Central Nervous system Injury

Pea Ridge Fire Department EMS refresher

Introduction

- The central nervous system (CNS) consists of the brain and spinal cord.
- Two primary divisions of insult:
  - Head trauma
  - Spinal cord injury (SCI)

The Scalp

- Composed of layers:
  - Subcutaneous tissue
  - Major vessels
  - Superficial fascia
- Do not underestimate the blood loss potential.
- Do not get distracted from other life-threatening injuries.

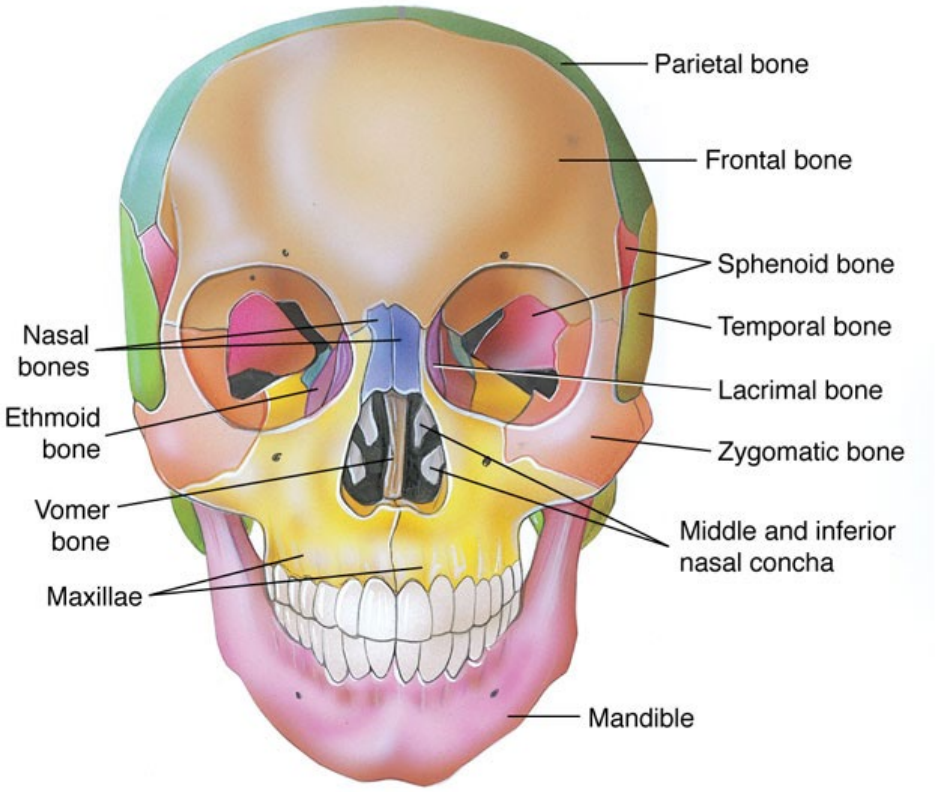
The Skull

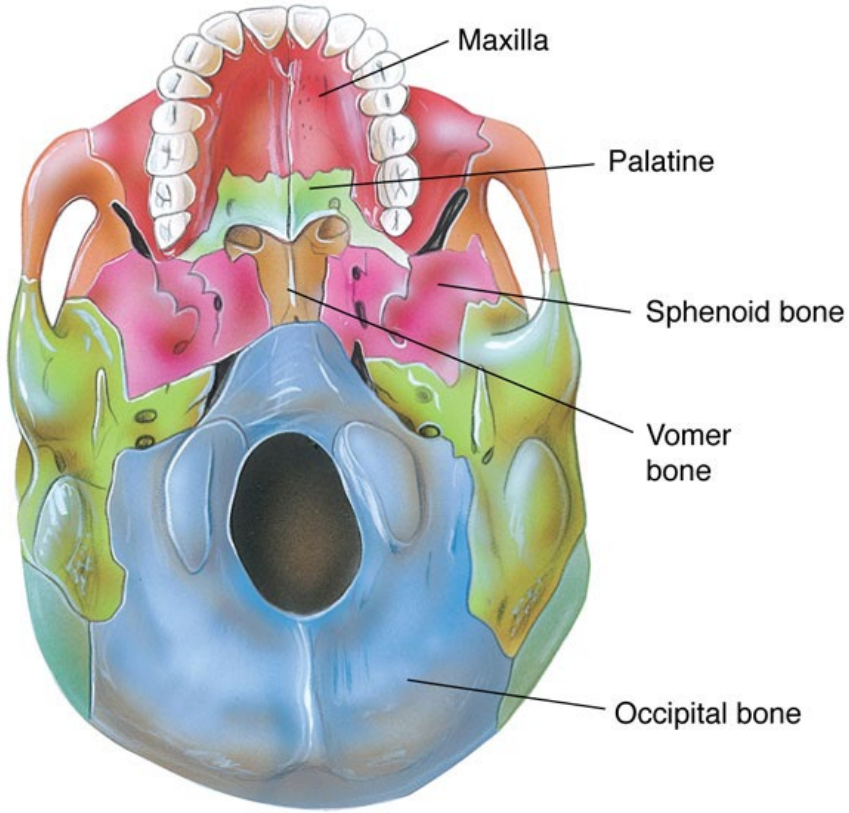
- Consists of 28 bones that make up the:
  - Cranium
  - Auditory ossicles
  - Face

The Skull

- The cranial vault consists of 8 flat, irregular bones.
  - Generates blood cells (hematopoiesis)
  - Protects the brain
  - Provides a nondistensible container for the brain, CSF, and blood

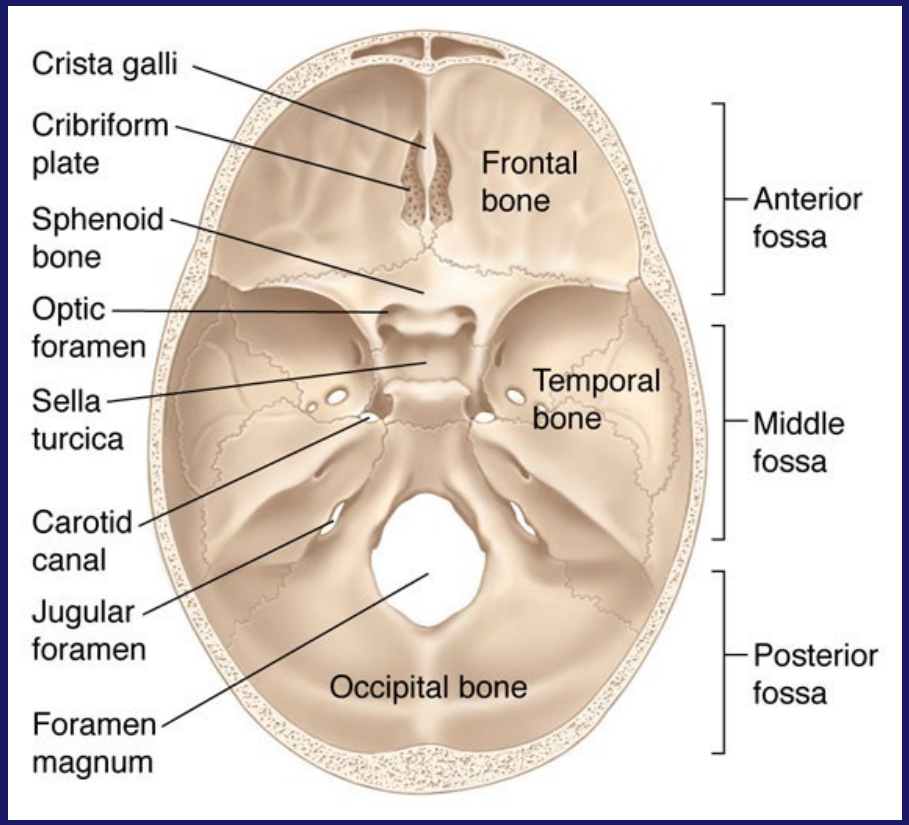
The Skull





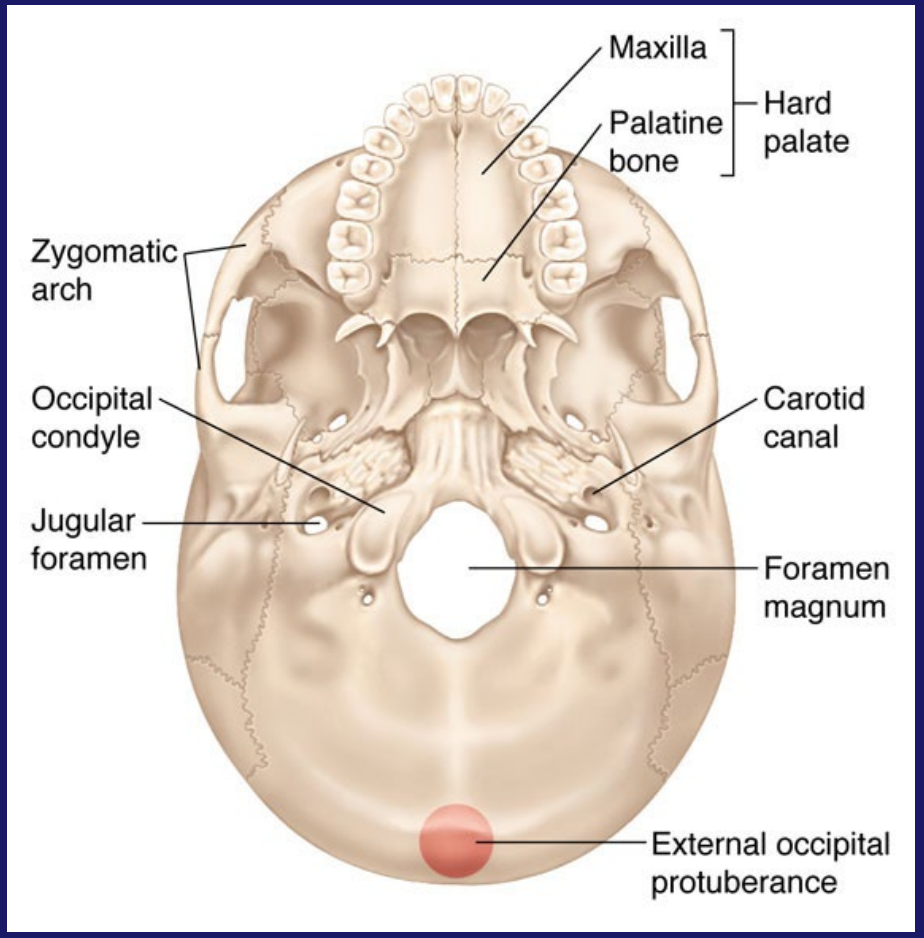
The Skull

- The floor of the cranial vault
  - Several ridges and depressions
  - Openings that allow nerves to exit the skull
    - Coup-contrecoup injury



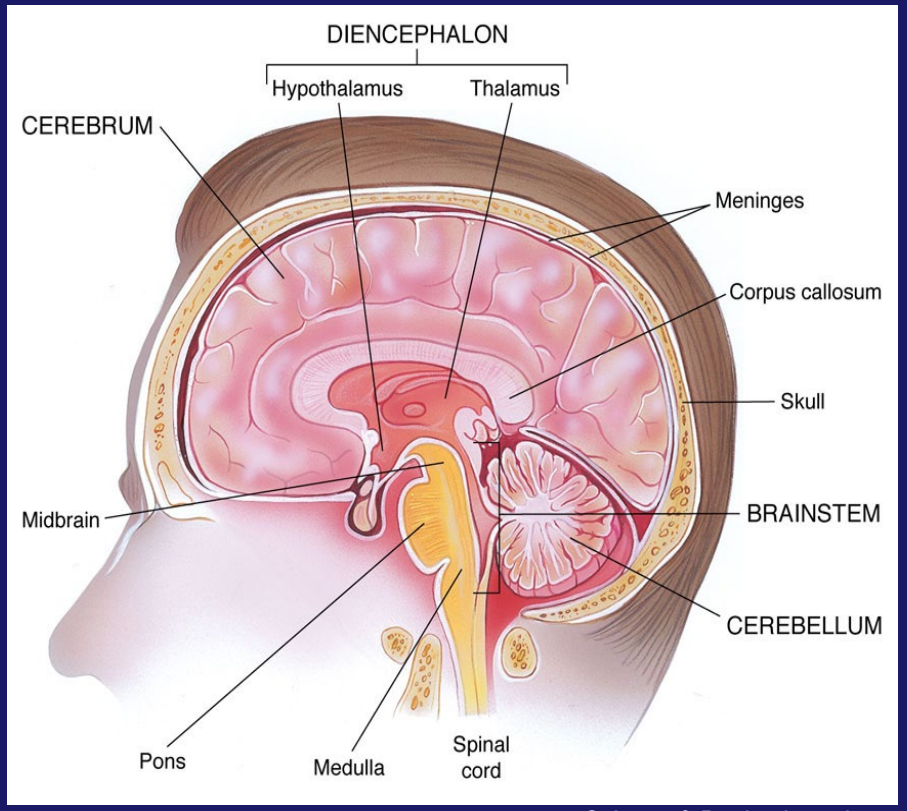
The Skull

- Base of the skull
  - Consists of the ethmoid, sphenoid, occipital, frontal, and temporal bones
  - Basilar skull fracture



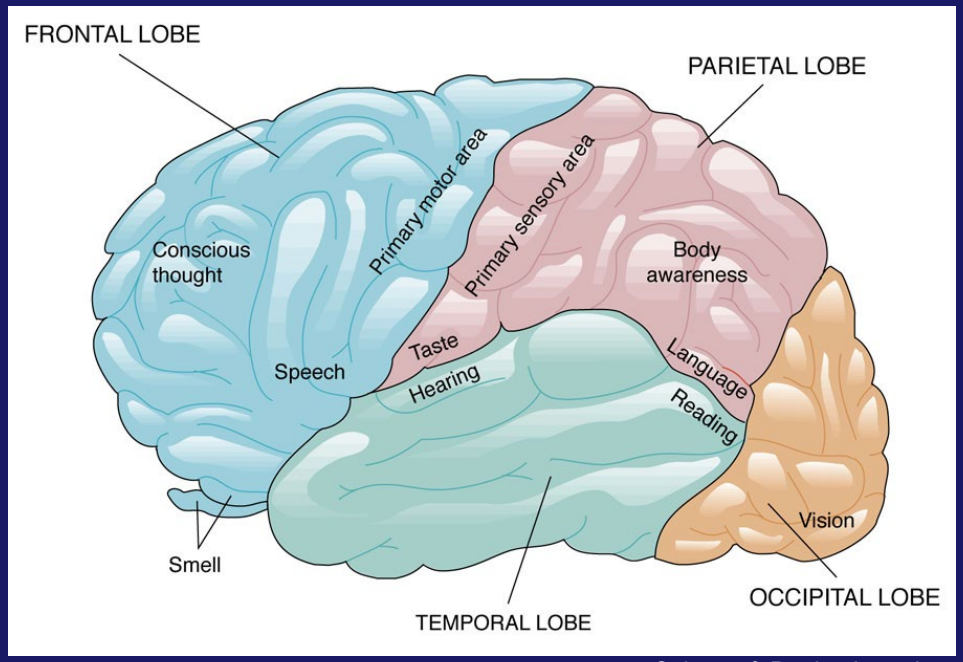
The Brain

- Contains billions of neurons that serve a variety of vital functions



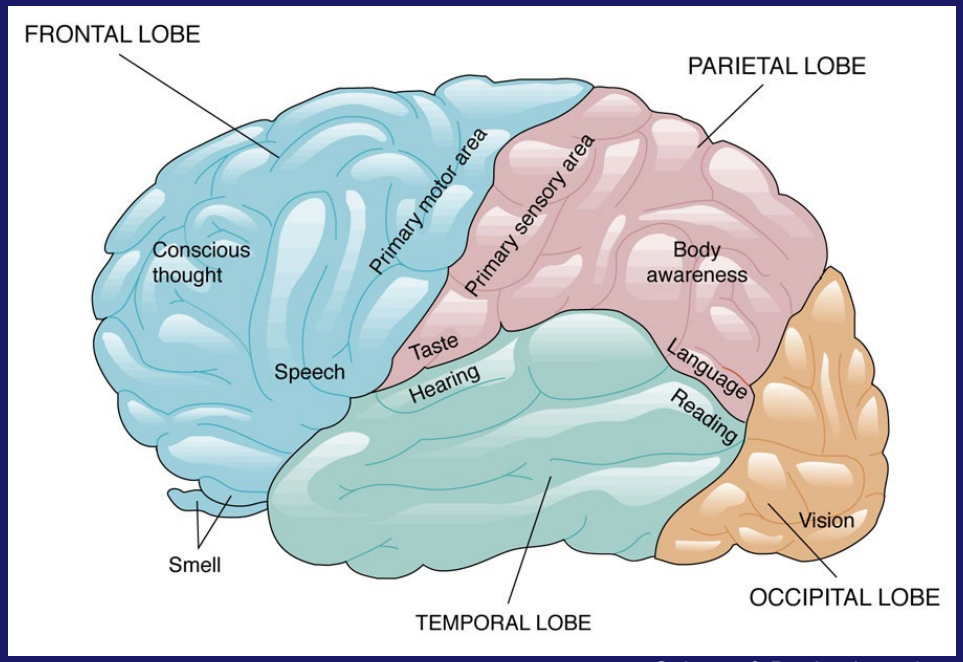
The Brain

- Cerebrum
  - Largest portion
  - Responsible for higher functions
  - Divided into hemispheres, which are divided into lobes



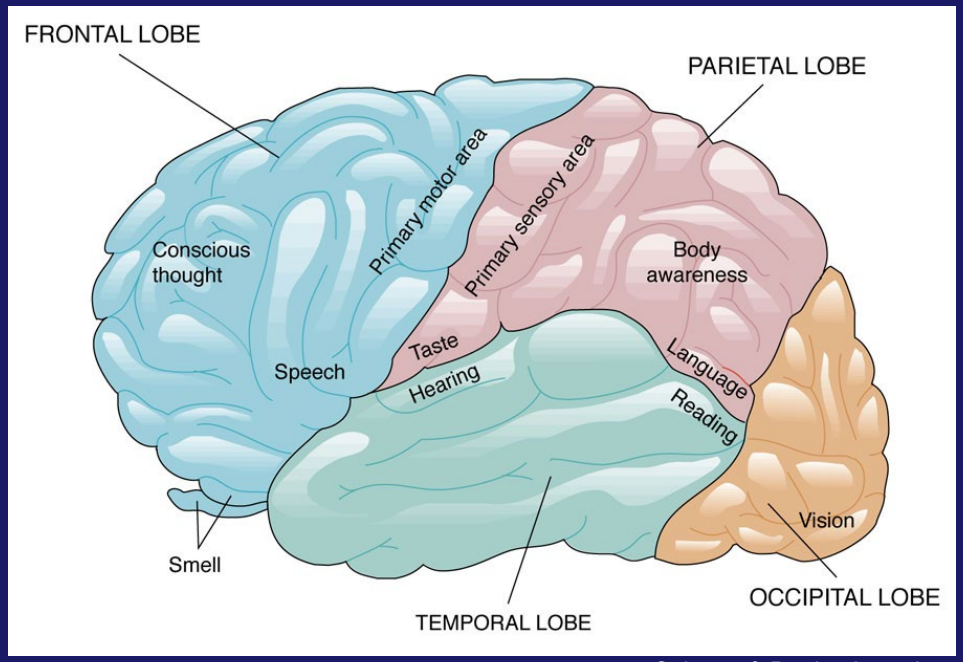
The Brain

- Cerebrum (cont'd)
  - Frontal lobe:
    - Important to voluntary motor action and personality traits
    - Filters emotional impulses from limbic system



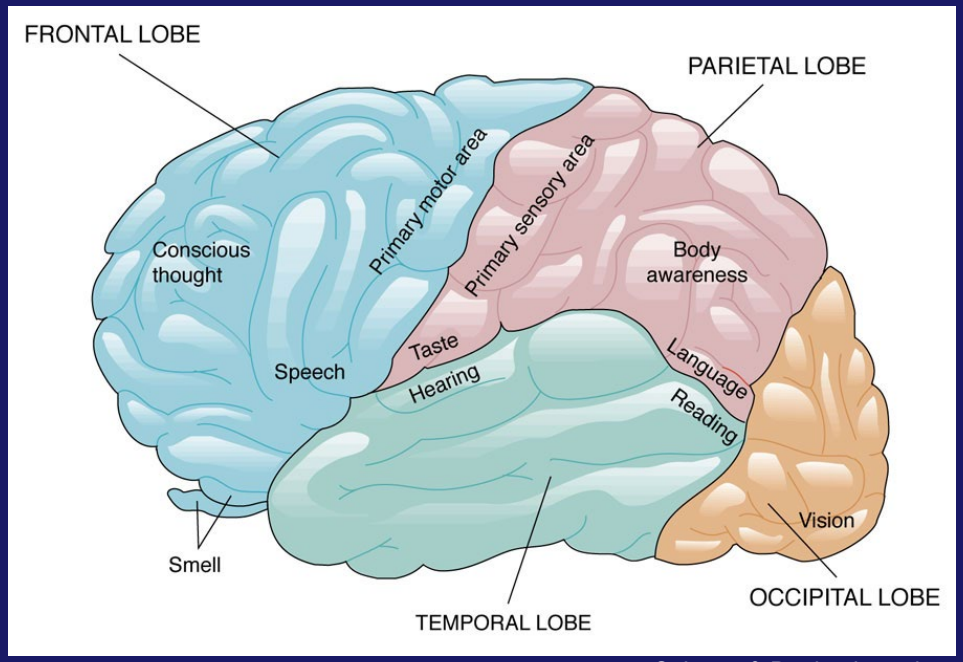
The Brain

- Cerebrum (cont'd)
  - Parietal lobe
    - Governs the perception of pain, temperature and vibration
    - Responsible for proprioception



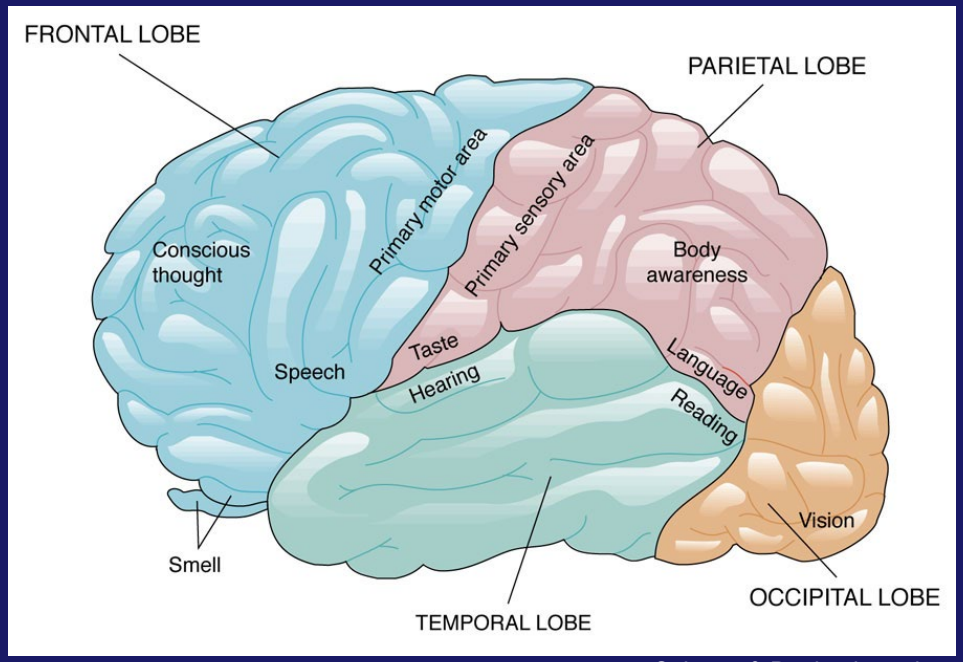
The Brain

- Cerebrum (cont'd)
  - Occipital lobe
    - Processes visual information



The Brain

- Cerebrum (cont'd)
  - Temporal lobe
    - Controls speech, long-term memory, hearing, taste, and smell



The Brain

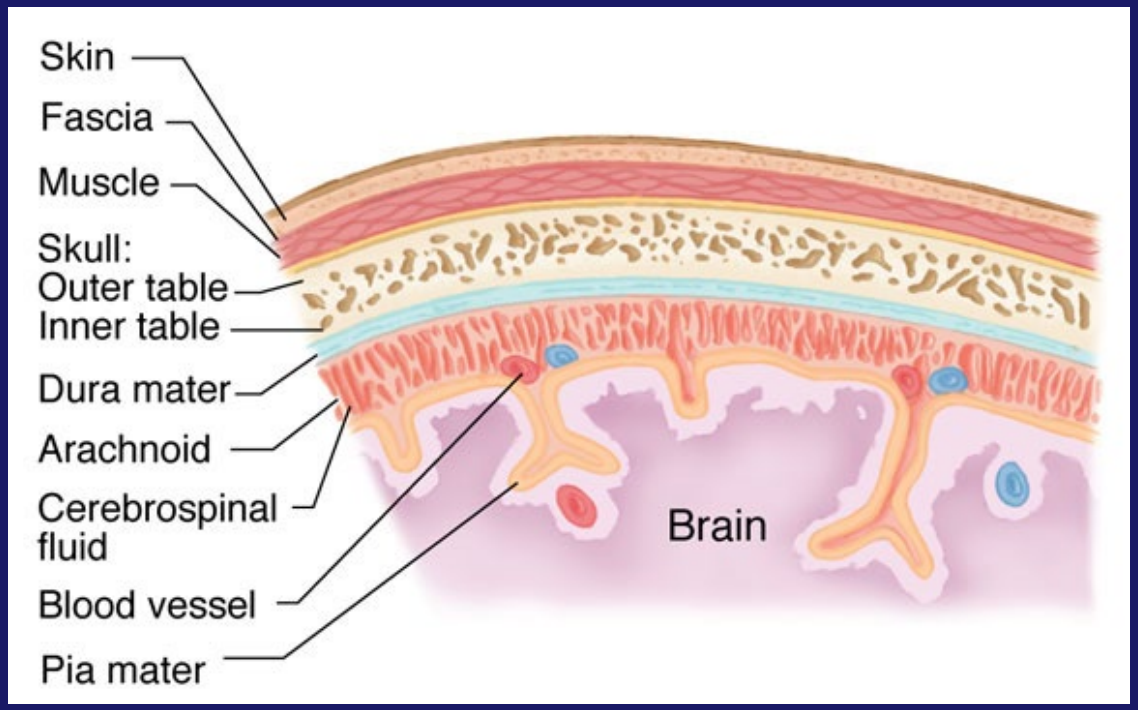
- Cerebellum
  - Sometimes called “athlete’s brain”
  - Responsible for maintenance of posture, equilibrium, and coordination

The Brain

- Brainstem
  - Consists of midbrain, pons, and medulla
  - Connects spinal cord to the rest of the brain
  - Houses many structures crucial to vital functions

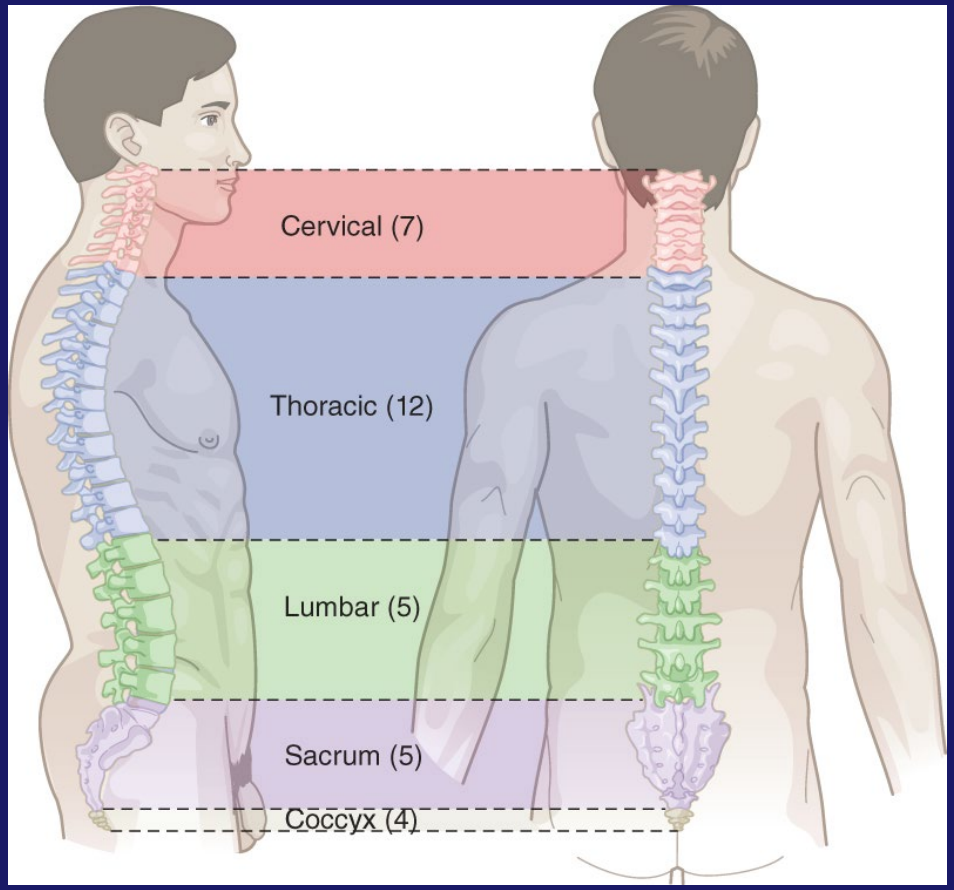
The Meninges

- Protective layers that surround and enfold the entire CNS



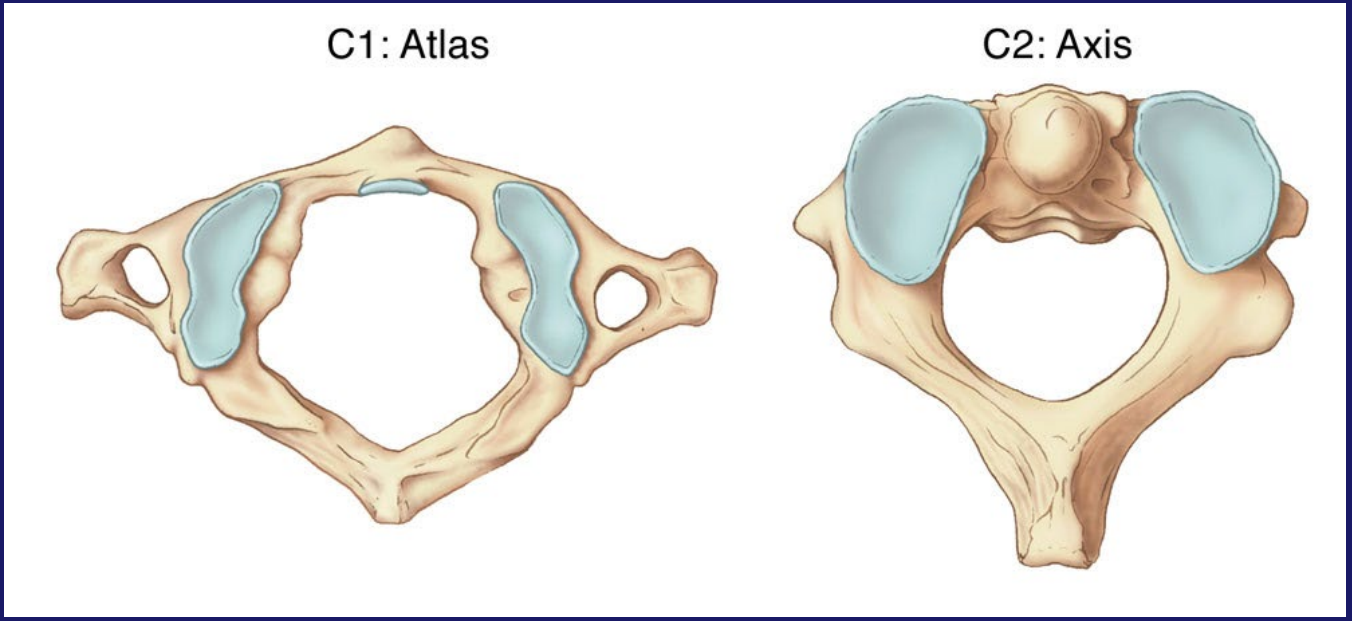
The Spine

- Consists of 33 vertebrae
- Divided into 5 sections



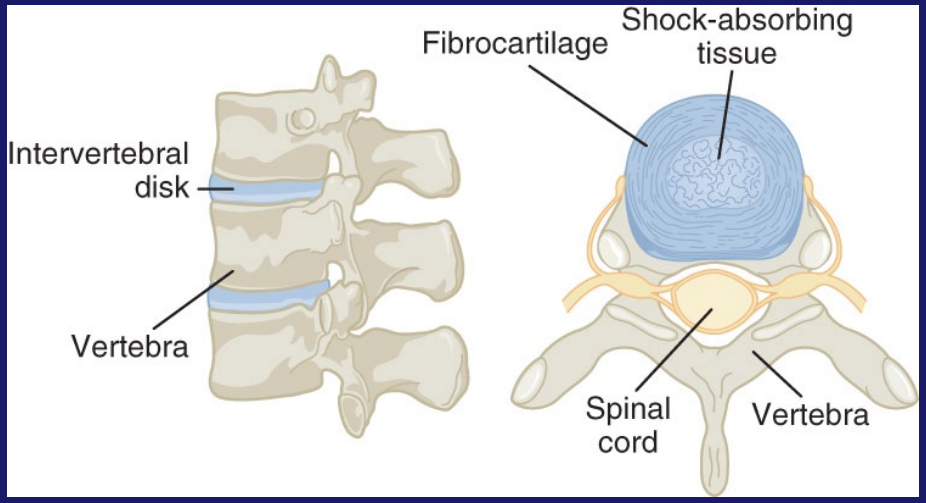
The Spine

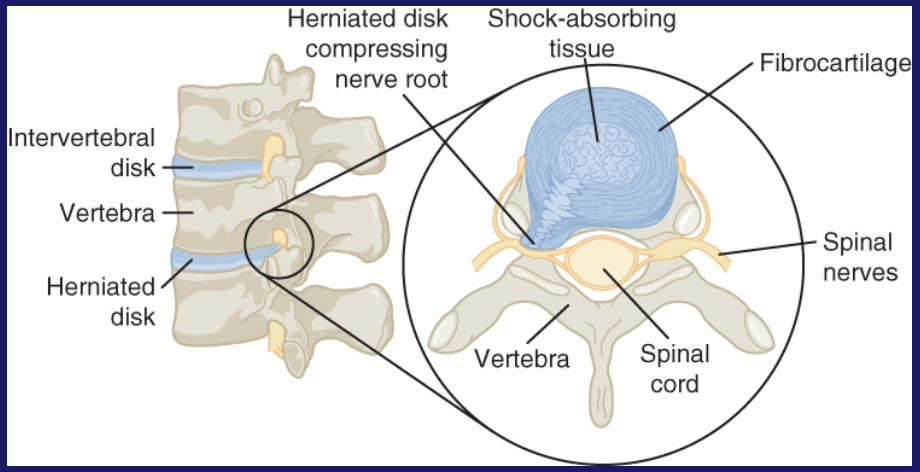
- Each vertebra is unique in appearance but shares basic characteristics.
  - Except the atlas and axis (C1 and C2)



The Spine

- Each vertebra is separated by intervertebral disks.
  - Stress on the vertebral column can cause the disks to herniate.



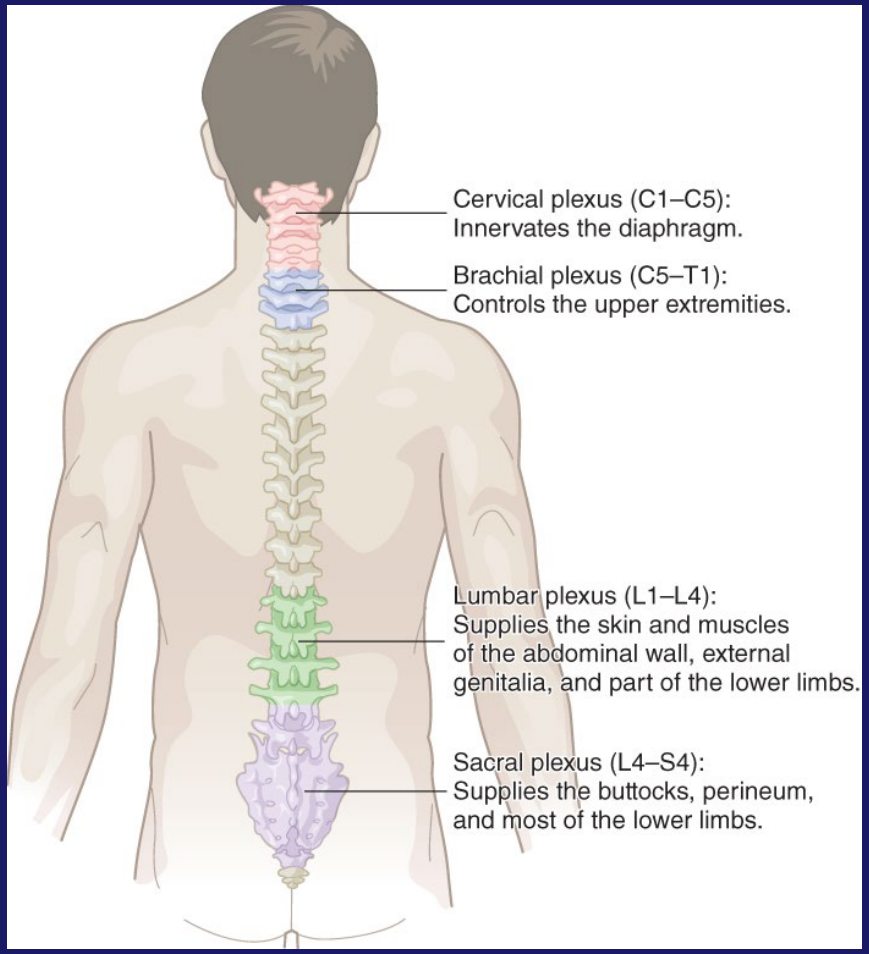


The Spine

- Spinal cord
  - Transmits nerve impulses between the brain and the body
  - Leaves the skull through the foramen magnum
  - At the base of the skull, separates into cauda equina

The Spine

- Spinal nerves
  - 31 pairs
  - Named for region and level
  - Plexus: cluster that functions as a group



The Spine

- Sympathetic nervous system
  - Mobilizes the body for activity.
  - Controls sweating, pupil dilation, temperature regulation, and flight or fight responses.
  - Loss of stimulation can disrupt homeostasis.

The Spine

- Parasympathetic nervous system
  - Includes fibers arising from cranial and sacral nerves (also called craniosacral nervous system)
  - Carries signals to organs of the abdomen, heart, lungs, and skin
  - Slows heart rate when the sympathetic nerves are stimulated

Scene Size-Up

- Assess scene safety.
- The following should prompt a search for signs of head and brain injuries:
  - Motor vehicle crashes (MVCs)
  - Direct blows
  - Falls from heights
  - Assaults
  - Sports-related injuries

Scene Size-Up

- The following indicate the need for full spinal motion restriction:
  - High-velocity crash with severe vehicle damage
  - Unrestrained occupant of vehicle crash
  - Vehicular damage with compartmental intrusion
  - Fall of an adult from a height greater than 20 feet
  - Fall of a child from a height greater than 10 feet
  - Penetrating trauma near the spine

Scene Size-Up

- The following indicate the need for full spinal motion restriction (cont'd):
  - Ejection from moving vehicle
  - Motorcycle crash
  - Auto-pedestrian or auto-bicycle crash of greater than 20 mph
  - Death of an occupant in the same compartment
  - Rollover crash (unrestrained)

Primary Survey

- Ensure manual stabilization of the cervical spine in a neutral, in-line position.
  - Determine the level of consciousness.
  - Conduct the primary survey.
    - Assess ABCs.
    - Assess pulse, motor, and sensory function.
  - Apply a cervical collar if findings require it.

Primary Survey

- Airway and breathing
  - Ensure an open airway.
  - Be prepared to roll patients to the side to prevent aspiration.
  - If a nasal airway is allowed, use caution:
    - If CSF or bloody rhinorrhea is present
    - If nasal fracture is suspected

Advanced Airway Management

- Maintain manual stabilization during all airway management procedures.
  - Nasotracheal intubation carries risk and is generally contraindicated.
- If the patient will not tolerate advanced airway management, consider pharmacologically assisted intubation.

Ventilation

- Ensure adequate oxygenation and ventilation.
  - If there are signs of hypoxia, do not defer oxygenation.
  - Administer 100% oxygen via nonrebreathing mask if the patient is breathing adequately.
  - Administer bag-mask ventilation and 100% oxygen for patients without adequate ventilation.

Ventilation

- Hyperventilation is recommended only if signs of cerebral herniation are present.

Table 34-3 Signs of Cerebral Herniation

Unresponsive patient with two or more of the following:

- Asymmetric (unequal) pupils *or* bilaterally fixed and dilated pupils
- Decerebrate (extensor) posturing *or* no motor response to painful stimuli
- Original Glasgow Coma Scale score of less than 9 that decreases by 2 or more points from the patient's best score

Circulation and Volume Resuscitation

- Circulation
  - In the absence of a pulse, immediately initiate CPR.
  - Control major bleeding with direct pressure.
    - No excessive pressure to scalp lacerations

Circulation and Volume Resuscitation

- Examine skin color, temperature, and moisture
  - Significant sensory loss
  - Neurogenic shock

Circulation and Volume Resuscitation

- Volume resuscitation might be necessary if the pulse is absent or diminished.
  - Establish at least one 18-gauge IV line with normal saline or lactated Ringer solution.
  - Do not administer dextrose-containing solutions because they may worsen cerebral edema.

Circulation and Volume Resuscitation

- Volume resuscitation might be necessary if the pulse is absent or diminished (cont'd)
  - Restrict your use of IV fluids for patients with a severe closed head injury.
  - Patients in pure neurogenic shock may need vagolytic drugs and vasopressors.
  - Use a cardiac monitor for every critical patient.

Assessment of Disability and Exposure

- Reevaluate the patient's mental status and response to stimuli.
- Check for the presence of a pulse.
- Evaluate motor and sensory function in each extremity.
- Observe the back to assess for penetrating trauma.

Assessment of Disability and Exposure

- Palpate the patient's spinal column for:
  - Deformity
  - Step-offs
  - Point tenderness
  - Crepitus

Assessment of Disability and Exposure

- Determine whether the patient needs spinal immobilization.
- Perform a quick baseline assessment.
- Remove any clothing that would obstruct the secondary assessment.

Level of Consciousness

- When you suspect a head injury:
  - Perform baseline neurologic assessment using AVPU.
  - Obtain a Glasgow Coma Scale (GCS) score.

Level of Consciousness

- When you suspect a head injury (cont'd):
  - The level of consciousness indicates the extent of brain dysfunction.
  - A change in the level is the single most important sign you can detect.

Format a Plan

- Prompt transport to a trauma center is crucial to the survival of the patient.
- Many patients will require surgery.

Spinal Restriction

- Spinal immobilization of the patient may involve:
  - A backboard
  - A scoop stretcher
  - A similar device

Spinal Restriction

- Timing is based on the condition of your patient.
  - Critical patient: apply the immobilization after the primary survey to enable rapid transport.
  - Noncritical patient: apply the immobilization after the secondary assessment.

Spinal Restriction

- Most patients can be logrolled while you watch for deformity or injury.
- A reliable patient meets the following conditions:
  - Is alert and oriented
  - Has no language barrier
  - Has no evidence of brain injury or intoxication
  - Has no alterations in his or her ability to make decisions or recognize pain and injury

Spinal Restriction

- In reliable patients, the following may eliminate the need for spinal immobilization:
  - No pain or tenderness along the spine, coupled with
  - A normal neurologic exam
  - No distracting injuries

Spinal Restriction

- Always protect paralyzed limbs with appropriate restraint and stretcher immobilization.
- Patients in severe pain may require an alternative method of transfer to a long backboard.

Spinal Restriction

- Time on the backboard should be limited.
- Several devices offer improved comfort:
  - Vacuum mattress
  - The Back Raft
  - Concave backboards

History Taking

- The patient's reliability should be assessed.
  - Unreliable patients should have continuous spinal protection until an appropriate radiographic evaluation at the receiving facility.
- Maintain a high index of suspicion.
- Obtain a SAMPLE history.

Secondary Assessment

- Modify the examination of any patient with suspected SCI based on:
  - Level of consciousness
  - Reliability as a historian
  - MOI

Secondary Assessment

- Complete the physical exam with the patient in a neutral position without moving the spine.
- Apply manual stabilization.
- Administer sedation or conduct rapid sequence intubation procedures if necessary.

Secondary Assessment

- Thoroughly assess the head and neck for:
  - Soft-tissue injuries
  - Bony instability
  - Depression
  - Drainage from the ears or nose
  - Retroauricular ecchymosis (Battle sign) or periorbital ecchymosis (raccoon eyes)

Secondary Assessment

- Reevaluate these areas if the cervical collar is not in place.
- Frequently monitor the pupils.
- Evaluate the chest and abdomen for internal and external injuries.

Secondary Assessment

- Monitor the cardiovascular system for signs of shock.
- In male patients, assess the urethral meatus.
- Look for abnormal posturing.
- Obtain a glucose level in patients who show evidence of alterations in sensation.

Secondary Assessment

- Assessing ICP

Table 34-4 Levels of Intracranial Pressure

Elevation Level	Clinical Indicators
Mild elevation	▪ Increased blood pressure; decreased pulse rate ▪ Pupils still reactive ▪ **Cheyne-Stokes respirations** (gradually increasing rate and depth of respirations followed by a gradual decrease of respirations with intermittent periods of apnea) ▪ Patient initially attempts to localize and remove painful stimuli; this is followed by withdrawal and extension ▪ Vomiting (often without nausea) ▪ Headache ▪ Altered level of consciousness ▪ Seizures ▪ Effects are reversible *with prompt treatment*
Moderate elevation (indicates middle brainstem involvement)	▪ Widened pulse pressure and bradycardia ▪ Pupils are sluggish or nonreactive ▪ **Central neurogenic hyperventilation** (deep, rapid respirations; similar to Kussmaul, but without an acetone breath odor) ▪ Decerebrate posturing ▪ Survival possible but often with significant permanent neurologic deficit
Marked elevation (indicates involvement of lower portion of brainstem/ medulla)	▪ Unilaterally fixed and dilated ("blown") pupil ▪ **Biot (ataxic) respirations** (irregular pattern, rate, and depth of breathing with intermittent periods of apnea) or absent respirations ▪ Flaccid paralysis ▪ Irregular pulse rate ▪ Changes in the QRS complex, ST segment, or T wave ▪ Fluctuating blood pressure; hypotension common ▪ Many patients do not survive this level of intracranial pressure

Data from: Stiver SI, Gean AD, Manley GT. Survival with good outcome after cerebral herniation and Duret hemorrhage caused by traumatic brain injury. *J Neurosurg*. 2009;110(6):1242-1246.

Secondary Assessment

- Neurologic exam
  - The neurologic exam is intended to establish a baseline for later comparison.
  - Determine the level of consciousness.

Secondary Assessment

- Neurologic exam (cont'd)
  - Myotomes: regions where motor components of spinal nerves supply specific tissues and muscles

Table 34-5 Myotomes

Nerve Root	Muscle Group	Nerve Root	Muscle Group
C3-C5	Diaphragm	L2	Hip flexors: iliopsoas
C5	Elbow flexors: biceps, brachialis, brachioradialis	L3	Knee extensors: quadriceps
C6	Wrist extensors	L4	Ankle dorsiflexors: tibialis anterior
C7	Elbow extensors: triceps	L5	Long toe extensors: extensor hallucis longus
C8	Finger flexors: flexor digitorum profundus to middle finger	S1	Ankle plantar flexors (gastrocnemius, soleus)
T1	Hand intrinsics: interossei, small finger abductors	S4-S5	Anus, bowel, urinary bladder
T2-T7	Intercostal muscles		

Secondary Assessment

Secondary Assessment

Secondary Assessment

- Dermatomes: regions where sensory components of spinal nerves innervate

Table 34-6 Dermatomes

Nerve Root	Anatomic Location	Nerve Root	Anatomic Location
C2	Occipital protuberance	T10	Umbilicus
C3	Supraclavicular fossa	L1	Inguinal line
C5	Lateral side of antecubital fossa	L2	Mid anterior thigh
C6	Thumb and medial index finger (six-shooter)	L3	Medial aspect of the knee
C7	Middle finger	L5	Dorsum of the foot
C8	Little finger	S1-S3	Back of leg
T2	Apex of axilla	S4-S5	Perianal area
T4	Nipple line		

Reassessment

- Monitor vital signs:
  - Every 5 minutes in an unstable patient
  - Every 15 minutes in a stable patient
- Be alert for hypotension without other signs of shock.

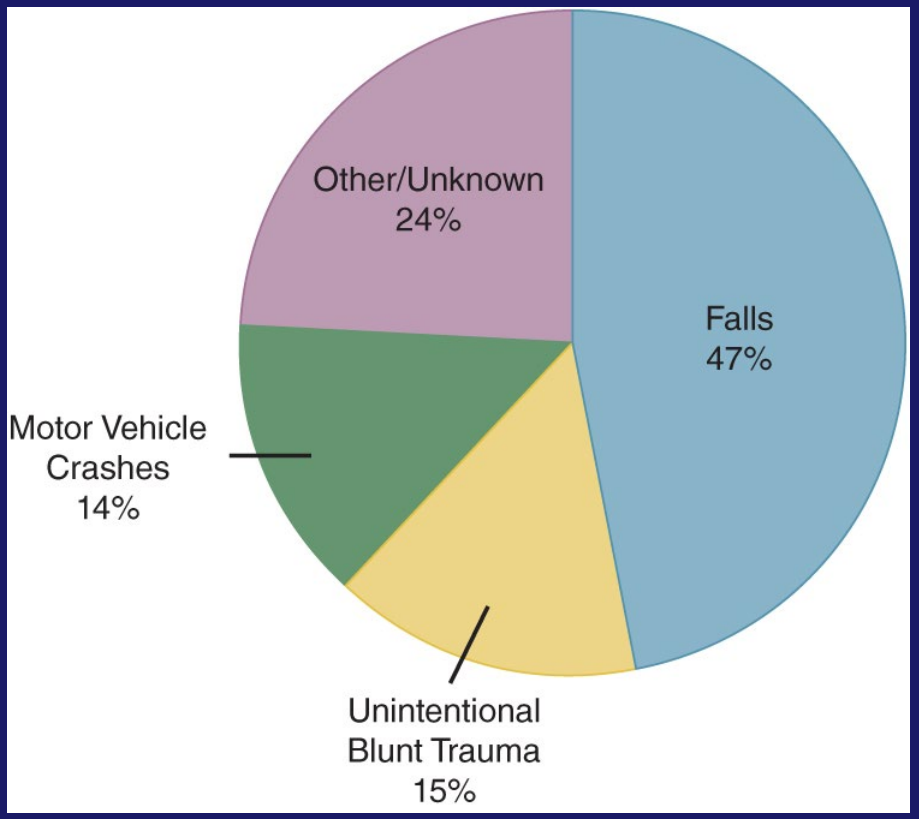
Reassessment

- Check interventions.
- Repeat the physical exam and reprioritize.
- Document suspected SCI.

Incidence of Head Trauma

- TBI is responsible for about 30% of trauma-related deaths each year.
- In 2013, TBI resulted in:
  - 2.8 million visits to emergency departments 282,000 hospitalizations
  - 50,000 deaths

Incidence of Head Trauma



Data from TBI: Get the Facts. Concussion. Traumatic Brain Injury. CDC Injury Center. (2016). www.cdc.gov/traumaticbraininjury/get_the_facts.html.

Types of Head Injuries

- Two general types:
  - Closed head injury (most common)
    - Associated with blunt trauma
    - Brain tissue unexposed
    - May be focal or diffuse
  - Open head injury
    - Associated with penetrating MOI
    - Brain tissue exposed

Pathophysiology of Scalp Lacerations

- Can vary between minor and serious
- Can lead to significant blood loss
  - Do not become distracted by the injury.

Assessment and Management of Scalp Lacerations

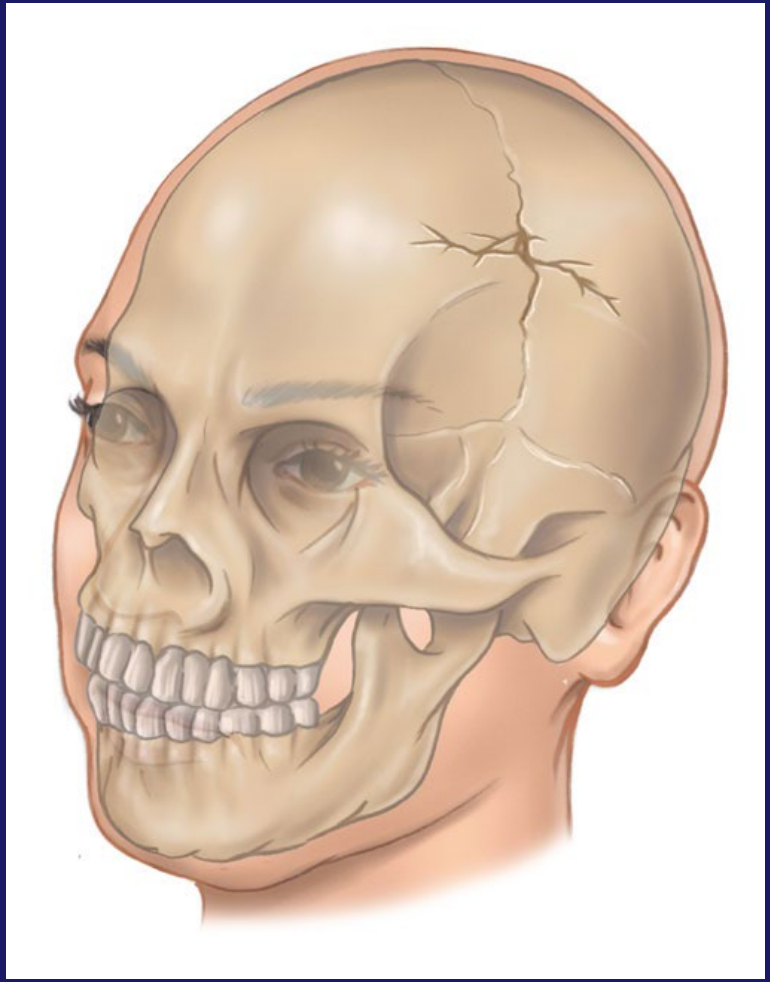
- Consider the mechanism.
  - Inspect for missing tissue, impaled objects, or residual contaminants.
  - Evaluate for signs of continued bleeding.
  - Reevaluate often.
- In isolated lacerations, stop the bleeding.
- Do not explore the injury.

Skull Fracture

- Significance is related to:
  - Type of fracture
  - Amount of force
  - Area of the head that sustained the blow
- Potential complications:
  - Intracranial hemorrhage
  - Cerebral damage
  - Cranial nerve damage

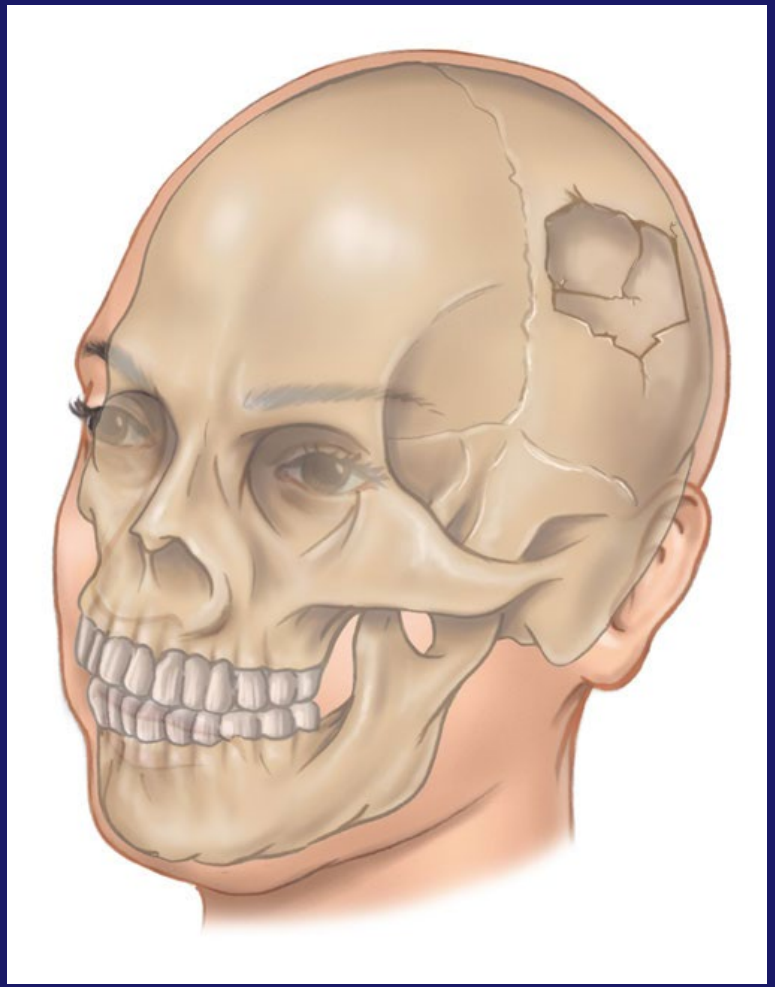
Skull Fracture

- Linear skull fractures
  - Account for the majority of all skull fractures
  - No gross physical signs



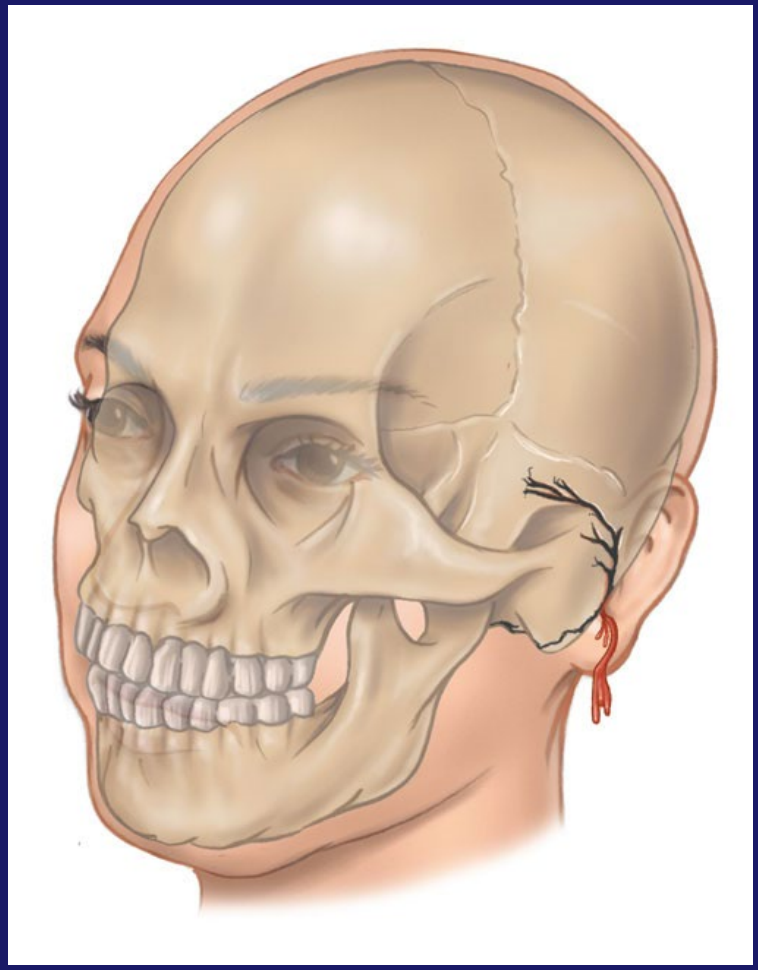
Skull Fracture

- Depressed skull fractures
  - These result from high-energy direct trauma.
  - Patients often present with neurologic signs.



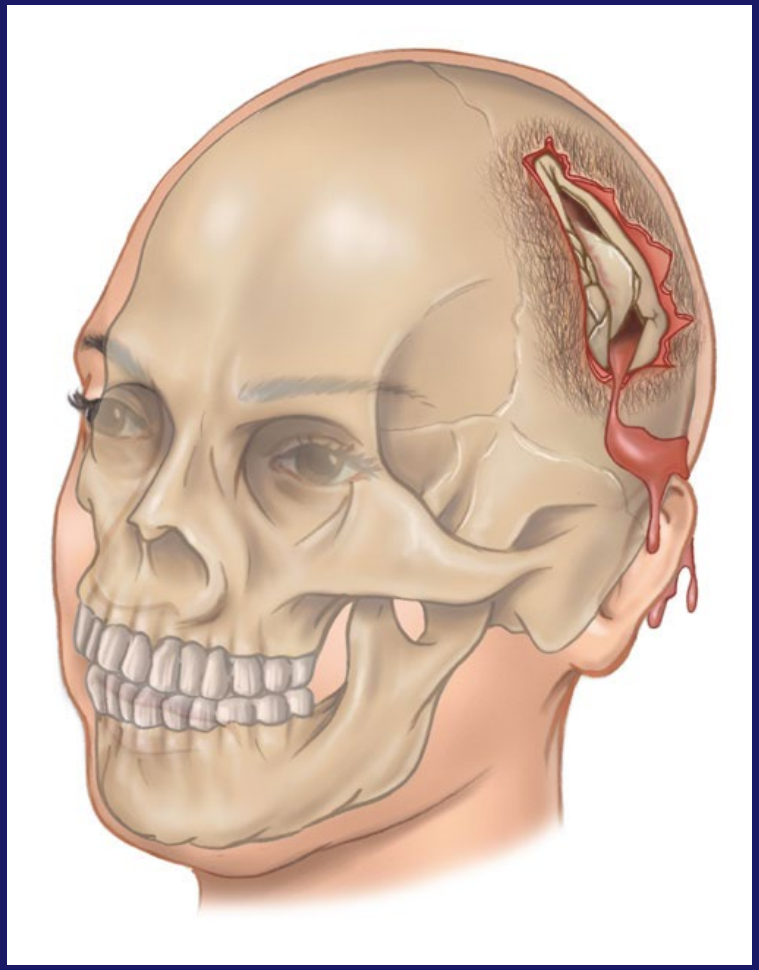
Skull Fracture

- Basilar skull fractures
  - Usually occur following a diffuse impact to head
  - Signs include:
    - CSF drainage
    - Raccoon eyes
    - Battle sign



Skull Fracture

- Open skull fractures
  - Result of severe force
  - Possible exposure of brain tissue
  - High mortality rate



Assessment and Management of Skull Fractures

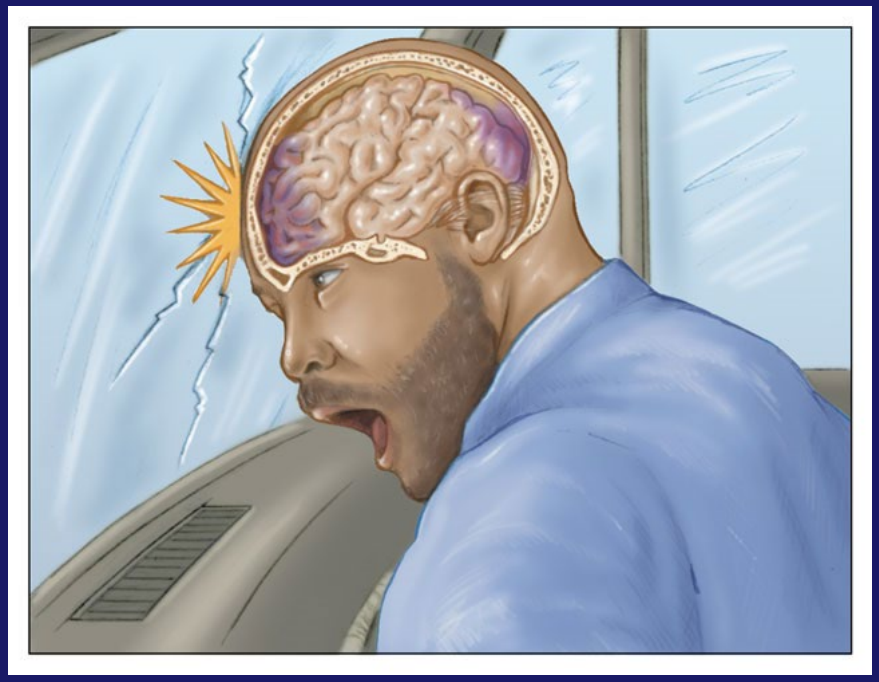
- Use the pads of your fingers to apply pressure over the entire skull.
- Identify and treat any life threats.
- Provide manual in-line stabilization of the cervical spine.
- Provide supportive care for linear fractures.

Traumatic Brain Injury

- Classified into:
  - Primary brain injury
    - Injury to the brain and its associated structures
  - Secondary brain injury
    - Consequence of primary injury

Traumatic Brain Injury

- Most common cause an MVC
- Coupe-contrecoup
  - Front-and-rear type of injury

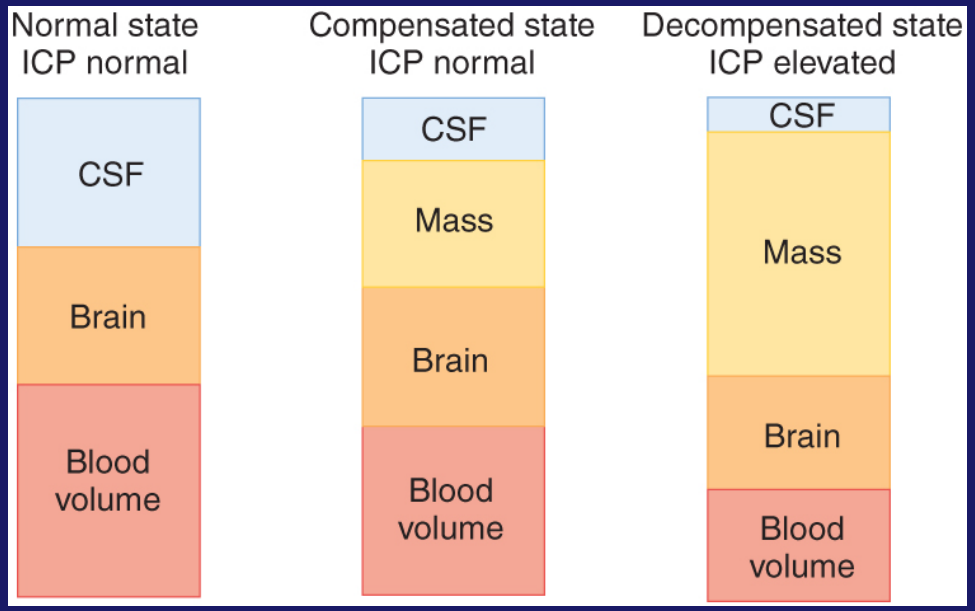


Intracranial Pressure

- An increase in ICP can be caused by:
  - Accumulation of blood within the skull
  - Swelling of the brain
- Increase in ICP decreases cerebral perfusion pressure (CPP) and blood flow.
  - CPP = MAP - ICP

Intracranial Pressure

- To combat increasing ICP, the body expels CSF and venous blood from the cranial vault.
- This keeps ICP within normal limits in the early stages.



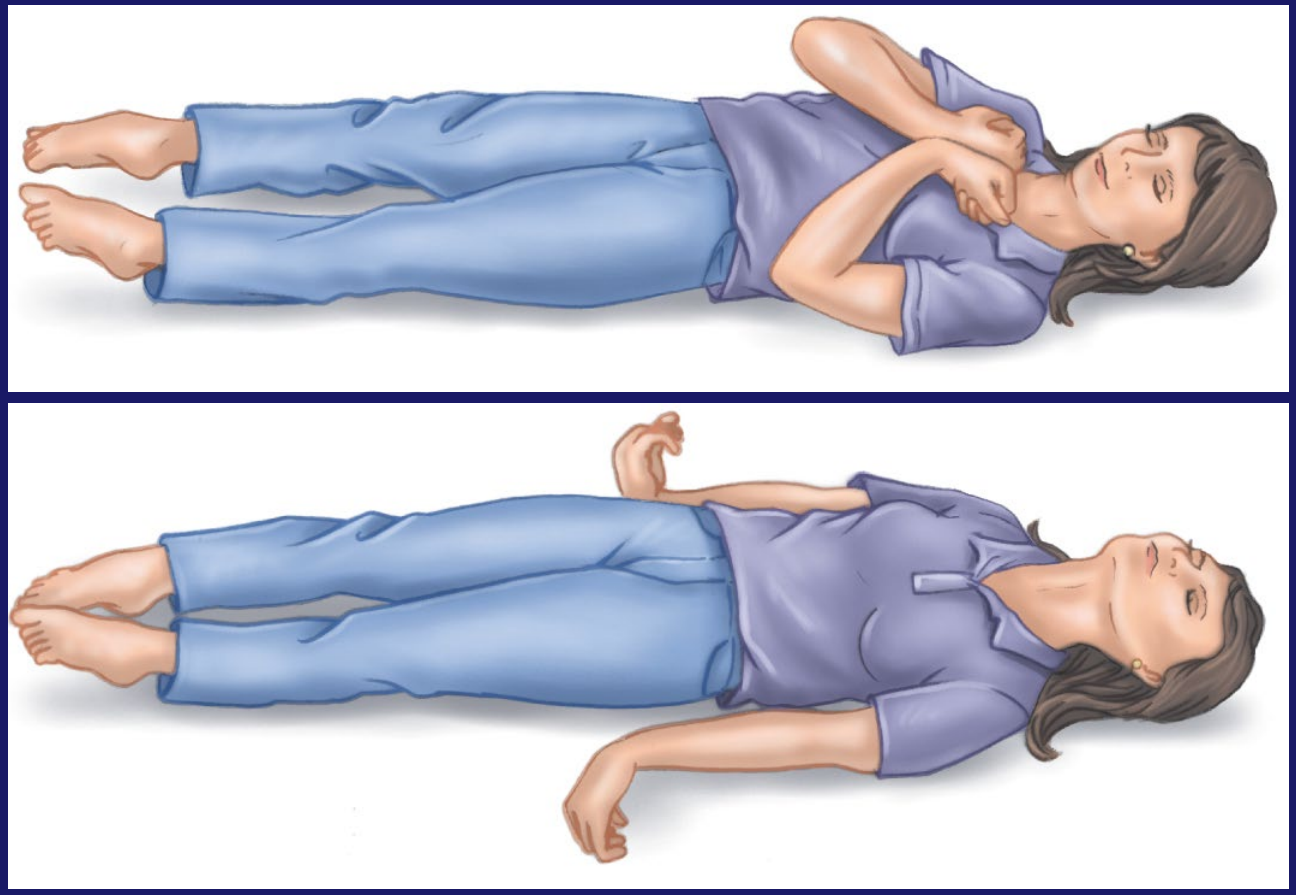
Herniation

- Uncal herniation syndrome
  - A portion of the temporal lobe (the uncus) is displaced laterally.
  - Signs include:
    - Ipsilateral pupil dilation
    - Contralateral motor dysfunction

Signs of ICP

- Early warning signs of ICP:
  - Vomiting
  - Headache
  - Altered level of consciousness
  - Seizures
- Ominous signs:
  - Hypertension
  - Widening pulse pressure
  - Bradycardia
  - Cushing triad
  - Nonreactive pupil
  - Coma
  - Posturing

Signs of ICP



Diffuse Brain Injuries

- Cerebral concussion
  - Brain is jarred around in the skull.
  - Signs include:
    - Headache
    - Confusion, disorientation
    - Loss of consciousness
    - Retrograde amnesia
    - Anterograde (posttraumatic) amnesia

Diffuse Brain Injuries

- Cerebral concussion (cont'd)
  - Assessment and management
    - Perform a primary survey.
    - Address any life-threatening conditions.
    - Evaluate for the presence of concussion.
    - The main treatment is physical and mental rest.

Diffuse Brain Injuries

- Second impact syndrome
  - Ask the patient about recent concussions.
  - Symptoms include:
    - Sudden loss of consciousness
    - Dilated pupils
    - Coma
    - Respiratory failure

Diffuse Brain Injuries

- Postconcussion syndrome
  - At least three of the following signs for 3 months following a concussion:
    - Headache
    - Dizziness
    - Insomnia
    - Memory difficulty
    - Intolerance of stress or emotion

Diffuse Brain Injuries

- Diffuse axonal injury
  - One of the most common diffuse brain injuries
  - Involves stretching, shearing, or tearing of nerve fibers and axonal damage
  - Classified as mild, moderate, or severe

Diffuse Brain Injuries

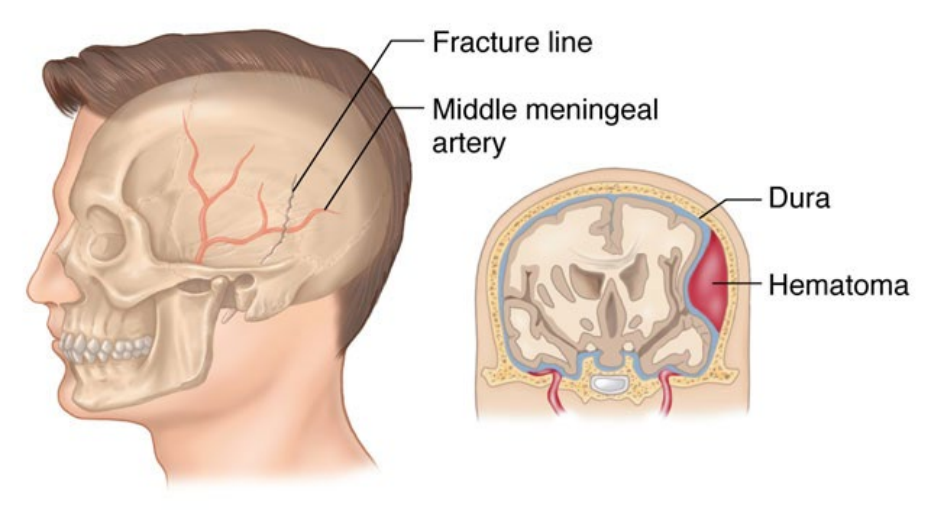
- Diffuse axonal injury (cont'd)
  - Assessment and management
    - The primary finding is unresponsiveness for more than 6 hours.
    - Treatment is primarily supportive.
    - Transport to the closest facility with in-house neurologists.

Focal Brain Injuries

- Cerebral contusion
  - Brain tissue is bruised and damaged in a local area.
  - Greater neurologic deficits are observed with cerebral contusion than with a concussion.
  - Swelling of the brain leads to increased ICP.

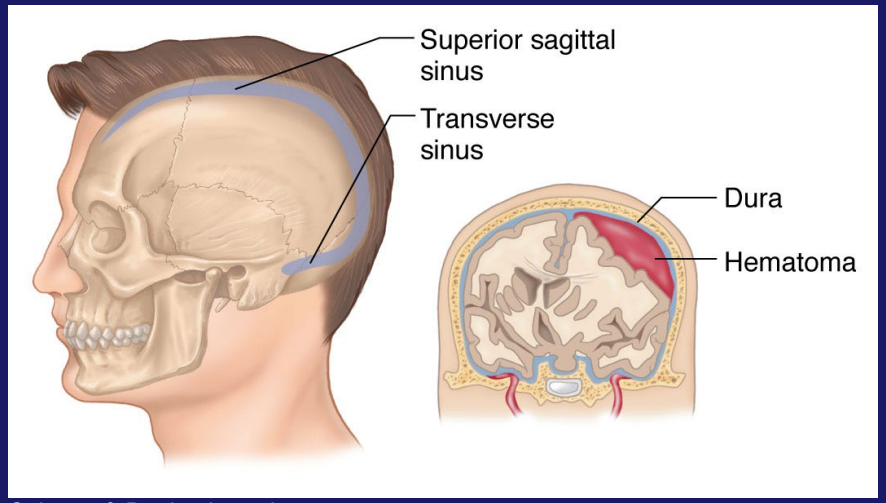
Focal Brain Injuries

- Intracranial hemorrhage
  - Epidural hematoma
    - Accumulation of blood between the skull and the dura mater
    - Results from a blow to the head



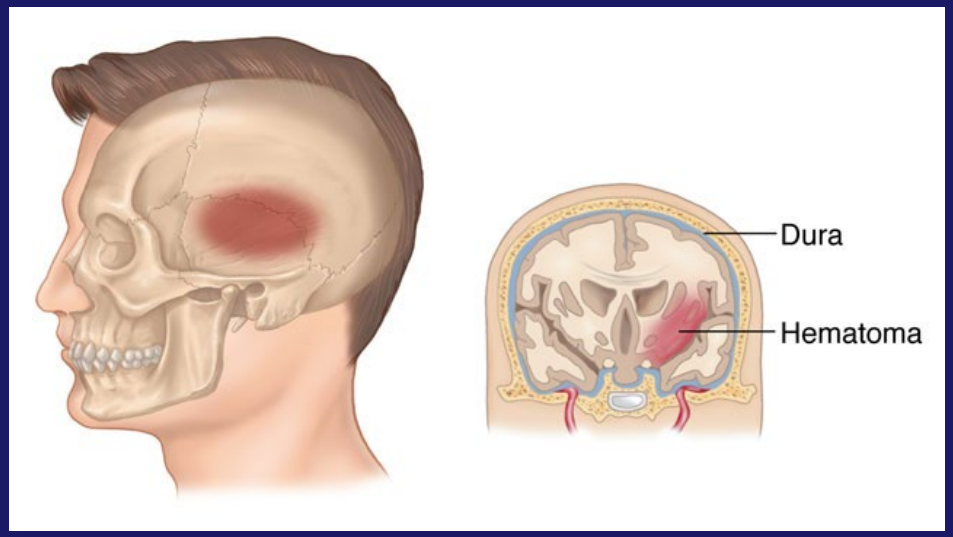
Focal Brain Injuries

- Intracranial hemorrhage (cont'd)
  - Subdural hematoma
    - Accumulation of blood beneath the dura mater outside the brain
    - Associated with venous bleeding
    - Acute, subacute, or chronic



Focal Brain Injuries

- Intracranial hemorrhage (cont'd)
  - Intracerebral hematoma
    - It refers to bleeding in the brain tissue.
    - The patient's condition deteriorates quickly.



Focal Brain Injuries

- Intracranial hemorrhage (cont'd)
  - Subarachnoid hemorrhage
    - Bleeding into the subarachnoid space.
    - The patient presents with a sudden, severe headache.

Focal Brain Injuries

- Intracranial hemorrhage (cont'd)
  - Subgaleal hemorrhage
    - Bleeding between the periosteum and galea aponeurosis
  - Supragaleal hemorrhage
    - Firm, nodular mass: "goose egg"

Assessment and Management

- Should be guided by factors such as:
  - Severity of injury
  - Patient's level of consciousness

Assessment and Management

- Thermal management
  - Do not allow the patient to develop hyperpyrexia.
- Pharmacologic therapy
  - Usually not indicated for brain-injured patients
  - May be ordered if transport will be prolonged
    - Mannitol (Osmitrol)
    - Furosemide (Lasix)

Assessment and Management

- Pharmacologic therapy (cont'd)
  - Benzodiazepines should be used for seizures.
  - No neuroprotective agents are currently administered in a prehospital setting.

Pathophysiology, Assessment, and Management of Spinal Injuries

- Spinal cord injury (SCI) has limited treatment options.
  - Reducing incidence is the best option for decreasing associated morbidity and mortality.

Flexion Injuries

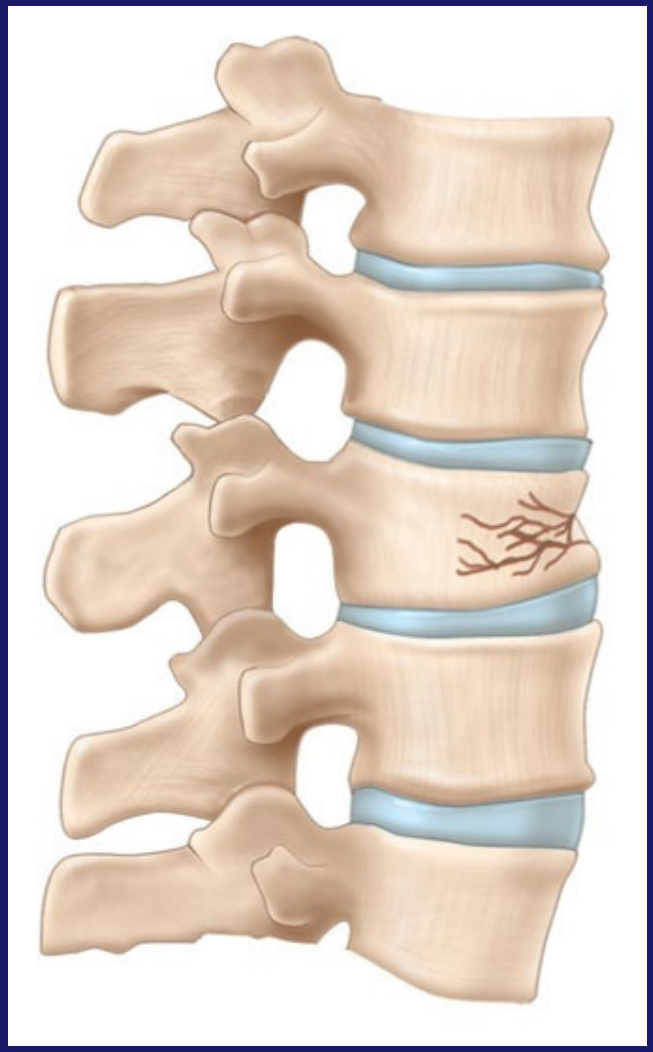
- Result from forward movement of the head
- Typically result of rapid deceleration or a direct blow to the occiput

Rotation With Flexion

- The only area of the spine that allows for rotation is C1 to C2.
- Injuries are considered unstable.

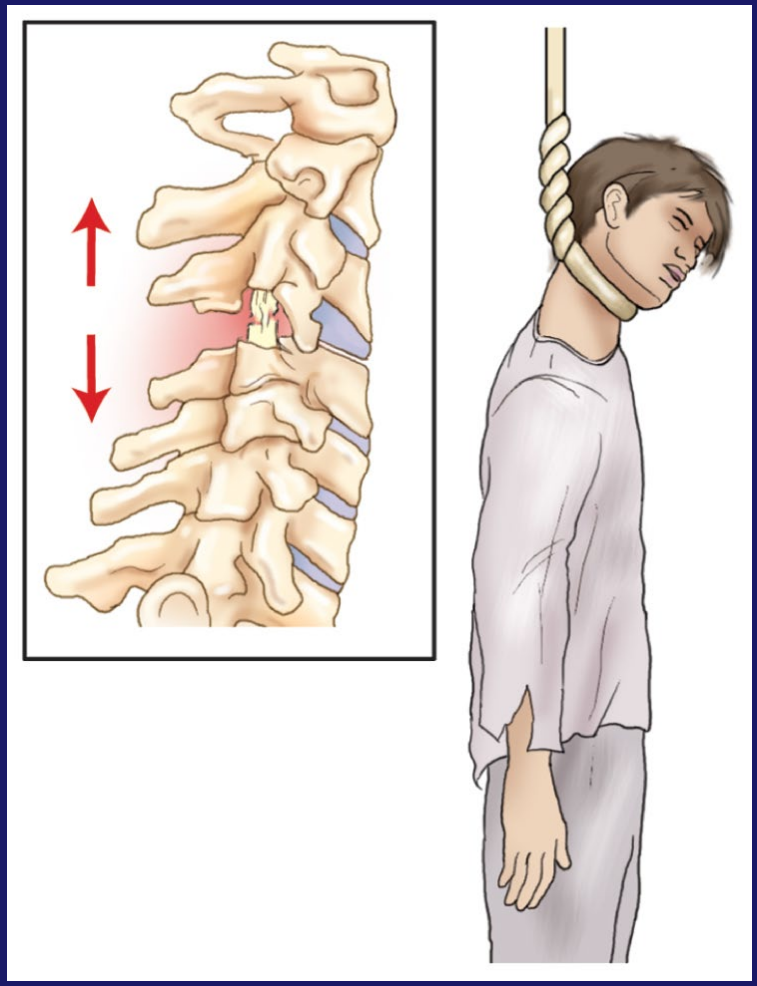
Vertical Compression

- Transmitted through vertical bodies
- Results from a direct blow to the crown or rapid deceleration from a fall



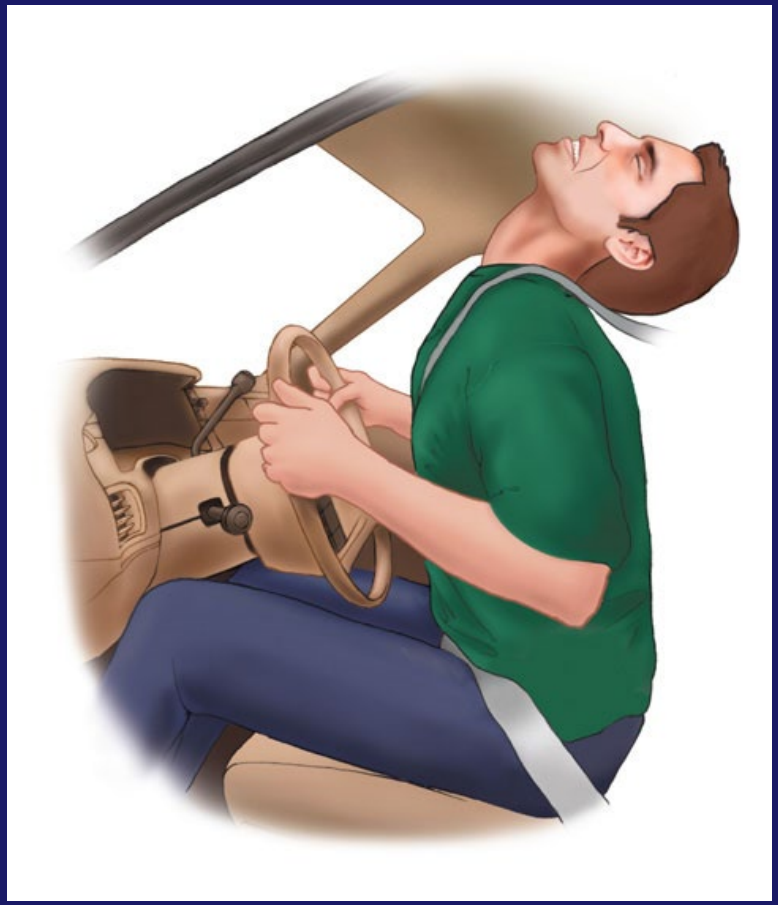
Distraction

- Opposite of compression forces
- Results when parts of the body are pulled in opposite directions



Hyperextension

- Results in fractures and ligamentous injury of variable stability



Primary Spinal Cord Injury

- Occurs at the moment of impact
- Spinal cord concussion
  - Temporary dysfunction that lasts 24 to 48 hours
  - May be due to a short-duration shock or pressure wave within the cord

Primary Spinal Cord Injury

- Spinal cord contusions
  - Caused by fracture, dislocation, or direct trauma
- Cord laceration
  - Caused when a projectile or bone enters the spinal canal

Secondary Spinal Cord Injury

- Occurs when multiple factors create a progression of the primary SCI.
- Minimize further injury through stabilization, neutral alignment, and spinal immobilization.

Secondary Spinal Cord Injury

- Anterior cord syndrome
  - Displacement of bony fragments into the anterior portion of the spinal cord
  - Paralysis below the level of insult
- Central cord syndrome
  - Hyperextension injuries to the cervical area
  - Loss of function in upper extremities

Secondary Spinal Cord Injury

- Posterior cord syndrome
  - Associated with extension injuries
  - Presents as decreased sensation to:
    - Light touch
    - Proprioception
    - Vibration

Secondary Spinal Cord Injury

- Cauda equina syndrome
  - Compression of a bundle of nerve roots
  - Can produce the following:
    - Low back pain
    - Myalgia, paresthesia, or myasthenia
    - Loss of sensation
    - Acute bladder/bowel dysfunction

Secondary Spinal Cord Injury

- Brown-Séquard syndrome
  - Functional hemisection of the cord; complete damage to spinal tracts on the involved side
- Spinal shock
  - Temporary local neurologic condition that occurs immediately after spinal trauma

Secondary Spinal Cord Injury

- Neurogenic shock
  - Results from temporary loss of autonomic function at the level of injury
  - Hemodynamic and systemic effects

The Evolution of Spinal Care

- Immobilization is one of the most common emergency medical services procedures.
- Debate continues on consequences of using cervical collars and backboards.

The Evolution of Spinal Care

- Potential negatives of using a backboard
  - Neurologic deficit due to hyperextension
  - Pain in the occipital, sacral, and lumbar areas
  - Ulcers and pressure sores
  - Increased risk of aspiration
  - Respiratory compromise
  - Increased ICP due to improperly fitted collars
  - Difficult airway management

The Evolution of Spinal Care

- Views on immobilization may be based on historical approaches to treatment, opinion, interpretation of data, or other factors.
- Follow your local protocols.

Assessment and Management

- Perform a primary survey including the ABCDEs.
- Form a treatment plan and perform appropriate treatments.

Assessment and Management

- During the disability phase, perform a:
  - Neurologic exam
  - Complete assessment of the spinal column for:
    - Deformity
    - Crepitus
    - Step-offs
    - Point tenderness

Assessment and Management

- Place a cervical collar, if indicated, and immobilize the patient.
- If protocols allow selective immobilization, and immobilization is not indicated, then release manual stabilization and continue the assessment based on the patient's condition.

Assessment and Management

- Spend no more than 10 minutes on the scene.
- Use a slower approach for patients who have spinal injury with no life threats.

Assessment and Management

- Do not ignore life threats to airway, breathing, and circulation by focusing on immobilization and packaging.

Assessment and Management

- Spinal splinting
  - Consider the spine one long bone.
  - Traditional spinal immobilization uses a:
    - Cervical collar
    - Cervical immobilization device
    - Long spine board

Manual Stabilization

- Grasp the patient's head firmly between your hands.
  - Extend the fingers and thumbs to avoid extension, flexion, lateral bending, or rotation of the head.

Manual Stabilization

- Do not force the head into a neutral, in-line position if the patient has:
  - Muscle spasms in the neck
  - Increased pain with movement
  - Numbness, tingling, or weakness
  - Compromised airway or ventilation

The Cervical Collar

- A rigid cervical collar should be measured and placed appropriately.
- Maintain manual stabilization until the patient is fully immobilized.

Spinal Splinting for Supine Patients

- A patient can be immobilized by securing him or her to a long backboard.
- Provide the greatest possible stabilization.
  - Try not to have voids between the patient's body and the backboard.

Spinal Splinting for Supine Patients

- Place premade blanket rolls on each side of the patient and between the legs.

Spinal Splinting for Supine Patients

- If you are using individual straps to secure the patient to the backboard, use at least five straps.

Spinal Splinting for Seated Patients

- The severity of the spinal and associated injuries will dictate your approach to the seated patient.
  - Place a cervical collar and manually stabilize the entire spine as you move the patient.

Spinal Splinting for Seated Patients

- Seated patients may have no indication for spinal immobilization.
  - Have the patient step out of the vehicle (or stand up) and sit on the stretcher.
  - If the patient is unable, a backboard can be used for extrication to transfer the patient to the stretcher.

Spinal Splinting Procedures for Rapid Extrication

- Use in the following situations:
  - Vehicle or scene is unsafe.
  - Patient cannot be assessed before being removed from the car.
  - Patient needs immediate intervention.
  - Patient's condition requires immediate transport.
  - Patient blocks access to another injured patient.

Spinal Splinting Procedures for Rapid Extrication

Packaging and Removal of Injured Patients From the Water

- Assume spinal injury for the following:
  - Diving injury
  - Boating injury
  - Watercraft injury
  - Falls from heights

Packaging and Removal of Injured Patients From the Water

Patients Wearing Helmets

- Helmets hinder efforts at airway management and spinal stabilization.
- The removal of helmets can result in spinal motion.
- Only providers familiar with the procedure should attempt removal.

Patients Wearing Helmets

Pharmacotherapy of Spinal Cord Injury

- Short-acting, reversible sedatives are commonly recommended for acute agitation.
- Pain medication may be necessary.
- Corticosteroids are sometimes used in the acute phase of SCI.

Complications of Spinal Cord Injury

- Potential for aspiration or respiratory arrest
- Predisposal to atelectasis and pneumonia
- Deep vein thrombosis and pulmonary embolism

Complications of Spinal Cord Injury

- Autonomic dysreflexia
  - Potentially life threatening
  - Most commonly occurs with injuries above T4 to T6
  - Patients present with a massive, uncompensated cardiovascular response.

Complications of Spinal Cord Injury

- Autonomic dysreflexia (cont'd)
  - Common causes include:
    - Skin lesions
    - Constrictive clothing
    - Sharp objects compressing the skin
  - Prehospital management focuses on supporting vital systems.

Nontraumatic Spinal Conditions

- Back pain is a common presenting complaint.
- Risks for developing low back pain include:
  - Occupations that require repetitive lifting
  - Exposure to vibrations
  - Comorbid diseases such as osteoporosis

Nontraumatic Spinal Conditions

- When evaluating:
  - Consider disease processes that can result in debilitating lesions.
  - Keep anatomy and neurophysiology in mind.
  - Pay attention to medications.

Nontraumatic Spinal Conditions

- Degenerative disk disease
  - Disk loses height and shock-absorbing effect.
  - Disk herniation may occur.
- Prehospital management: decreasing pain or discomfort

Nontraumatic Spinal Conditions

- Spinal stenosis
  - A narrowing of the spinal canal that causes compression of exiting nerve roots.
  - Pain radiates from the back into the legs.
    - Aggravated by prolonged standing and extension
    - Relieved by rest and spinal flexion

Injury Prevention

- Prevention includes safety measures that can decrease risk of injury.
  - Driving safely
  - Adhering to posted safety alerts