early above-elbow amputation and shoulder fusion may be done based on degree of neurovascular and scapular muscle damage.
Figure 10: Scapulothoracic dissociation with associated clavicle fracture.

Figure 11: Sacpulothoracic dissociation with injury to the subclavian artery and brachial plexus.
Bilateral Cervical Facet Dislocation (Fig. 12)

**Introduction**

- Dislocation of the cervical facet joints may be unilateral or bilateral.
  - Unilateral dislocation may lead to ~25% subluxation on x-ray.
  - Bilateral dislocation may lead to ~50% subluxation on x-ray.
    - Increased incidence of spinal cord injury.

**Etiology**

- Typically result from flexion, distraction, and rotational forces on the cervical spine.

**Diagnosis**

- Patients may present with neurological symptoms ranging from a monoradiculopathy to complete or incomplete spinal cord injury.
- Displacement of <50% of the vertebral body width (unilateral dislocation) or >50% (bilateral dislocation) can be seen on lateral cervical x-ray.
- CT is essential to further evaluate malalignment or any associated fractures.
- MRI prior to reduction and stabilization is necessary to rule out disc herniation.
**Treatment**

- In patients that are awake and cooperative, immediate closed reduction is to be performed.
  - MRI followed by surgical stabilization is then performed for definitive fixation.
- In patients that have mental status changes, immediate MRI followed up open reduction and stabilization is performed.

**Spinal Cord Compression (Fig. 13)**

**Introduction**

- Spinal cord compression may be caused by any condition that exerts pressure on the spinal cord.

**Etiology**

- Osteoarthritis.
- Bleeding or infection.
- Spinal trauma.
  - Cervical or thoracolumbar burst fractures.
  - Cervical flexion-compression teardrop fractures.
  - Chance fracture (flexion-distraction injury).

**Concomitant Injuries**

- Spinal cord compression is more common with cervical spine injuries and thoracic spine injuries.
- Neurogenic shock (hypotension with bradycardia) must be managed with pressors.

**Diagnosis**

- Xray, CT, and MRI may all be used to evaluate extent of injury.
- Serial clinical exams closely evaluating reflexes, motor, and sensory function.

**Treatment**

- Initial management involves resuscitation and hemodynamic stabilization of associated neurogenic shock.
- High-dose methylprednisone should be given intravenously within 8 hours of spinal cord injury.
- Definitive treatment involves surgical stabilization.

Figures 13: Burst Fracture of Thoracic Vertebra
Cauda Equina Syndrome (Fig. 14)

Introduction
- Cauda equina syndrome is a manifestation of compression of the terminal spinal lumbosacral nerve roots.

Etiology
- Central disc herniation which leads to cord compression (most common)
- Trauma, tumor, or infection may all cause compression of the cauda equina.

Diagnosis
- Presents with a constellation of symptoms, including:
  - Bilateral radicular leg pain.
  - Saddle anesthesia.
  - Bowel and bladder dysfunction.
  - Lower extremity sensorimotor changes.
- Immediate MRI is necessary if suspected.

Treatment
- Urgent surgical decompression is necessary within 48 hours.

Figure 14: Central disc herniation compressing the cauda equina
Necrotizing Fasciitis

Introduction
- Rapidly advancing soft tissue infection characterized by widespread tissue necrosis.
- Without prompt recognition and treatment, amputation or death may result.

Etiology
- May result from minor or major trauma in both healthy and immunocompromised patients.
- Most cases are polymicrobial, however the most common organism is group A beta-hemolytic strep.

Complications
- High mortality rate (33%) with sepsis and renal failure.
- Amputation and mortality rate is increased when there is a delay in surgical treatment of greater than 24 hours.

Risk Factors
- Immunocompromise
- Hepatitis C
- Diabetes
- Urogenital and anogenital infections

Four Types
1. Type 1: polymicrobial
2. Type 2: Group A beta-hemolytic streptococcus
3. Type 3 – Marine Vibrio vulnificus
4. Type 4 - MRSA

Diagnosis
- Early symptoms include pain and tenderness beyond the apparent margin of infection.
- Symptoms rapidly advance and may include erythema, bullae, crepitus, and skin necrosis.
- Patients may rapidly deteriorate and become hypotensive and tachycardic.
- Fascial biopsy may be done if the patient is stable but it should not delay debridement if there is a high suspicion of necrotizing fasciitis.

**Treatment**

- Immediate radical surgical debridement combined with broad-spectrum intravenous antibiotics.
- Infectious disease and critical care consults are necessary.

**Fat Embolism**

**Introduction**

- Occurs due to the migration of fat particles from the bone marrow at the time of trauma or during reaming of an intramedullary nail.
- Results in the release of inflammatory mediators, with endothelial lung damage and hypoxemia.

**Etiology**

- Pelvic and long bone fractures.
- Severe soft tissue injury.
- Medical conditions including diabetes mellitus and pancreatitis.

**Risk Factors**

- Patients with femur fractures with a head injury.
- Overreaming.
- Pathological fractures.
- Multiple trauma patients.

**Diagnosis**

- Fat embolism is a diagnosis of exclusion.
  - 1 major sign or 4 minor signs are needed for diagnosis.
- The clinical signs usually develop within 24-72 hours.
- Major Signs:
  - Hypoxemia (PaO2 < 60 mm Hg), confusion, and petechial rash (axillae, conjunctivae, and palate).
- Minor Signs:
- Tachycardia, fever, anemia, thrombocytopenia, and presence of fat in urine.

**Treatment**

- Supportive treatment.
  - Patients may require supplemental oxygen and intubation.
  - Outcome depends on pre-injury condition of the heart and lungs.

**Septic Arthritis (Fig. 15)**

**Introduction**

- Infection within a joint that causes rapid destruction of articular cartilage.
- Can occur within any joint (knee is most common).

**Etiology**

- May occur as a result of direct inoculation from trauma or surgery, bacteremia, or contiguous spread from adjacent osteomyelitis.
- *S. aureus* is the most common organism.

**Complications**

- Rapid destruction of articular cartilage occurs within 8 hours.

**Diagnosis**

- Patients will present with a painful, swollen joint and an inability to bear weight on it.
  - Pain with passive range of motion.
- Joint aspiration is necessary for diagnosis.
  - Aspirate should be analyzed for cell out, gram stain, culture, and crystal analysis.
  - Cell count of >50,000 WBC is considered diagnostic.

**Treatment**

- Emergent operative irrigation and debridement of joint (open or arthroscopic).
- Broad spectrum IV antibiotics that are transitioned to organism-specific antibiotics based on culture and sensitivity results.
Figure 16: Inflamed hip resulting from septic arthritis.

Inflamed intraarticular structures and decreased blood supply to the femoral head from increased intracapsular pressure.

1) A 42 year-old male is in a motorcycle accident and sustains an open segmental tibia fracture. The wound is 3cm in size with good soft tissue coverage. You perform an irrigation and debridement in the emergency room and apply a splint. What is the most appropriate Gustilo-Anderson classification for his injury?
   a) Grade I  
   b) Grade II  
   c) Grade IIIA  
   d) Grade IIIB

2) Within how many hours after an open fracture should antibiotics be administered?
   a) 1 hour  
   b) 3 hours  
   c) 6 hours  
   d) 12 hours

3) A 39 year-old female is in a motor vehicle accident and sustains a displaced femoral neck fracture. What is the most appropriate treatment?
   a) Hip hemiarthroplasty  
   b) Total hip arthroplasty  
   c) Open reduction internal fixation within 12 hours  
   d) Closed reduction percutaneous pinning within 24 hours

4) What is the most prevalent complication after femoral neck fracture in a young patient?
   a) Osteonecrosis of the femoral head  
   b) Dislocation  
   c) Nonunion  
   d) Infection

5) What artery is responsible for the majority of bleeding in an anteroposterior compression (APC) pelvic fracture?
   a) Femoral  
   b) Inferior gluteal  
   c) Superior gluteal  
   d) Popliteal
6) A 21 year-old male is struck by a car crossing the street. Upon initial presentation in the trauma bay, he is hypotensive and not responding to fluid resuscitation. Pelvic radiograph demonstrates open-book pelvic fracture. What is the most appropriate initial treatment?
   a) Pelvic external fixator placement in the emergency room
   b) Take the patient to CT to further evaluate the injury
   c) Take the patient to the OR for emergent fixation of the pelvic injury
   d) Apply a pelvic binder

7) What is the most appropriate initial treatment for a patient with a posterior hip dislocation?
   a) CT scan to further evaluate injury
   b) Closed reduction
   c) Take the patient to the OR for open reduction and fixation of any associated fractures
   d) Observation

8) Within how many hours should a dislocated hip be reduced to minimize the risk of avascular necrosis?
   a) 3 hours
   b) 6 hours
   c) 9 hours
   d) 12 hours

9) What is the best imaging study to do after reducing a dislocated hip to identify entrapped fragments in the joint?
   a) Xray
   b) Ultrasound
   c) MRI
   d) CT

10) Reduced mortality has been shown when operative fixation of a fractured hip in an elderly patient is performed within what time frame?
    a) 12 hours
    b) 24 hours
    c) 48 hours
    d) 72 hours

11) What injury is most strongly associated with vascular injury?
    a) Distal radius fracture
    b) Lateral tibial plateau fracture
    c) Medial tibial plateau fracture
    d) Tibial pilon fracture
12) Warm ischemia with a time less than ___ hour(s) is associated with a lower rate of amputation.
   a) 1
   b) 3
   c) 6
   d) 9

13) What should be done when treating a fracture with a vascular injury?
   a) Repair of injured vascular structure
   b) Stabilization of fracture
   c) Fasciotomy
   d) All of the above

14) What is the most common location for the development of compartment syndrome after a fracture?
   a) Leg
   b) Forearm
   c) Hand
   d) Foot

15) A 37 year-old male sustains a tibia fracture after his leg was crushed by machinery at work. He undergoes immediate external fixation in the OR. After surgery he is having unrelenting pain out of proportion to what is expected. On exam he has significant pain with passive movement of his ankle and toes. What is the next most appropriate step?
   a) Measurement of compartment pressures
   b) Observation
   c) Pain management consult
   d) Fasciotomy

16) How is compartment syndrome diagnosed?
   a) Compartment pressure within 30 mmHg of diastolic blood pressure ($\Delta P <30$)
   b) Absolute pressure within a compartment greater than 30 mmHg
   c) Clinical exam consistent with compartment syndrome
   d) All of the above

17) TRUE or FALSE: Bedside fasciotomy is a viable treatment option in a patient with acute compartment syndrome.
   a) True
   b) False
18) Knee dislocation may be associated with which of the following?
   a) Vascular injury
   b) Nerve injury
   c) Fracture
   d) All of the above

19) A 64 year-old woman is an unrestrained passenger in a motor vehicle accident. Upon presentation in the emergency room she is found to have a posterior knee dislocation. She has a diminished dorsalis pedis pulse when compared to her contralateral extremity. What is the most appropriate initial step in management?
   a) CT scan to further evaluate injury
   b) Reduction of dislocation in emergency room
   c) Take to operating room for open reduction and external fixation
   d) Observation

20) Which direction of knee dislocation is most strongly correlated with complete tear of the popliteal artery?
   a) Posterior
   b) Anterior
   c) Lateral
   d) Rotational

21) A patient sustains an anterior knee dislocation that is reduced in the emergency department. Upon reduction dorsalis pedis and posterior tibial pulses are normal and symmetric with the contralateral side. What is the most appropriate next step in management?
   a) CT angiogram
   b) MRI
   c) Ankle-brachial index (ABI)
   d) Immediate surgical exploration

22) Posterior sternoclavicular (SC) joint dislocation may be associated with which of the following?
   a) Dysphagia
   b) Stridor
   c) Asymmetric pulses in the upper extremities
   d) All of the above

23) The xray view of choice when evaluating sternoclavicular dislocations is called...?
   a) Stryker Notch
   b) Serendipity
   c) Axillary
   d) West Point
24) What is the imaging modality of choice to diagnose sternoclavicular dislocations?
   a) Xray
   b) Ultrasound
   c) MRI
   d) CT

25) A 43 year-old male presents with stridor and dysphagia after being involved in an ATV accident. CT scan demonstrates posterior sternoclavicular dislocation. What is the most appropriate treatment option?
   a) Observation
   b) Closed reduction in the emergency room
   c) Closed vs open reduction in the operating room with thoracic surgery backup
   d) Closed vs open reduction in the operating room without thoracic surgery backup

26) Chest xray taken in a patient with scapulothoracic dissociation may show which of the following?
   a) Clavicle fracture
   b) Lateral displacement of the scapula
   c) Proximal humerus fracture
   d) All of the above

27) TRUE or FALSE: Scapulothoracic dissociation is associated with a high incidence of brachial plexus injuries?
   a) TRUE
   b) False

28) A 26 year-old male is in a high-energy motorcycle accident. Upon presentation in the trauma bay he shows labored breathing with an oxygen saturation of 73%. Initial chest xray shows lateral displacement of the scapula consistent with scapulothoracic dissociation as well as a clavicle fracture. What is the most appropriate initial step in management?
   a) Arteriogram to further evaluate possible vascular injury related to scapulothoracic dissociation
   b) Further evaluation and treatment of the airway, breathing, and circulation
   c) Take the patient to the operating room for exploration of possible brachial plexus injury
   d) Take the patient to the operating room for acute ORIF of the clavicle

29) Imaging findings consistent with transverse ligament rupture in cervical spine trauma includes:
   a) Atlantodens interval (ADI) > 5mm
   b) Sum of lateral mass displacement on open mouth odontoid view > 7mm
   c) CT showing a Jefferson burst fracture with bilateral fractures of the anterior and posterior arches
   d) All of the above
30) In a patient with an acute spinal cord injury who is in neurogenic shock, what will the patient most likely show?
   a) Hypotension and bradycardia
   b) Hypotension and tachycardia
   c) Hypertension and bradycardia
   d) Hypertension and tachycardia

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