



HEAD, NECK AND FACIAL TRAUMA

DND Primary Care Paramedicine

Module: 05

Section: 10

- Introduction
- Pathophysiology
- Assessment
- Management

- Common with major trauma
- 170 000 Canadians incur a brain injury annually (465/day)
- 34 000 people admitted to hospital each year with brain injuries in Canada
- 11 000 die each year
- Leading cause of death and disability under 44 years old.

Source: Brain Injury Association of NS

- Males 15 - 24
- Infants
- Young children
- Elderly
- Education initiatives have resulted in a great reduction in incidence

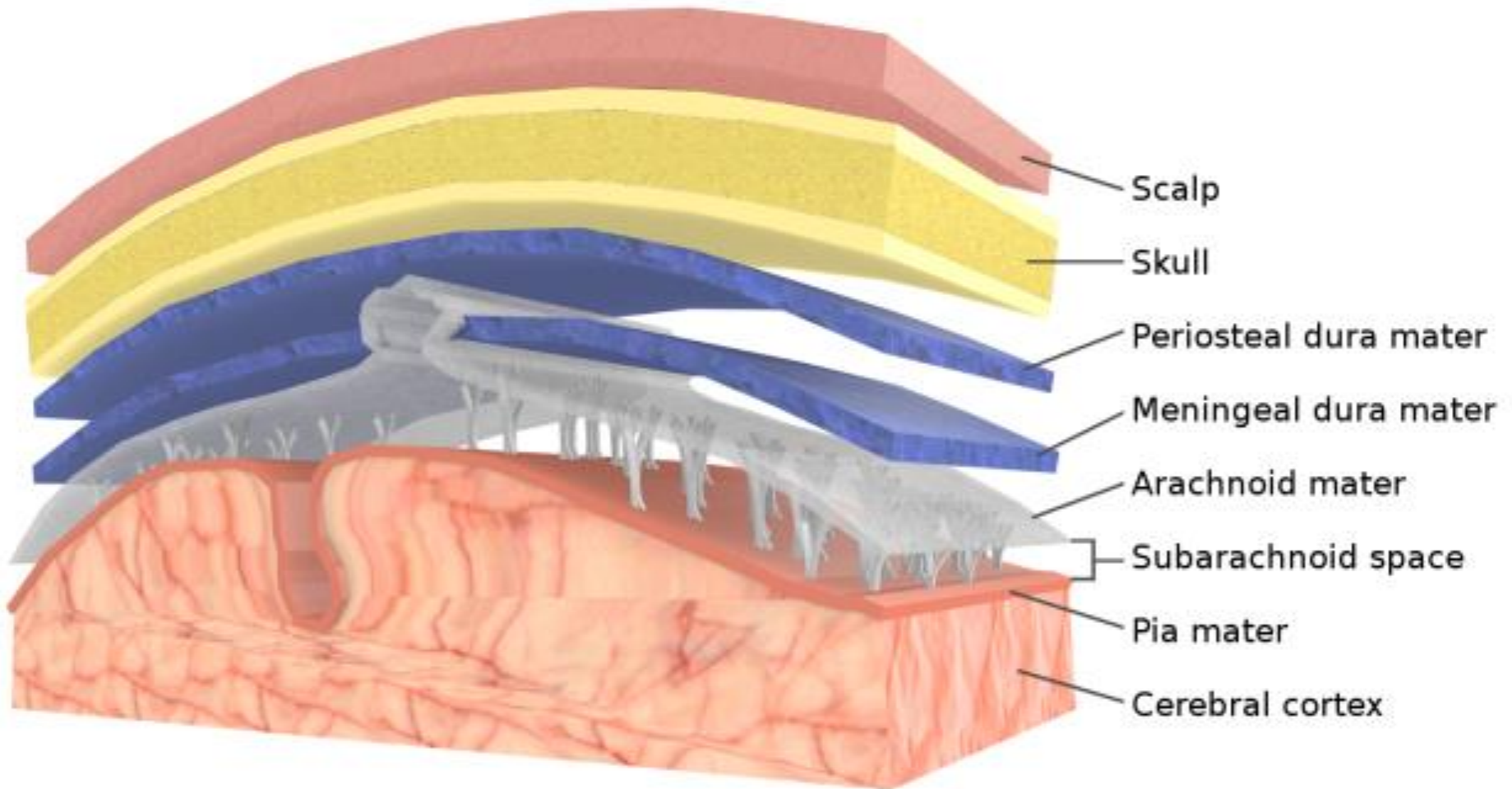
- Time becomes the critical consideration once an injury occurs
- Intracranial hemorrhage and progressing edema
 - Advancing intracranial pressure (ICP)
 - Increasing hypoxia
 - Permanent damage
- Severity is difficult to recognize
 - Subtle signs
 - Improve differential diagnosis/anticipate problems

- Risk Factors:
 - Alcohol intake
 - Substance intake
 - Anticoagulants
 - Not using/incorrect wearing of safety restraints
 - Not wearing a helmet
 - Not using proper safety equipment

- Causes of Head Injuries:
 - Motor vehicle collisions
 - Falls
 - Assaults
 - Sports
 - Fire arms

- Blunt Injury
 - Motor vehicle collisions
 - Assaults
 - Falls
- Penetrating Injury
 - Gunshot wounds
 - Stabbing
 - Explosions (shrapnel)
 - Pointy objects

Protective Layers



Open Head Injuries



- By itself tends to be a minor injury
 - May be the only overt indication of a more serious injury
- Scalp overlies the firm cranium and is very vascular
 - Tend to bleed heavily
 - Route for infection
 - May produce shock, especially in kids

- Often difficult to assess
 - Contusion often expands outward
- If no skull fracture present apply direct pressure and dressing
- If skull fracture is present, apply dressing but **NO** direct pressure
- Scalp Avulsion
 - Cover the open wound with bulky dressing
 - Pad under the fold of the scalp
 - Irrigate with NS to remove gross contamination

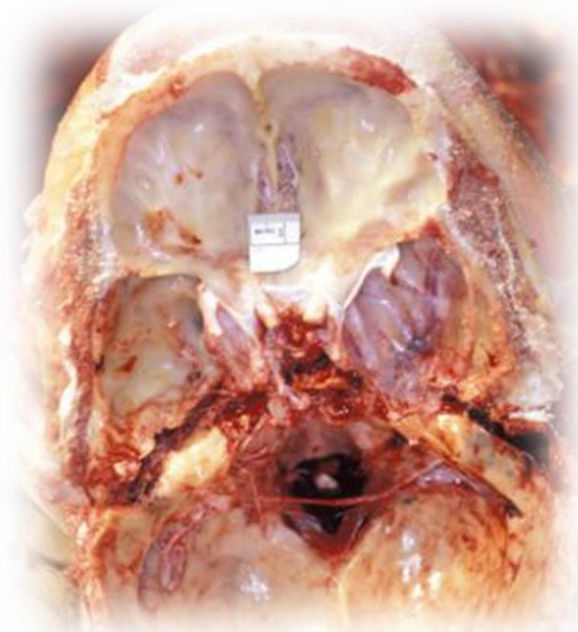


- Cranial injury is a skeletal injury that will heal
- Forces required to fracture the skull are extreme
 - Likely to cause injury within
 - Often sufficient to induce brain injury

- Forces must be severe to fracture the skull



Linear

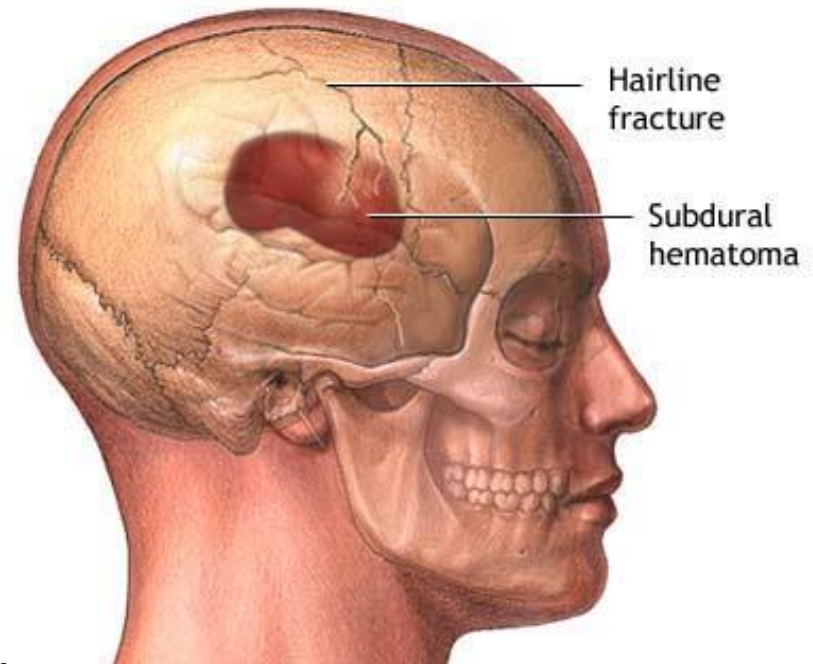


Basilar

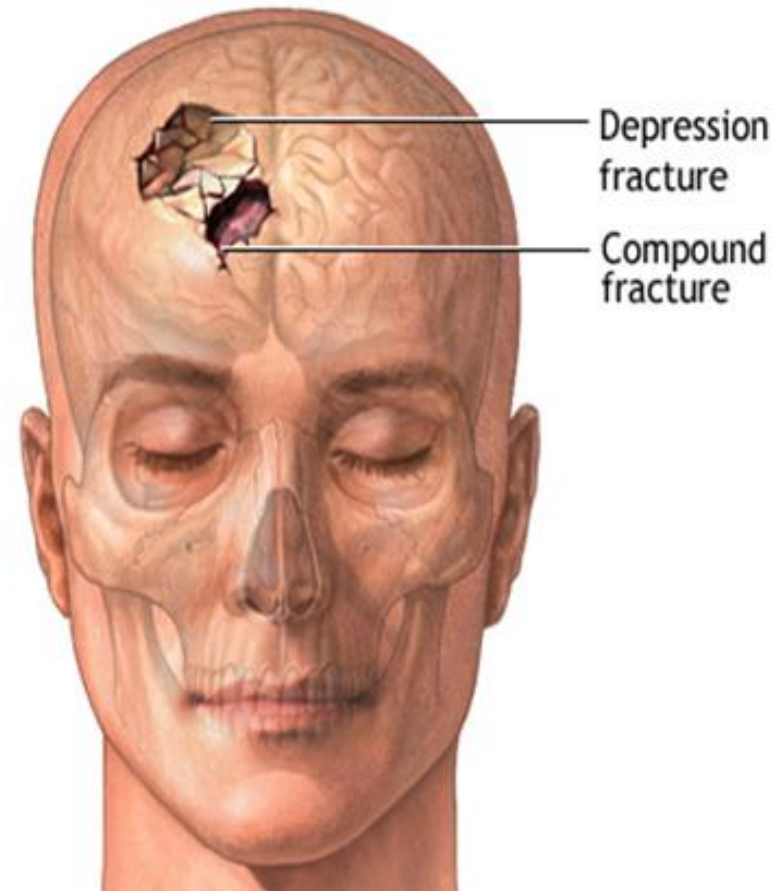


Depressed

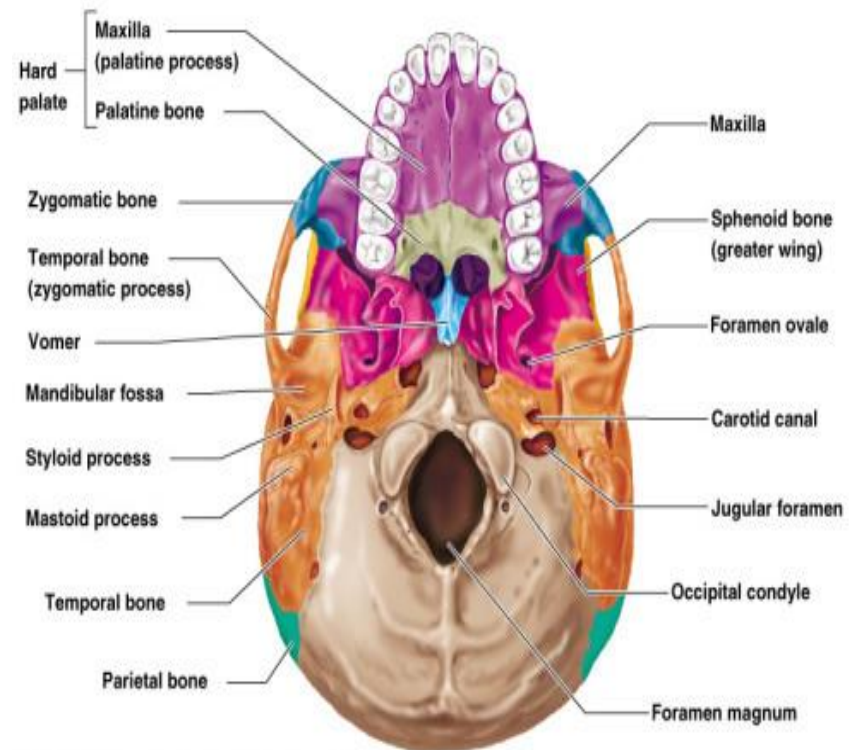
- Most common (80%)
- Small cracks in the cranium
- Bone is non-displaced
- Usually occurs to temporal bone (thinnest)
- If there are no intracranial injuries, poses very little danger to patient



- Inward displacement of skull's surface
- Greater likelihood of intracranial damage
- Comminuted fracture
 - Multiple skull fragments
 - May penetrate meninges and underlying structures

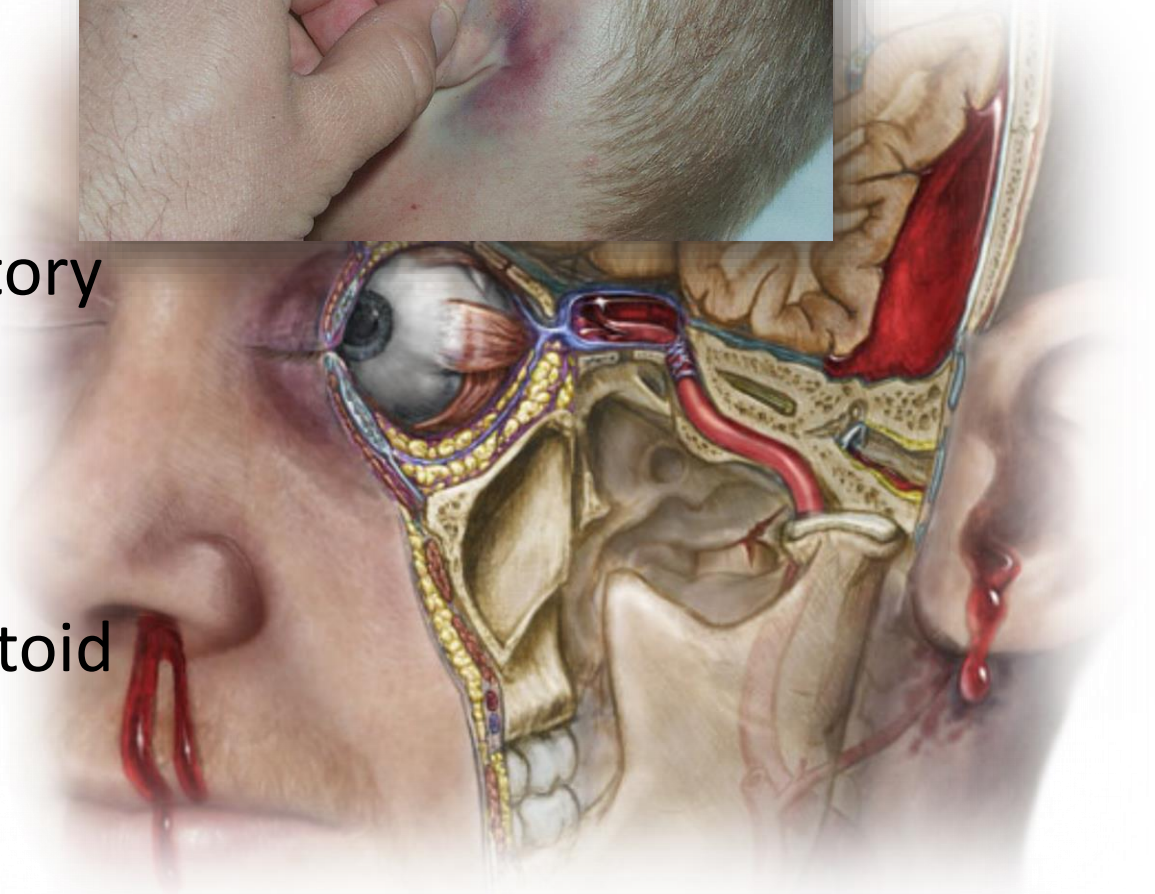


- Structure of the basilar skull
 - Permeated with foramina (openings)
 - Several hollow or open structures
 - Weaker and very prone to fracture
- Associated with
 - Brain injury
 - Dura laceration
 - Cranial nerve damage

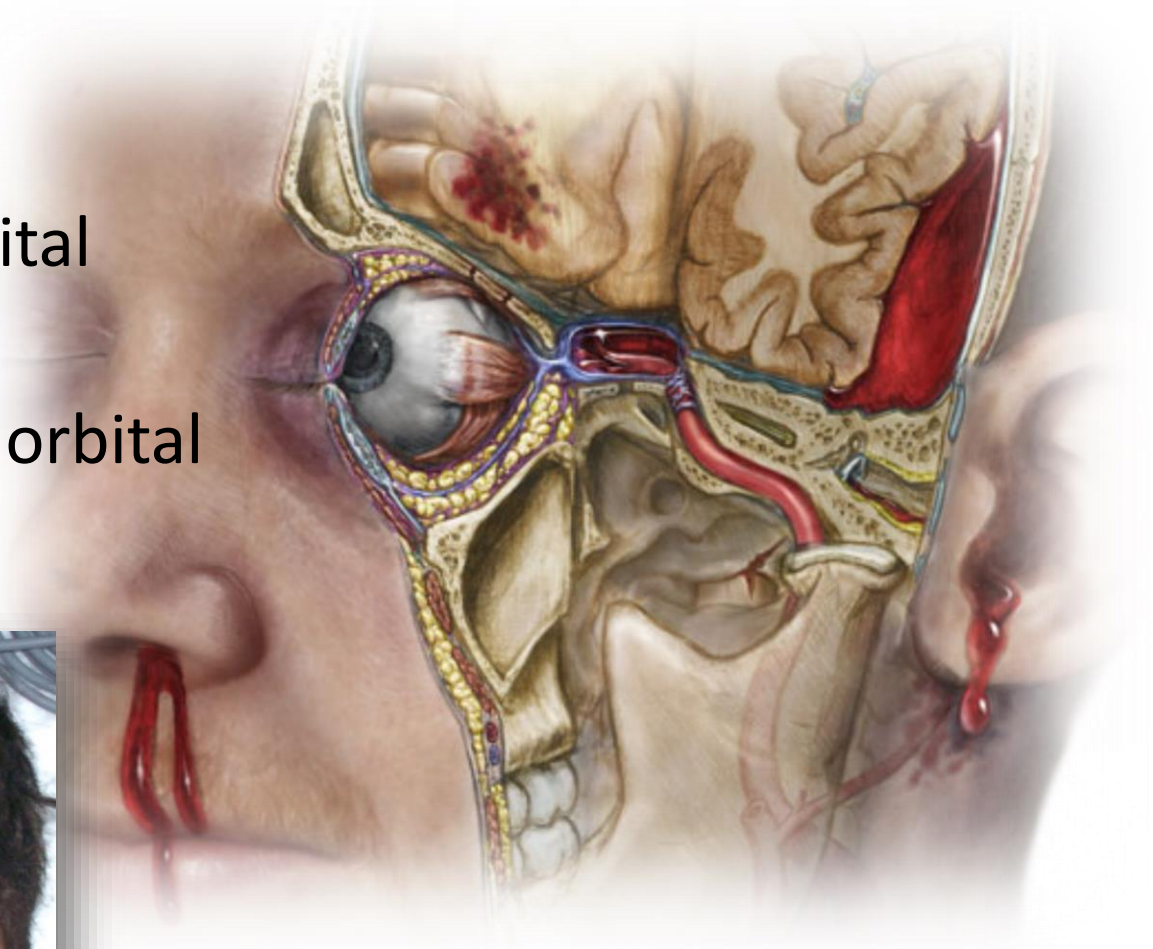


- Presentation varies with location of injury
- Associated signs:
 - Battle's signs
 - Raccoon eyes
 - Halo sign
- May take time to develop and may not be seen prehospital

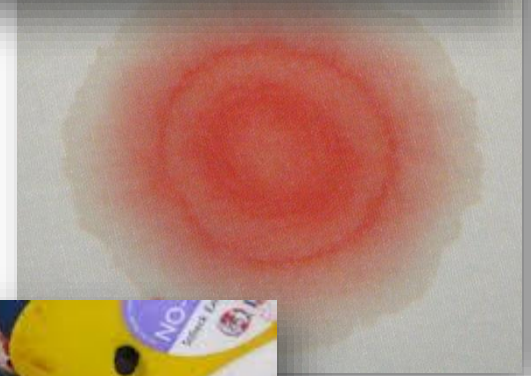
- Battle's Signs
 - Retroauricular Ecchymosis
 - Associated with fracture of auditory canal and lower areas of skull
 - Hemorrhage migrates to mastoid region



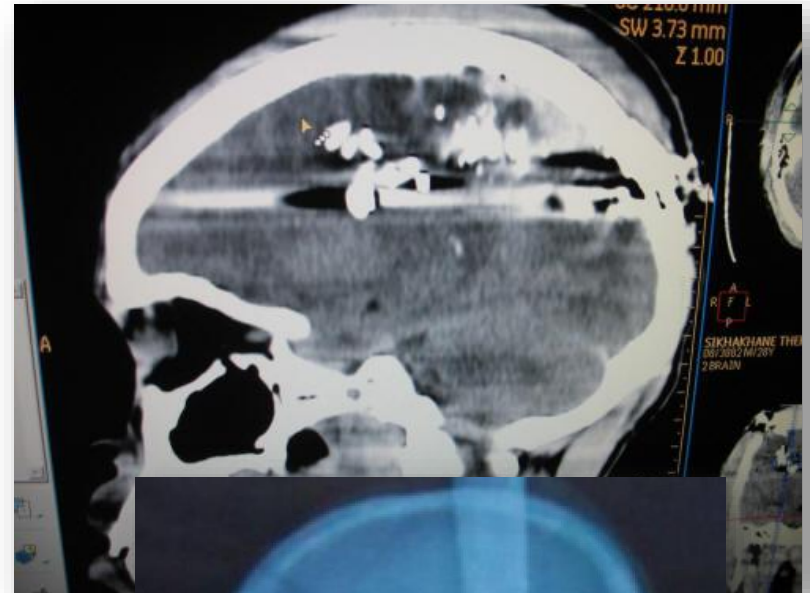
- Raccoon Eyes
 - Bilateral Periorbital Ecchymosis
 - Associated with orbital fractures



- A tear dura mater
 - Open wound between brain and body's exterior
- Permits CSF to seep out
 - Provides possible route for infection
 - May also provide escape for CSF, limiting ICP
- Produces Halo sign
 - Blood mixed with CSF from nose, mouth or ears
 - Target sign on sheet or 4x4



- Bullet impacts
 - Entry wound creates comminuted fracture
 - May create another fracture on exit
 - Bullet's path creates a large cavitation wave
- Impaled objects
 - Further motion may cause significant/devastating injury
 - Brain tissue does not immobilize objects as well as other tissues (objects move more)



- “A traumatic insult to the brain capable of producing physical, intellectual, emotional, social and vocational changes.”

(National Head Injury Foundation definition)



- Caused by:
 - Rapid acceleration/deceleration or collision
 - Blunt/penetrating forces
- Direct or indirect injury to tissue of the cerebrum, cerebellum or brainstem

- Brain is very perfusion sensitive
 - Rapid and devastating effects when compromised
- Cranial volume is fixed
 - Brain = 80%
 - Blood vessels and blood = 12%
 - CSF = 8%
- Increase in size of one component must be matched by a reduction in another

- Delivery of oxygen and nutrients to the brain is dependent on adequate cerebral perfusion pressure and autoregulatory mechanisms in the brain
- Any alterations in any of these systems can damage the brain

- CPP needs to be maintained > 60mmHg to allow for adequate cerebral perfusion
- Increasing the blood pressure with medications may be necessary to increase the CPP

$$CPP = MAP - ICP$$

Cerebral Perfusion Pressure = Mean Arterial Pressure – Intracranial Pressure

- As a mass expands within the cranium
 - Compensation via compression of venous blood vessels and reduces CSF
 - Responds quickly to maintain ICP close to normal
- As compensatory mechanisms reach their limits
 - Rise in systemic BP in attempt to ensure adequate perfusion (autoregulation)
 - Increasing ICP

- As CO₂ levels rise in CSF:
 - Cerebral arteries dilate
 - Encourage blood flow
 - Reduce hypercarbia
- In the presence of already high ICP
 - Devastating results
 - Causes classic hyperventilation and hypertension
- Reduced levels of CO₂ in CSF
 - Cerebral vasoconstriction
 - Results in cerebral anoxia

- Hypotension
 - Contributes to poor cerebral perfusion
 - Especially with pre-existing ICP
 - Further neural injury due to hypoxia and metabolic acids
- Poor ventilation
 - Increases severity of head injury
 - Cellular hypoxia

- Intracranial Pressure is comprised of three volumes within the skull – brain, cerebrospinal fluid and blood volume
- Body can compensate for loss of blood volume and low blood pressure for a short time before the ICP will increase
- Normal ICP is 10
- ICP above 20 is concerning

- Vasculature constriction
- Cerebral edema
- Systolic blood pressure
 - Low BP = Poor cerebral perfusion
 - High BP = Increased ICP
- Carbon dioxide
- Reduced respiratory efficiency

- Early Signs
 - Headache
 - Nausea and vomiting
 - Altered level of consciousness
 - Restlessness
 - Lethargy
 - Amnesia
 - Confusion

- Late Signs
 - Changes in pupil response
 - Unresponsive to verbal or tactile stimuli
 - Posturing
 - Changes in respiratory pattern
 - Cushing's response (very late sign)
 - Increased SBP with wide pulse pressure
 - Bradycardia
 - Decreased respiratory effort

Intracranial Pressure

Pulse

- Pulse Decreases

Bradycardia

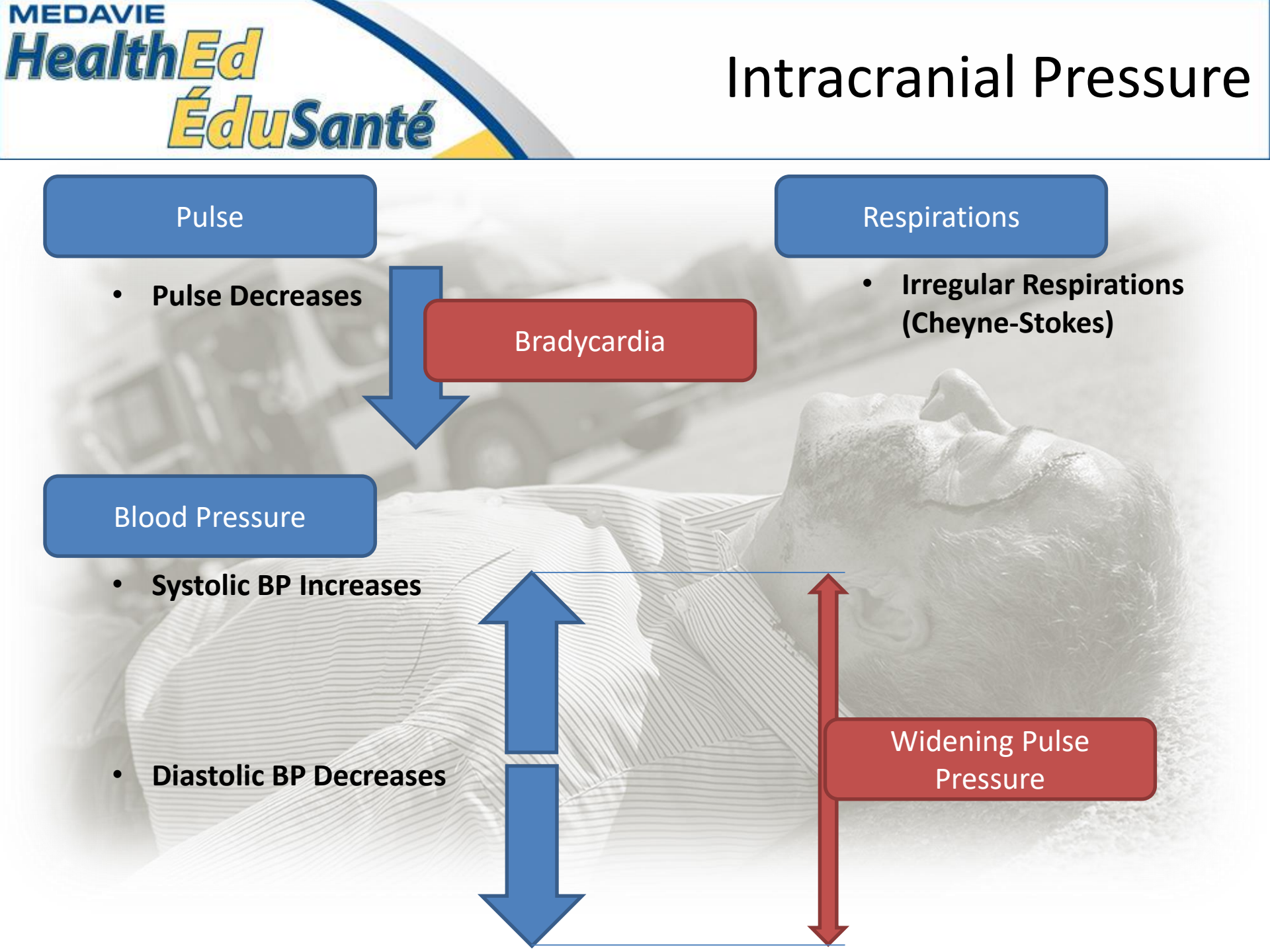
Respirations

- Irregular Respirations (Cheyne-Stokes)

Blood Pressure

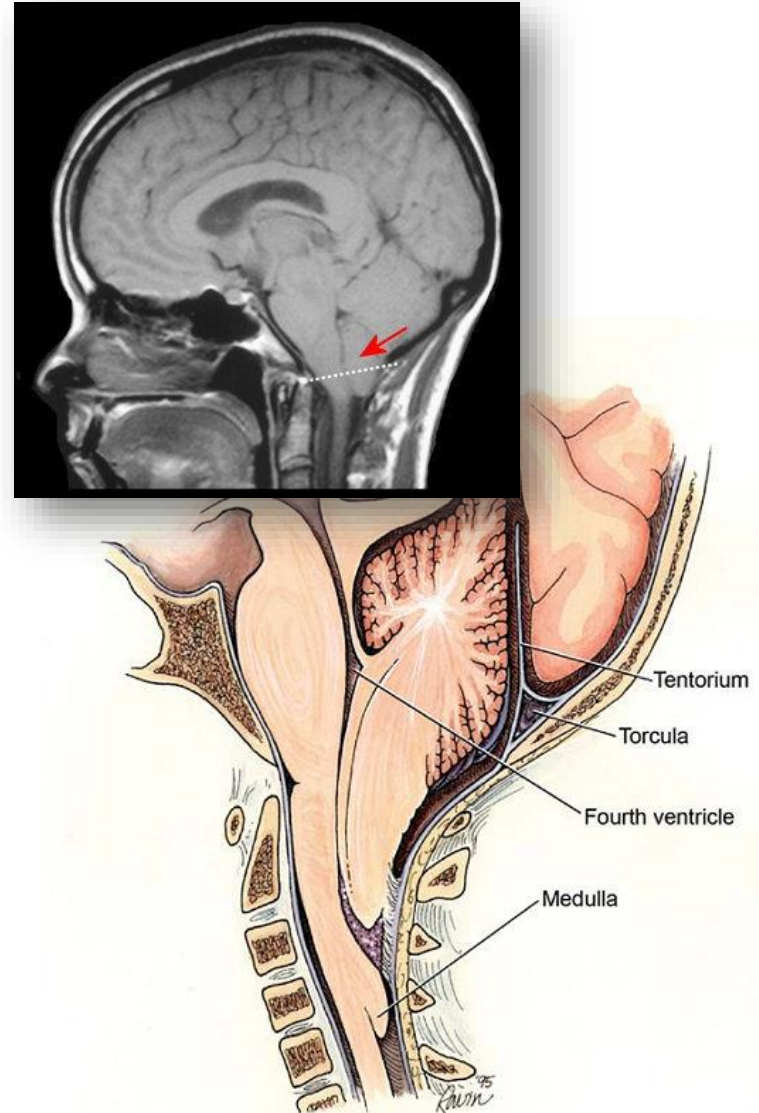
- Systolic BP Increases
- Diastolic BP Decreases

Widening Pulse Pressure



- As hemorrhage accumulates
 - Expansion pushes uninjured tissue away from injury site
 - Pressure on adjacent brain cells, especially brain stem
 - May push brain against falx cerebri and tentorium cerebelli

- Herniation
 - Portion of brain structure pushed through opening (foramen magnum)
 - Pressure on upper brainstem
 - Vomiting, decreased LOC, pupil dilation
 - Pressure on medulla oblongata
 - Disturbances in respirations, blood pressure and heart rate

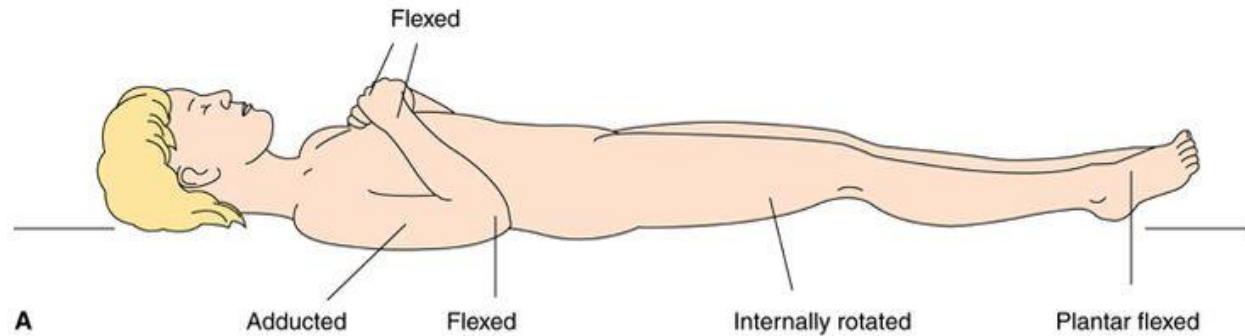


- Altered level of consciousness
- Altered level of orientation
- Alterations in personality
- Amnesia
 - Retrograde
 - Anterograde

- Cushing's reflex (aka Cushing's Triad)
 - Increasing blood pressure
 - Slowing pulse rate
 - Erratic respirations
- Vomiting
 - Without nausea, possibly projectile
- Body temperature changes
- Changes in breathing pattern
- Changes in reactivity of pupils
- Decorticate posturing

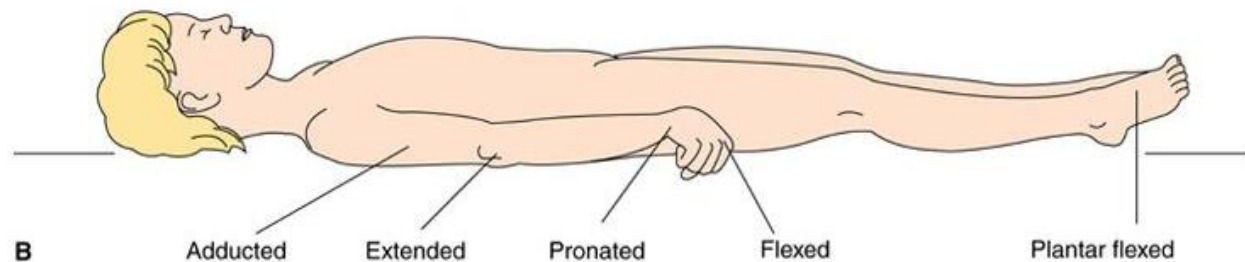
Decorticate

- Problem within cervical spinal tract or cerebral hemisphere



Decerebrate

- Problem within mid brain or pons



Both dilated (Mydriasis)



- Nonreactive: brainstem
- Reactive: often reversible

Eyelid Closure



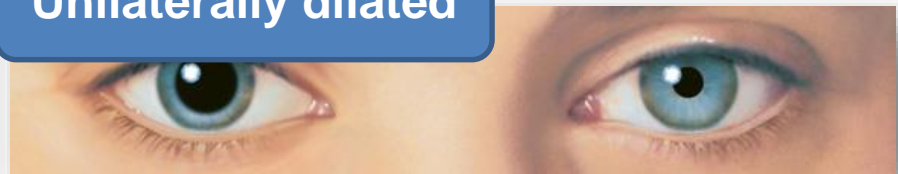
- Slow: cranial nerve III
- Fluttering: often hysteria

Unequal Pupils (Anisocoria)



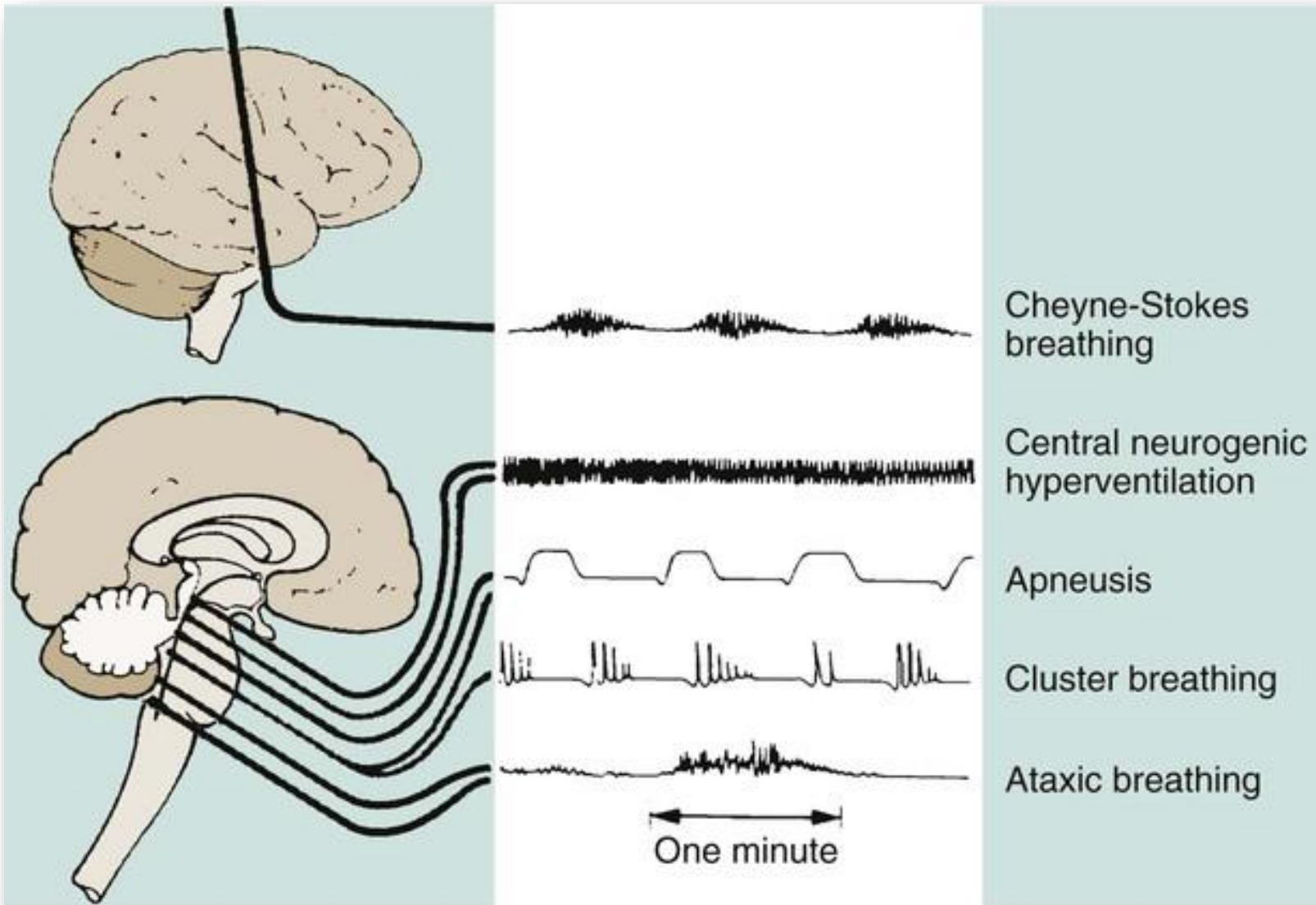
- Naturally occurs in 20% of population
- Cranial nerve III injury
- > 1mm (or more) difference

Unilaterally dilated



- Reactive: ICP increasing
- Nonreactive (altered LOC): increased ICP
- Nonreactive (normal LOC): not from head injury

Breathing Patterns



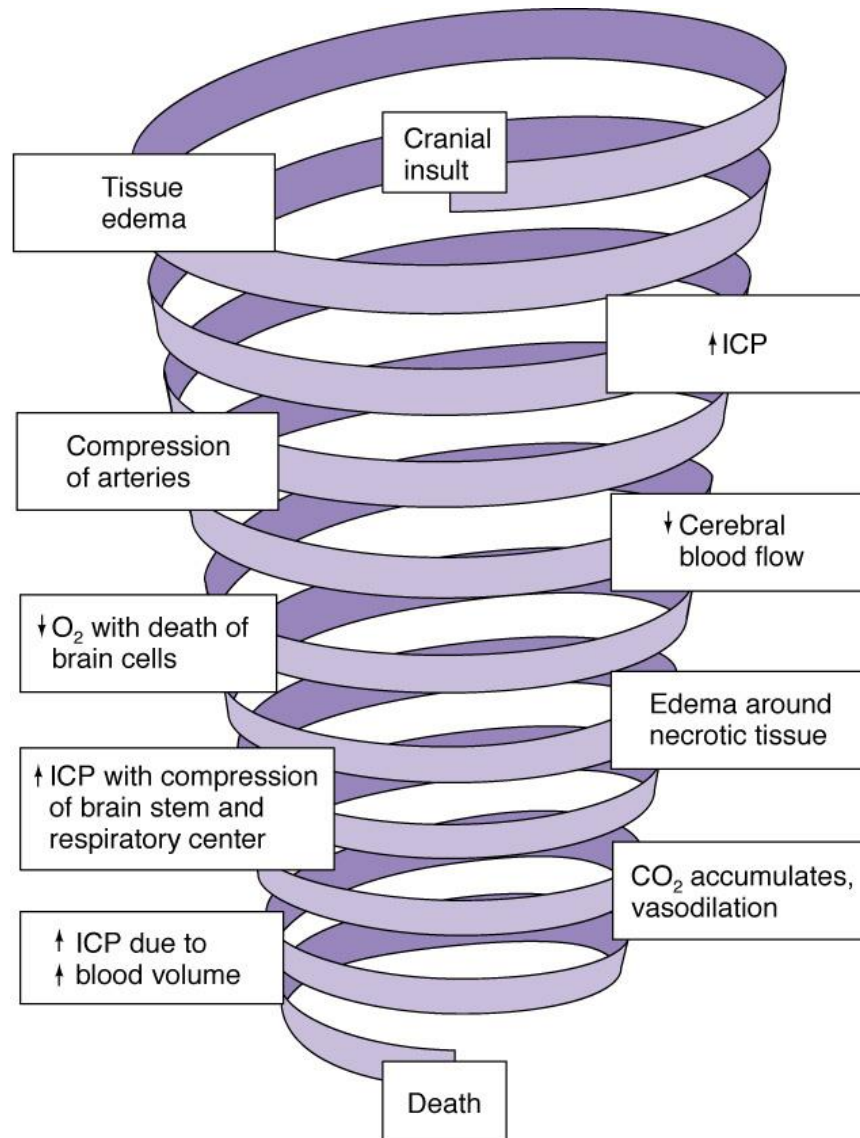
- As a portion of the cerebral cortex is impaired
 - The activity it controls is affected
- Frontal lobe injury
 - Alterations in personality
- Occipital lobe injury
 - Visual disturbances

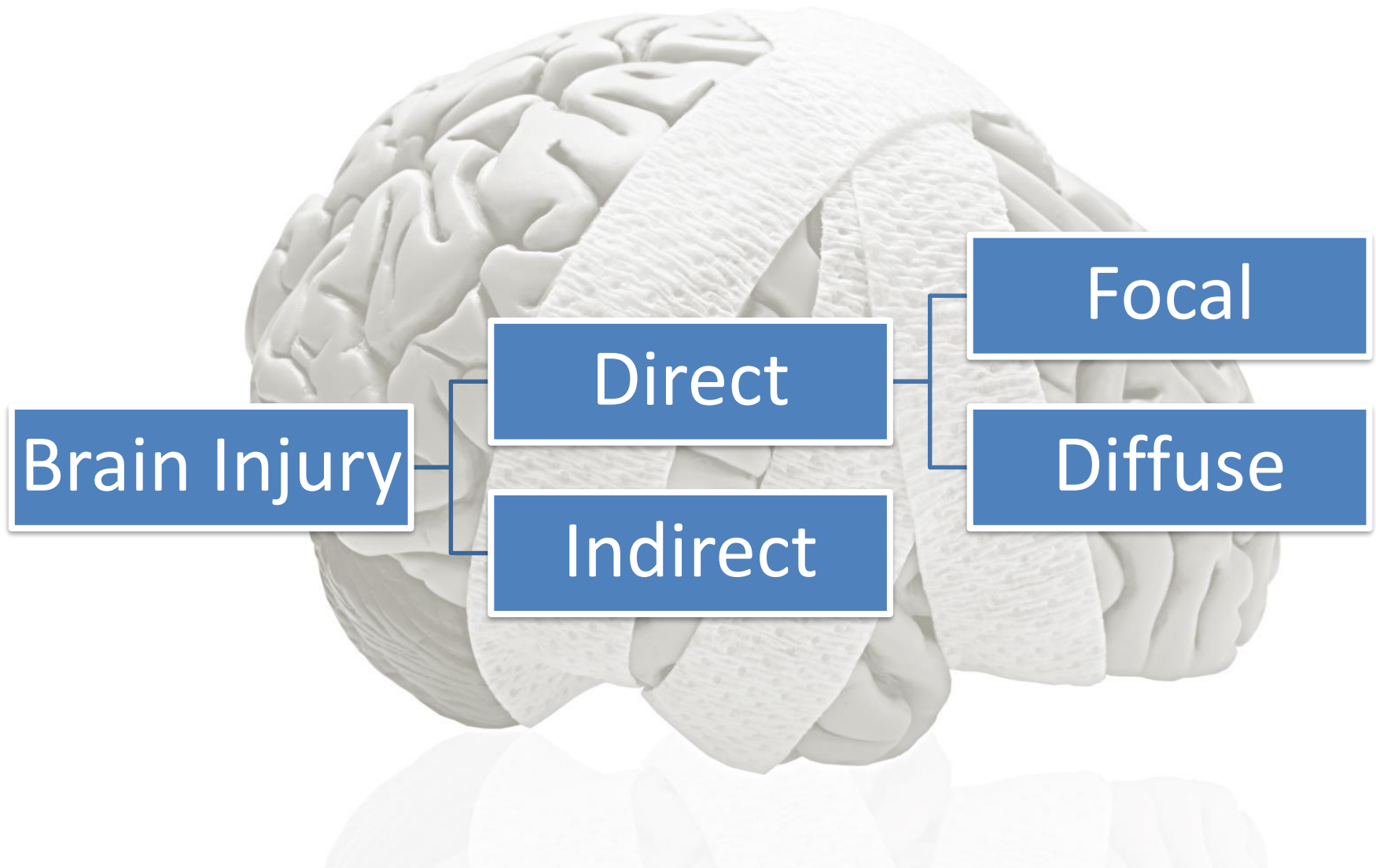
- Large scale cortical disruption
 - Reduce mental status or amnesia
 - Retrograde
 - Unable to recall events before injury
 - Antegrade
 - Unable to recall events after trauma
 - Repetitive questioning
- Focal Deficits
 - Hemiplegia, weakness or seizures

- Increasing blood pressure
- Reflex bradycardia
 - Vagus nerve stimulation
- Cheyne-stokes respirations
- Pupils become small and reactive
- Decorticate posturing
 - Neural pathway disruption

- Widening pulse pressure
- Increasing bradycardia
- CNS hyperventilation
 - Deep and rapid
- Bilateral pupil sluggishness or inactivity
- Decerebrate posturing

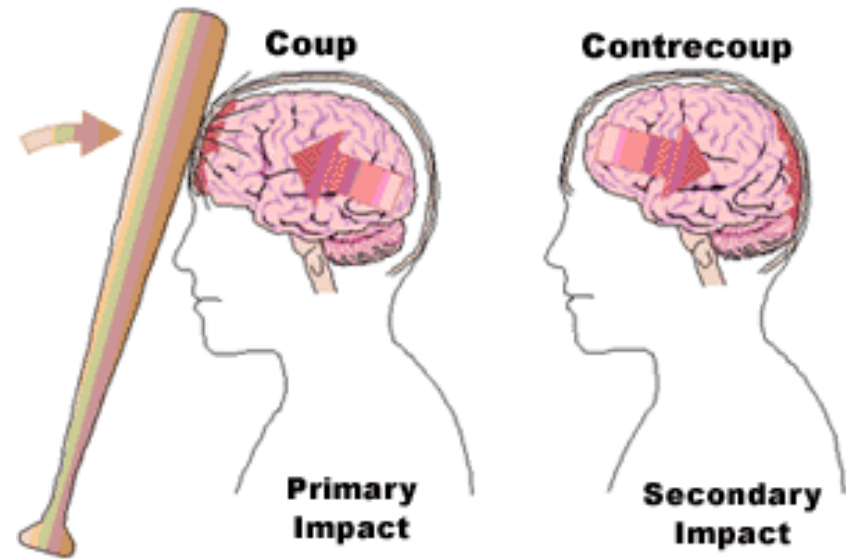
- Pupils dilated and unreactive
- Ataxic respirations
 - Erratic with no pattern
- Irregular and erratic pulse rate
- ECG Changes
- Hypotension
- Loss of response to painful stimuli





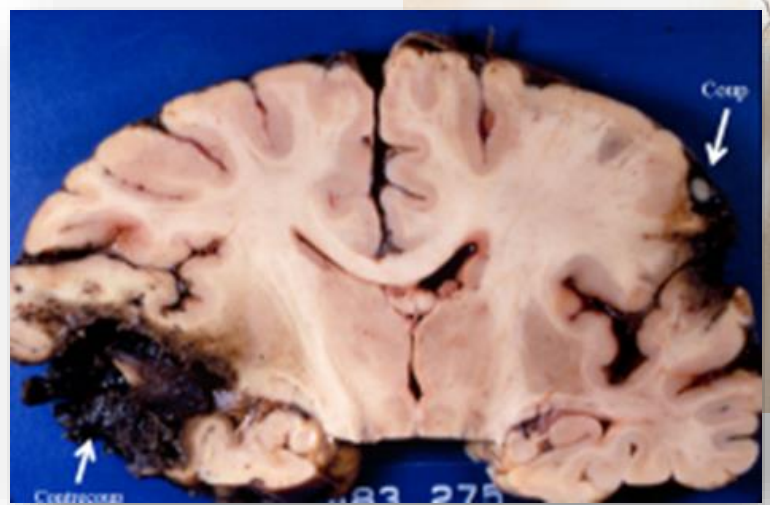
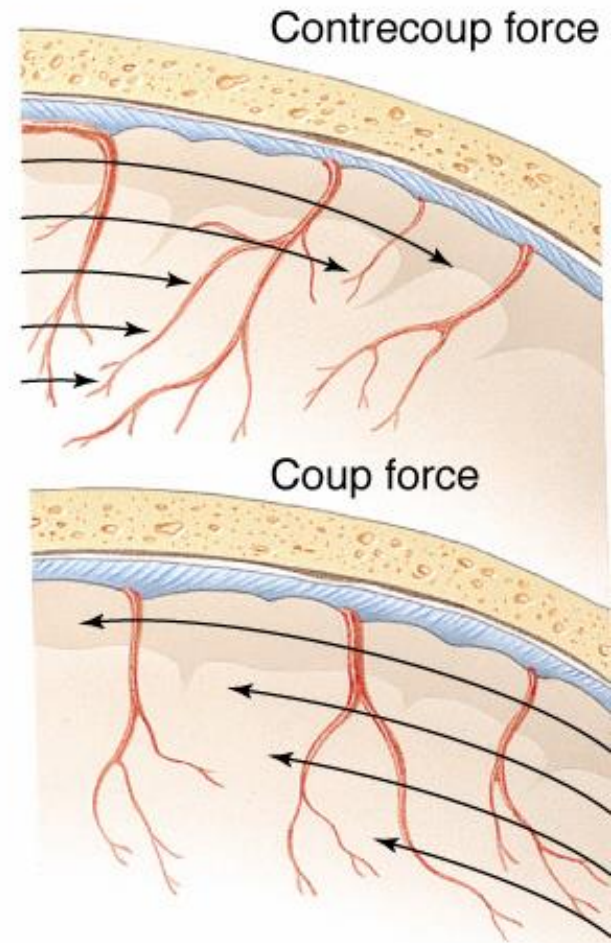
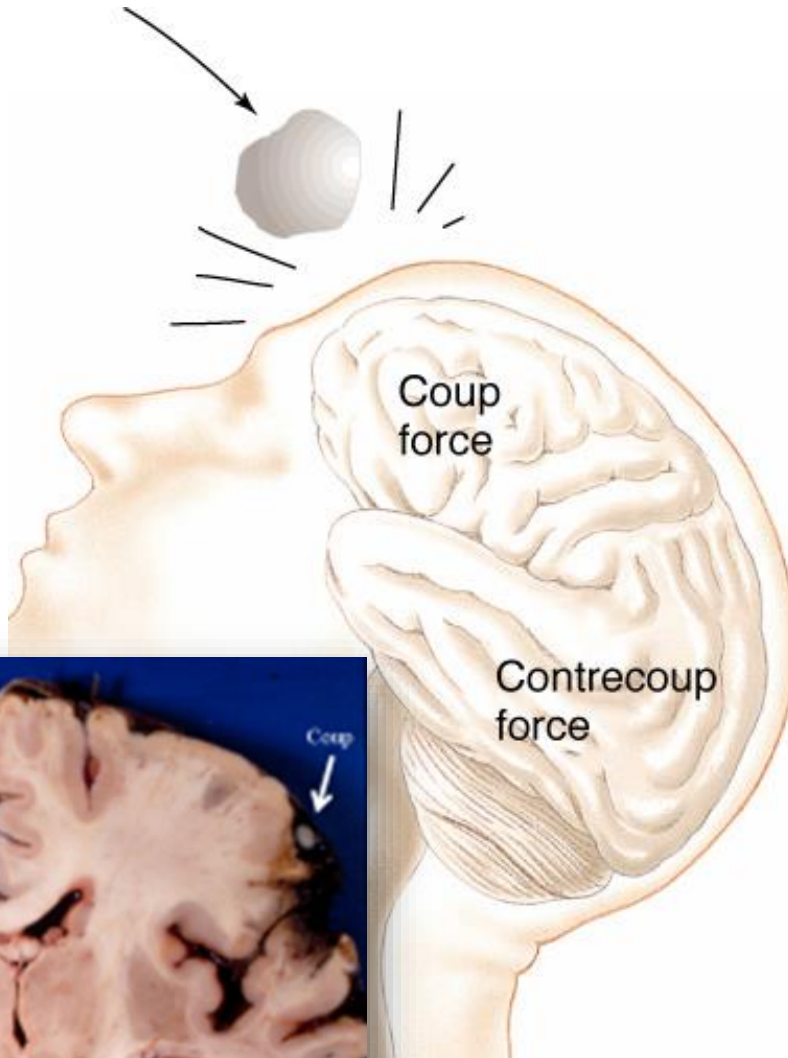
- Caused by the forces of trauma
- Focal:
 - Cerebral contusion
 - Intracranial hemorrhage
 - Epidural hematoma
 - Subdural hematoma
 - Intracerebral hemorrhage
- Diffuse:
 - Mild to moderate diffuse axonal injury (concussion)
 - Moderate diffuse axonal injury
 - Severe diffuse axonal injury

- Coup injuries
 - Injury at the site of the impact
 - Injuries inflicted as brain displaces towards the impact surface

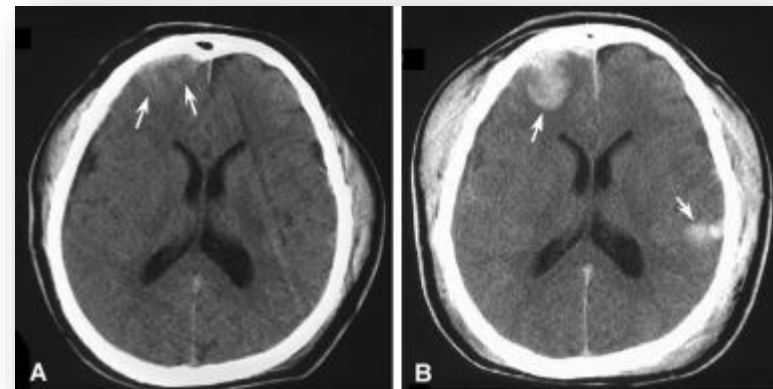
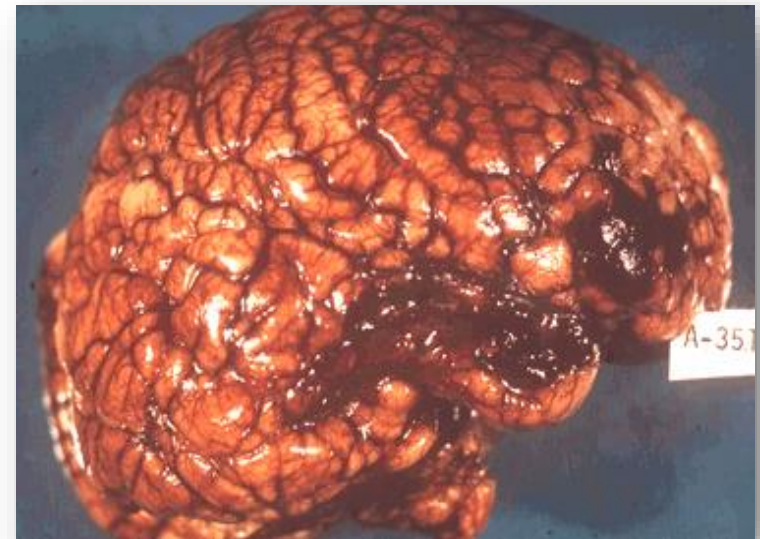


- Contrecoup injuries
 - Produce tissue damage away from the impact point
 - Brain sloshes toward then away from impact point

Coup and Contrecoup Movement of the Brain

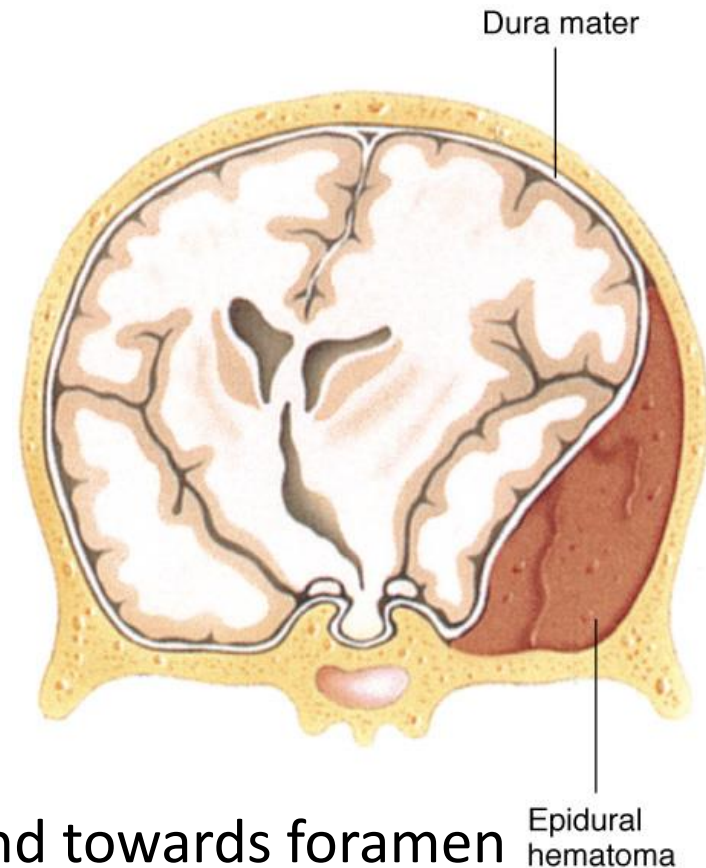


- Blunt trauma produces capillary bleeding
- Common with blunt head trauma
- Often produces
 - Confusion and/or neurological deficit
 - Personality changes (frontal lobe most commonly injured)
- Generally a coup-contrecoup injury



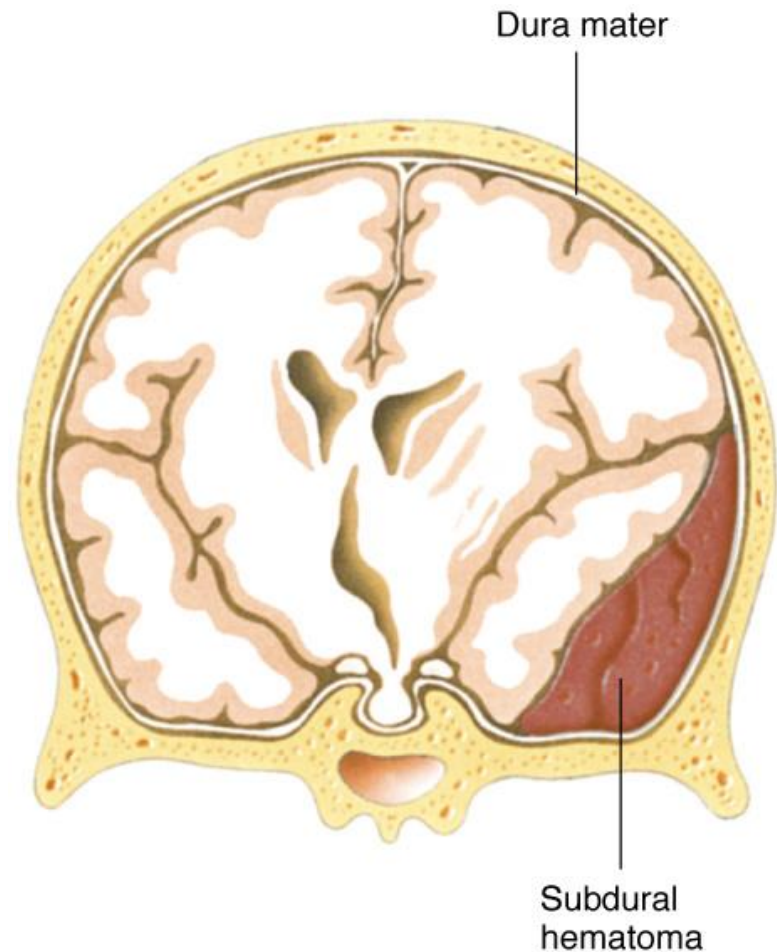
Epidural Hematoma

- Bleeding between dura mater and skull
- Involves arterial bleed
 - Middle meningeal artery in temporal lobe
- ICP builds rapidly
 - Unconsciousness
 - Reduces oxygenated circulation
 - Displaces brain away from injury and towards foramen magnum (herniation)
 - Rapid progression but can be surgically repaired



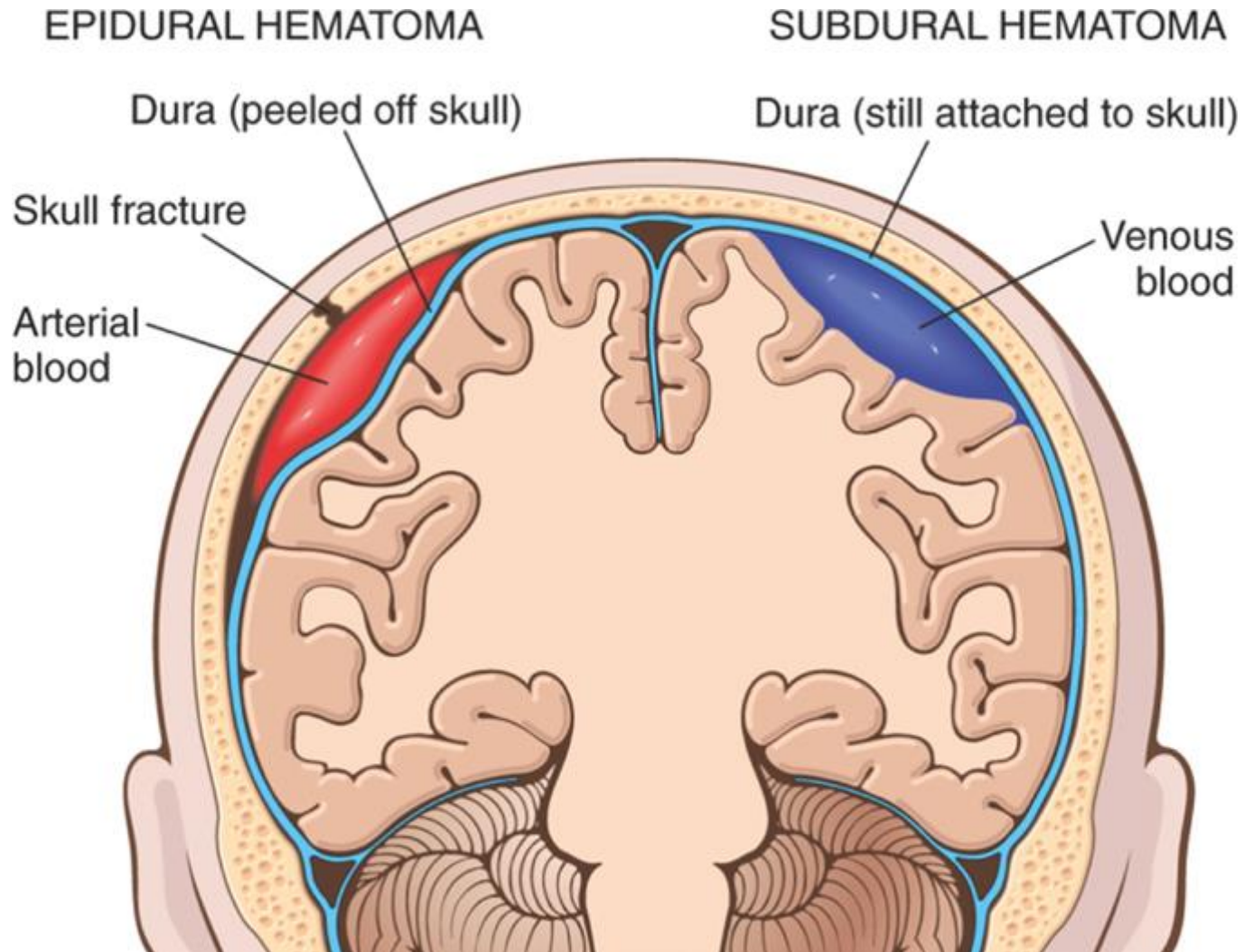
Subdural Hematoma

- Bleeding within meninges
 - Beneath dura mater and within subarachnoid space
- Usually a venous bleed
 - Bridging veins
 - Signs progress over hours to days
 - Slow deterioration of mentation

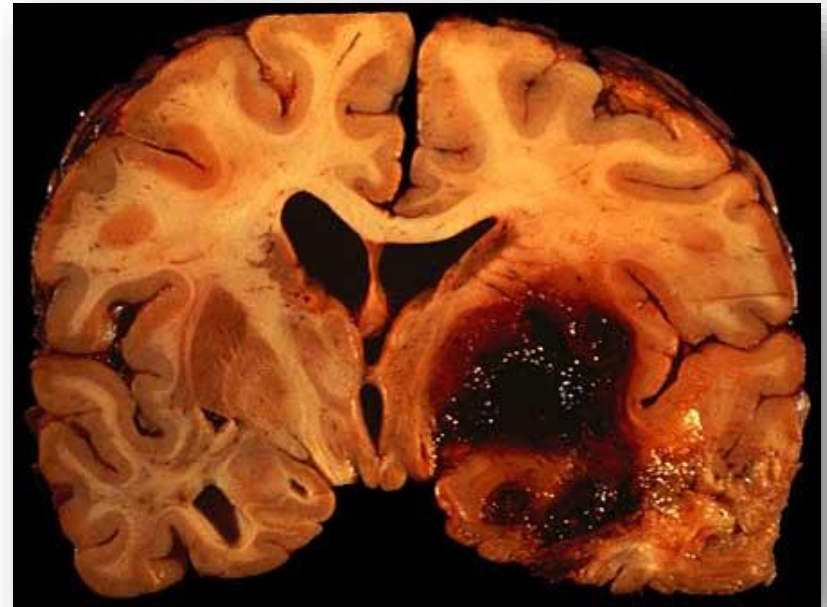


- Occurs above the pia mater
 - Lesser cerebral irritation
 - Increasing ICP takes longer
- At risk groups
 - Elderly and alcoholics
 - Chronic dehydration and stretching of bridging veins

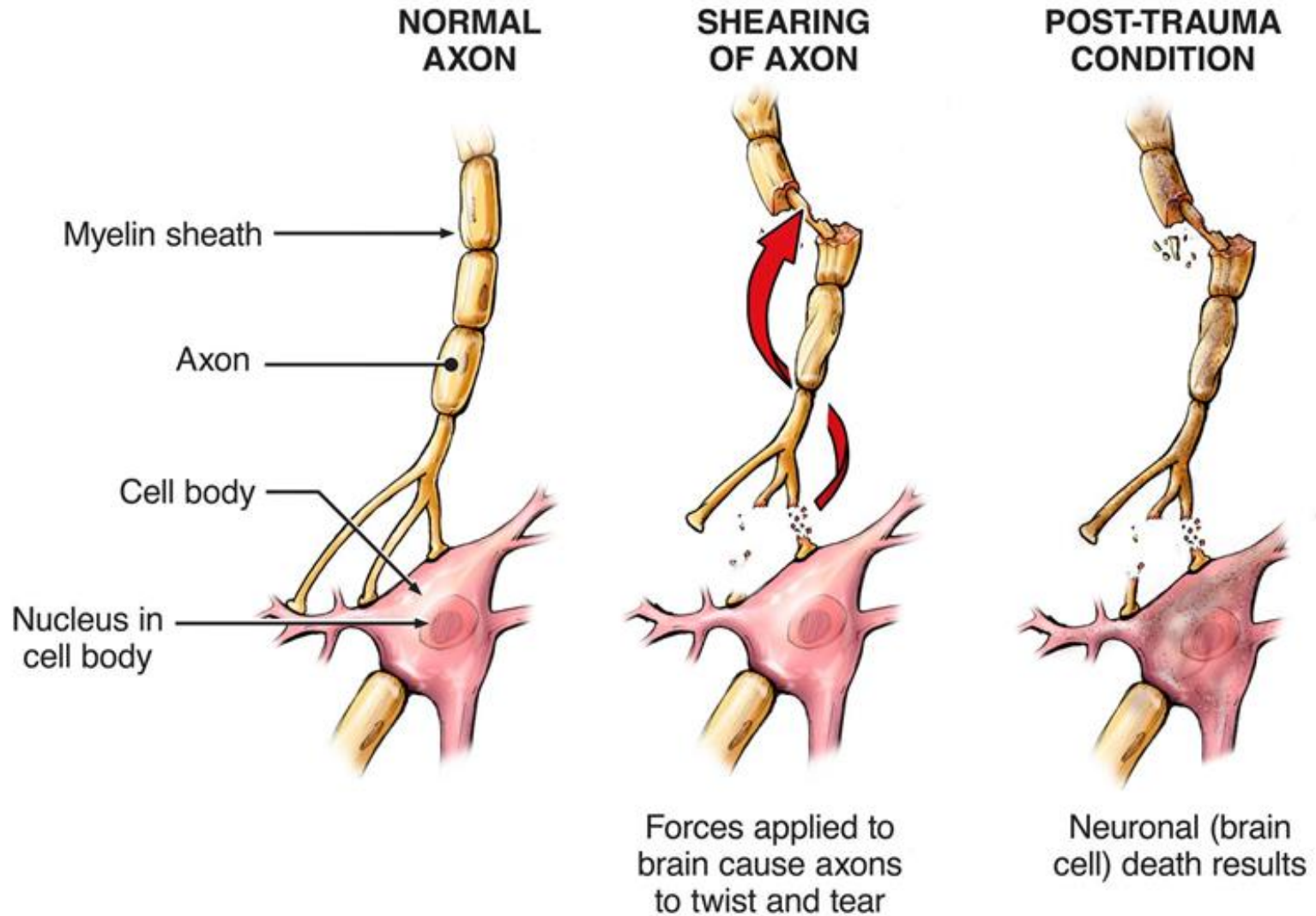
Epidural vs. Subdural



- Rupture blood vessel within the brain
 - Bleeding directly into brain
 - Direct cerebral irritation
- Presentation similar to stroke
 - Signs and symptoms worsen over time



- Shearing, stretching or tearing of nerve fibres with subsequent axonal damage
 - Communication pathways of the nerve cells
 - Pathology distributed through brain
- Common in MVCs
- Range from mild to severe



- “Classic concussion”
- Same mechanism as concussion
 - Involves minute bruising of brain tissue
 - Some degree of residual impairment
- Unconsciousness
 - Involvement of cerebral cortex and RAS
- Commonly associated with basilar skull fracture

- Mild to moderate form of DAI
 - Nerve dysfunction without anatomic damage
 - Most common outcome of blunt head trauma
- Transient episode of
 - Confusion, disorientation, event amnesia
- Suspect if patient has a momentary loss of consciousness
- Management
 - Frequent reassessment of mentation
 - ABC's

- Presentation
 - Unconsciousness or persistent confusion
 - Loss of concentration, disorientation
 - Retrograde and anterograde amnesia
 - Visual and sensory disturbances
 - Mood or personality changes

- Brainstem injury
- Significant mechanical disruption of many axons
 - Cerebral hemispheres with extension into brainstem
- High mortality rate
 - Survivors have some degree of neurologic impairment
- Presentation
 - Prolonged unconsciousness
 - Cushing's reflex
 - Decorticate or decerebrate posturing

- Common concurrent injuries:
 - Cervical
 - Facial
- Depending on type of trauma and MOI, concurrent injuries could involve any and all other body systems.

BEWARE OF

**Concurrent Injuries
In Head Trauma**

- Focused History
 - Any loss of consciousness/how long?
 - Complaints?
 - Any impact to head?
 - Amnesia?
 - Anterograde – No recollection after injury
 - Retrograde – No recollection prior to injury
 - Headache?
 - Nausea/vomiting?
 - Drug or alcohol use?
 - Previous brain injury or seizure disorder?

Do's

- Support Airway
- Support breathing/ventilations
- Initiate IV's
- Cover all open wounds with dressings

Don'ts

- Insert NPA if suspect basilar skull fracture
- Hyperventilate
- Run IV fluid w/o is suspected increased ICP
- Apply direct pressure over unstable skull fractures
- Pack nose or ears if bleeding

- Result of factors that occur as a result of but after the initial injury
- Progressive
- Pathological processes
 - Diminishing circulation to brain tissue due to increasing ICP
 - Pressure against brain tissue secondary to an expanding mass

- Skull not fully formed at birth
 - Distort with impact and transmit force more directly
 - Permits some intracranial expansion
- Increases direct injury associated with head trauma
 - Slows progression of ICP
- Proportionally larger head
 - Intracranial hemorrhage contributes to hypovolemia

- Obligate nasal breathers
 - Must have a patent nasal passage and pharynx to clear airway
- Avoid hyperextension of head
 - Tongue pushes soft pallet closed
 - Ventilate through mouth and nose

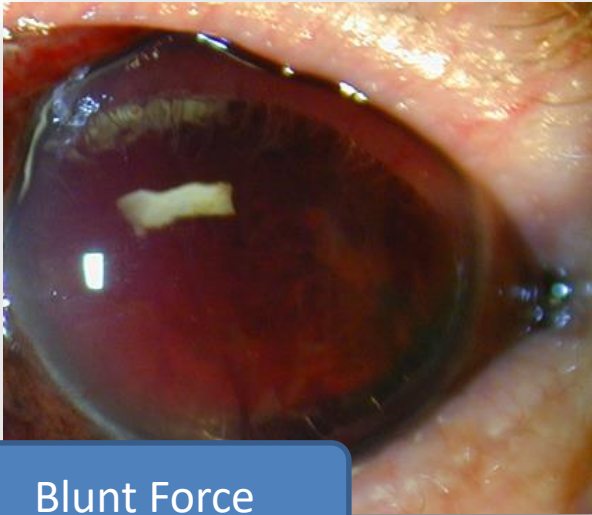
- Serious trauma complication
- Cosmetic importance
- Vasculature
- Location of initial airway and alimentary structures
- Sense organs
- Associated head and spinal injuries



- Highly vascular tissue
- Contribute to hypovolemia
- Airway effects
 - Deep injuries can result in blood being swallowed and endanger the airway
 - Soft tissue swelling reduces airflow
 - Superficial injuries rarely involve the airway
- Consider likelihood of basilar skull fracture or spinal injury

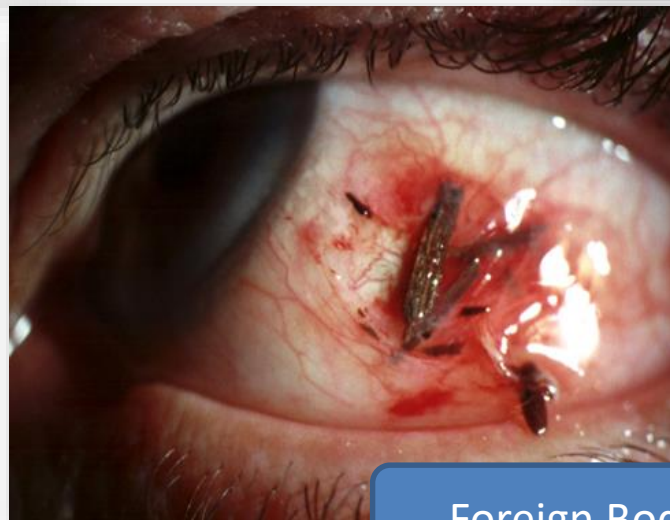


- Very specialized body tissue
- Can indicate problems with:
 - CN-II, CN-III, CN-IV and CN-VI
 - Perfusion associated with cerebral blood flow
- Surface of eye is highly dependent on good perfusion and lacrimal fluid flow
 - If perfusion diminished, eyes lose luster quickly
- Quick, highly visible signs of patient's demeanor
 - Anxiety, fear, anger, etc.



Blunt Force

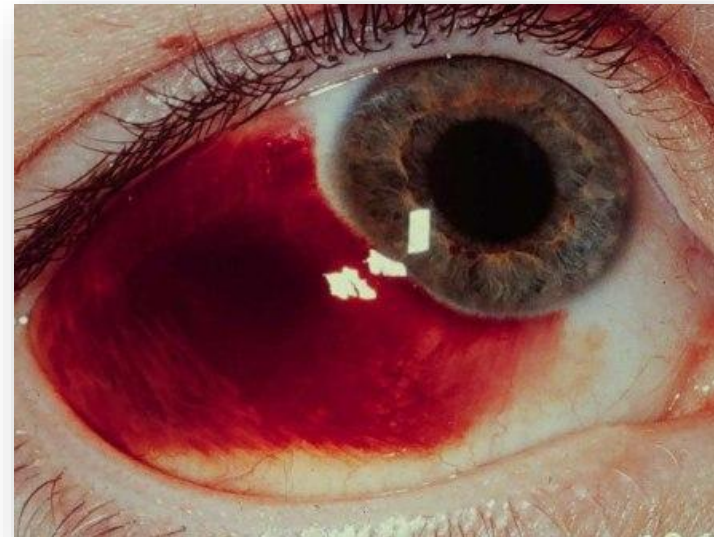
Penetrating



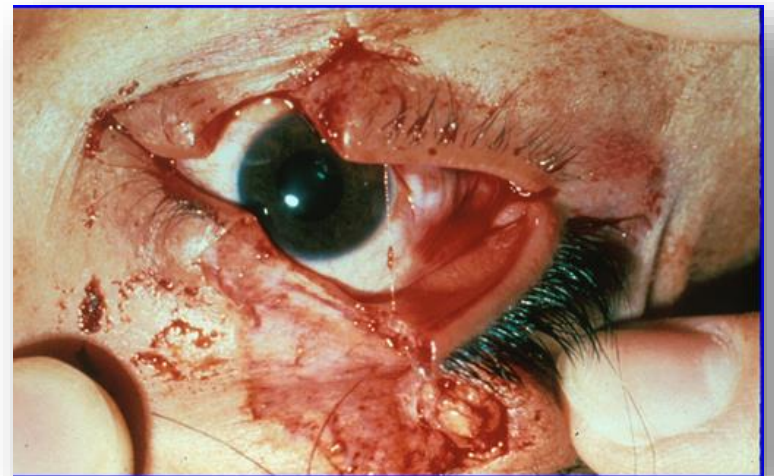
Foreign Body

- Penetrating trauma
 - Can result in long term damage
 - Suspect small foreign body if patient complains of sudden eye pain and sensation of something on the eye
 - Do not remove
- Corneal abrasions and lacerations
 - Common and usually superficial

- Hyphema
 - Blunt trauma to the anterior chamber of the eye
 - Blood in front of iris or pupil
- Sub-conjunctival hemorrhage
 - Less serious condition
 - May occur after strong sneeze, severe vomiting or direct trauma



- Retinal detachment
 - Traumatic origin
 - Complaint of dark curtain/obstruction in the field of view
 - Possibly painful depending on type of trauma
- Soft tissue lacerations
 - May disrupt lacrimal gland function



- Pupil size and reactivity can indicate underlying problems
- Reduced pupillary responsiveness
 - Depressant drugs or cerebral hypoxia
- Fixed and dilated
 - Extreme hypoxia
- Expanding cranial lesion
 - Ipsilateral pupil becomes sluggish, dilated then fixed

Hx

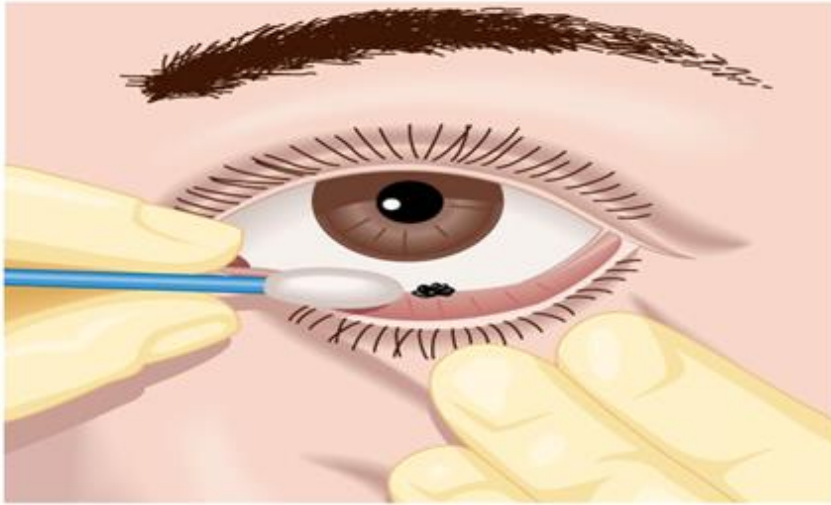
- Corrective/contact lens
- Contact lens currently in place
- Prosthetic eye
- Eye sight affected
- Change in vision
- Blurred vision
- Complete vision loss
- Visual field defect
- Onset of changes start

O/Ex

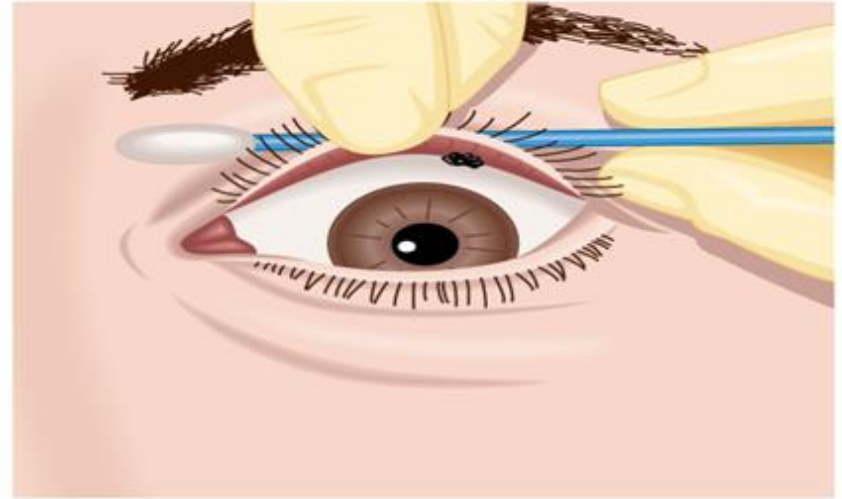
- Periorbital trauma
- Global rupture
- Redness
- Swelling
- Blood or purulent discharge
- Foreign body
- Papillary size
- Papillary abnormalities

- General Approach
 - Limit damage, cover both eyes
 - Avoid increase in intraocular pressure (vomiting), **dimenhydrinate 25 mg IV** , no direct pressure
 - Consider analgesics
- Penetrating
 - Immobilize object in place
- Blunt
 - Secure and immobilize to prevent movement
- Avulsed Eye
 - DO NOT attempt to put back in socket
 - Secure and immobilize to prevent movement

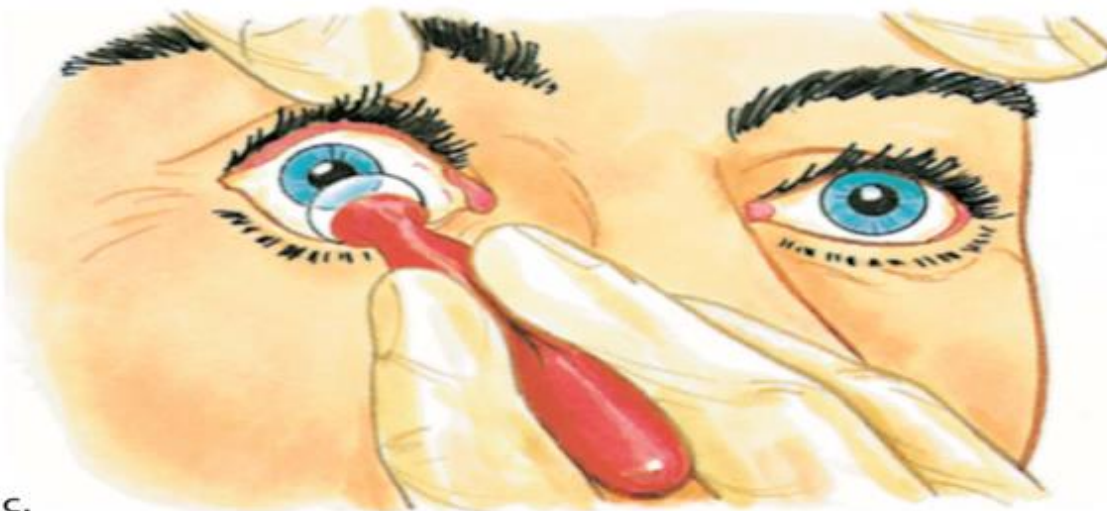
Removing Particles From the White of the Eye



a.



b.



c.

- a. Pull down the lower lid while the patient looks upwards, or
- b. Pull up the upper lid while the patient looks downward
- c. Use a moistened suction cup to remove contact lenses

Dimenhydrinate (Gravol)

Classification

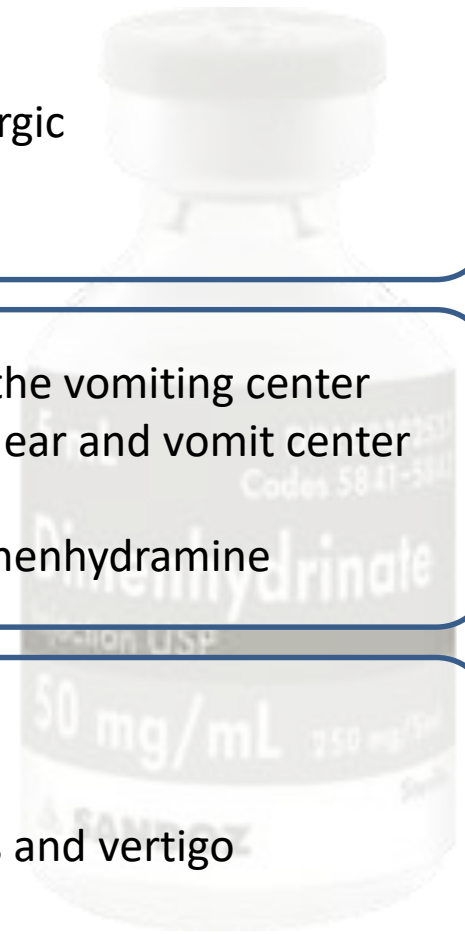
- Antiemetic, Antihistamine, Anticholinergic

Mechanism of Action

- Blocks histamine and ach receptors in the vomiting center
- Blocks the pathway between the inner ear and vomit center that can cause N/V
- Similar to chemical composition of diphenhydramine

Indications

- Nausea and vomiting
- Relief or prevention of motion sickness and vertigo



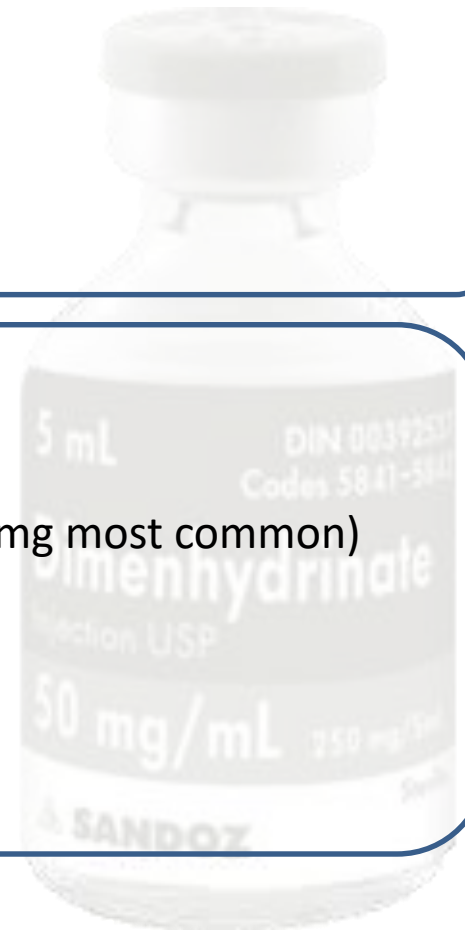
Dimenhydrinate (Gravol)

Contraindications

- Hypersensitivity

Dosage

- Adults
 - 25 – 100 mg IM q 4h PRN (25 – 50 mg most common)
 - 12.5 – 50 mg IV q 4h PRN
- Pediatric
 - 1.0 mg/kg IV/IM max of 25 mg



Classification

- Topical anesthetic

Mechanism of Action

- Topical ophthalmic anesthetic to allow for flushing of an eye by removing the blink reflex

Indications

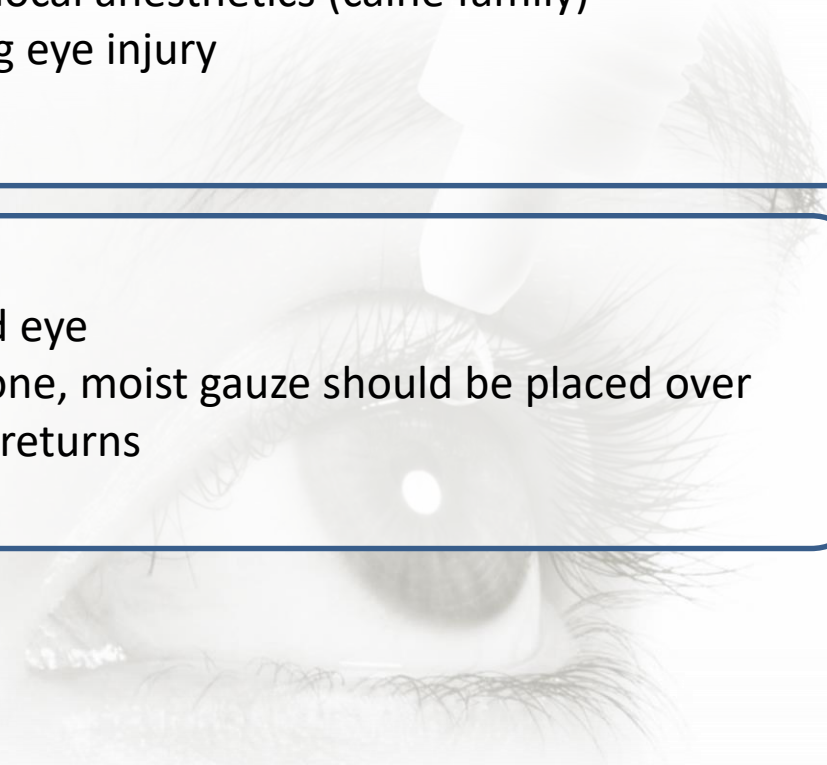
- To facilitate eye flushing

Contraindications

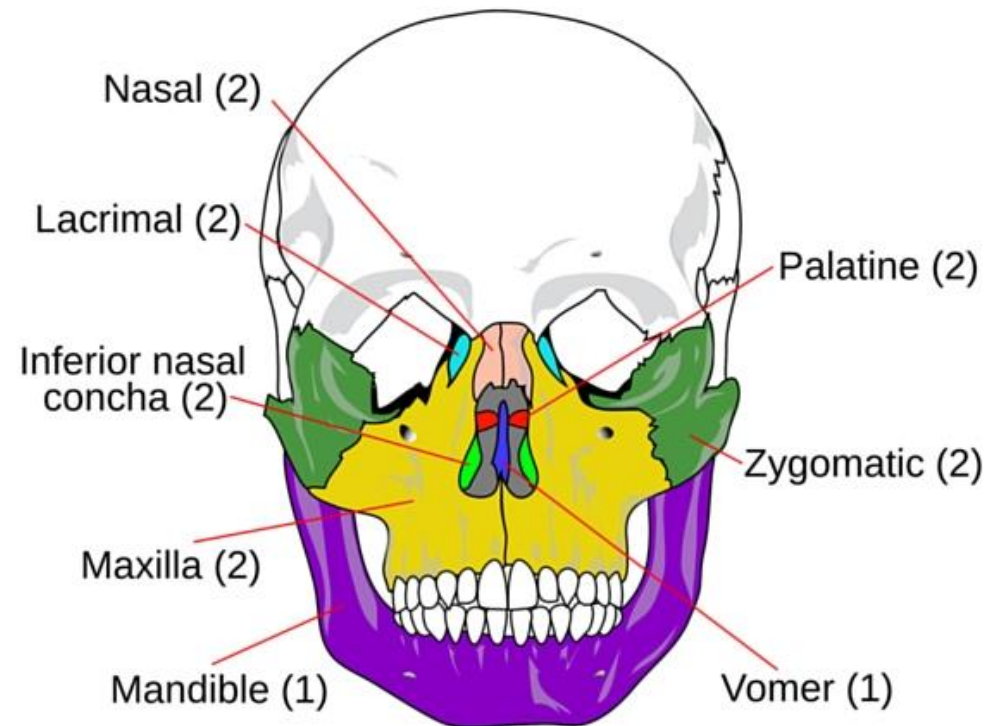
- Hypersensitivity to local anesthetics (caine family)
- Possible penetrating eye injury

Dosage

- 2 -3 drops in affected eye
- Once treatment is done, moist gauze should be placed over eye until blink reflex returns



- Most common causes:
 - Assault
 - MVC
 - Falls
 - Contact sports
- S/Sx
 - Pain
 - Bruising
 - Deformity
 - Asymmetrical facial features

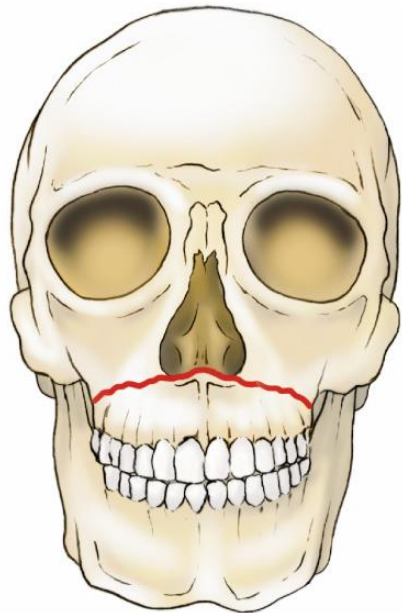


- Mandibular dislocation
 - Displaces from the TMJ
 - Results in malocclusion of mouth, misalignment of teeth, immobility of jaw
 - Rarely a threat to airway or breathing
- Mandibular fractures
 - Deformity along jaw and loss of teeth
 - Possible airway compromise if patient placed supine
 - Evaluate for multiple fracture sites

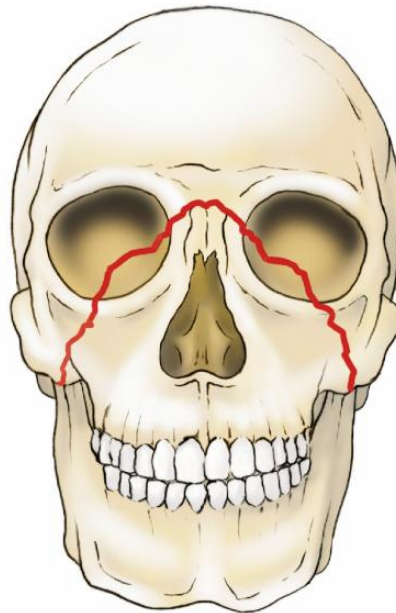
- Maxillary fractures
 - Classified according to Le Fort criteria
 - Le Fort I
 - Slight instability, involving maxilla alone
 - No associated displacement
 - Le Fort II
 - Fracture of both maxilla and nasal bones
 - Le Fort III
 - Entire facial region below brow ridge
 - Le Fort II and III usually result in CSF leakage and endanger patency of airway

Le Fort Facial Fracture Classification

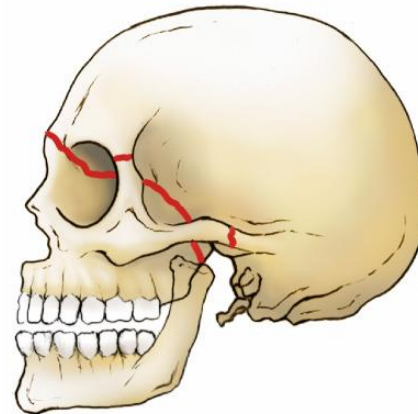
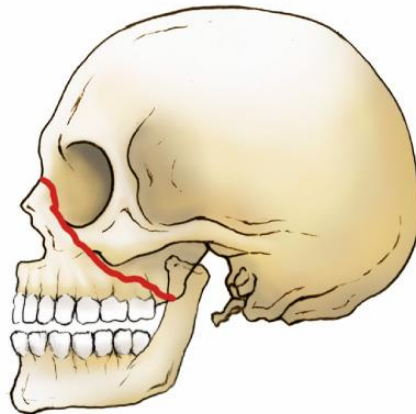
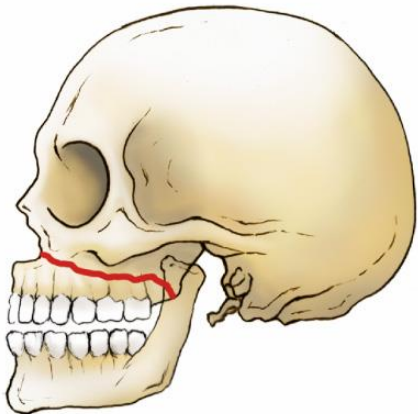
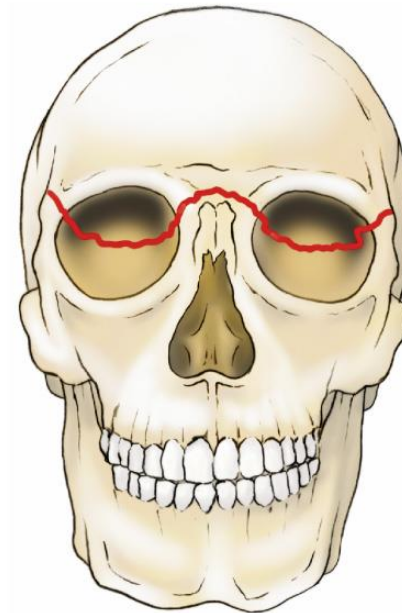
Le Fort I



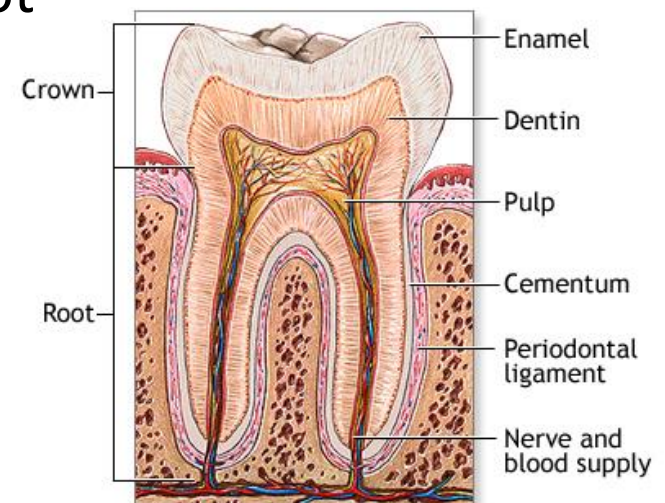
Le Fort II



Le Fort III



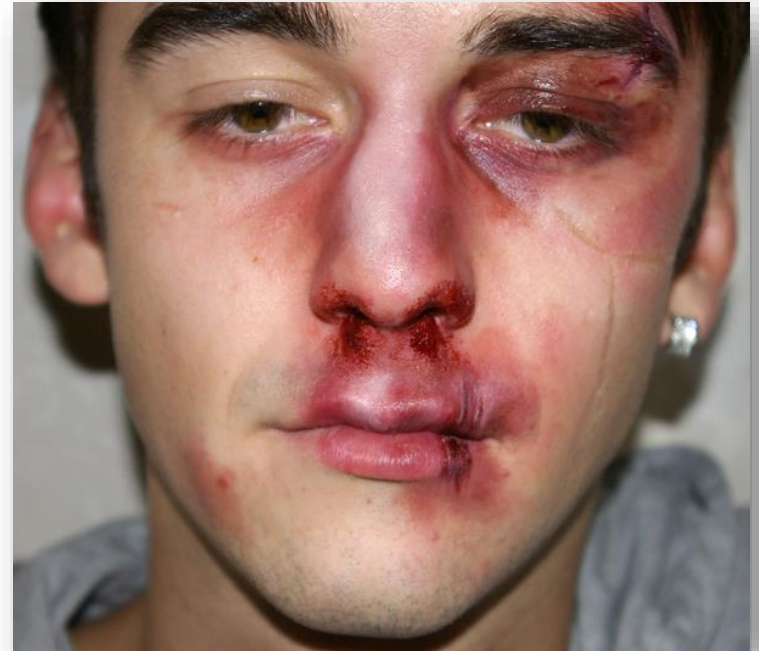
- Dental injury (tooth avulsion)
 - Commonly associated with blunt facial trauma
 - May become foreign objects drawn into airway
 - Broken teeth may be reimplanted if fully intact
 - Handle by crown, avoid handling root
 - Do not rinse/scrape tooth
 - Cover in gauze
 - Keep tooth moist
 - Transport in milk, saliva or saline if possible. Not tap water.



- Orbital fractures
 - Involve zygoma, maxilla and/or interior shelf
 - Reduction of eye movement
 - Possible diplopia
 - Limitation of jaw movement



- Nose Fracture:
 - Painful and often create grossly deformed appearance
 - Rarely life threatening
 - Swelling and hemorrhage may interfere with breathing
- Epistaxis
 - Most common problem
 - Anterior
 - Comes from septum, usually self-limiting
 - Posterior
 - May be severe and cause blood to drain into patient's throat



- Conscious/no c-spine issue
 - Advise patient to gently blow nose to express clots
 - Position patient to lean forward
 - Maintain continual firm pressure on bilateral nares
 - Do not apply pressure to bridge or boney part of nose
- Unconscious/c-spine
 - Place in recovery position
 - Suction PRN
- Other considerations
 - If nauseated, give dimenhydrinate
 - Pt with bleeding disorders or taking anti coagulant meds may require IV fluid challenge

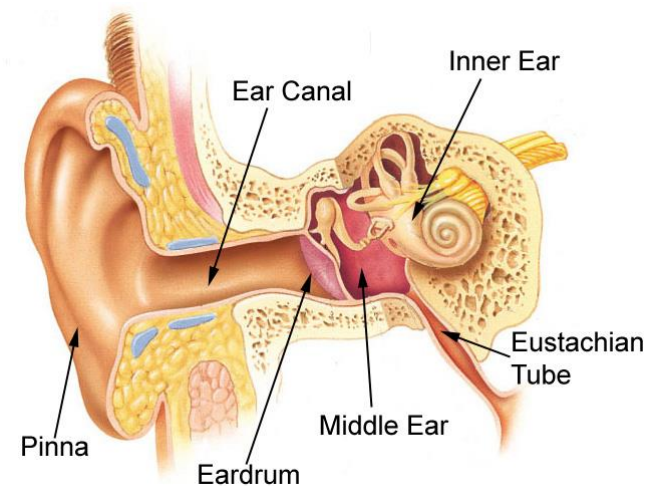
Sit and lean
forward slightly



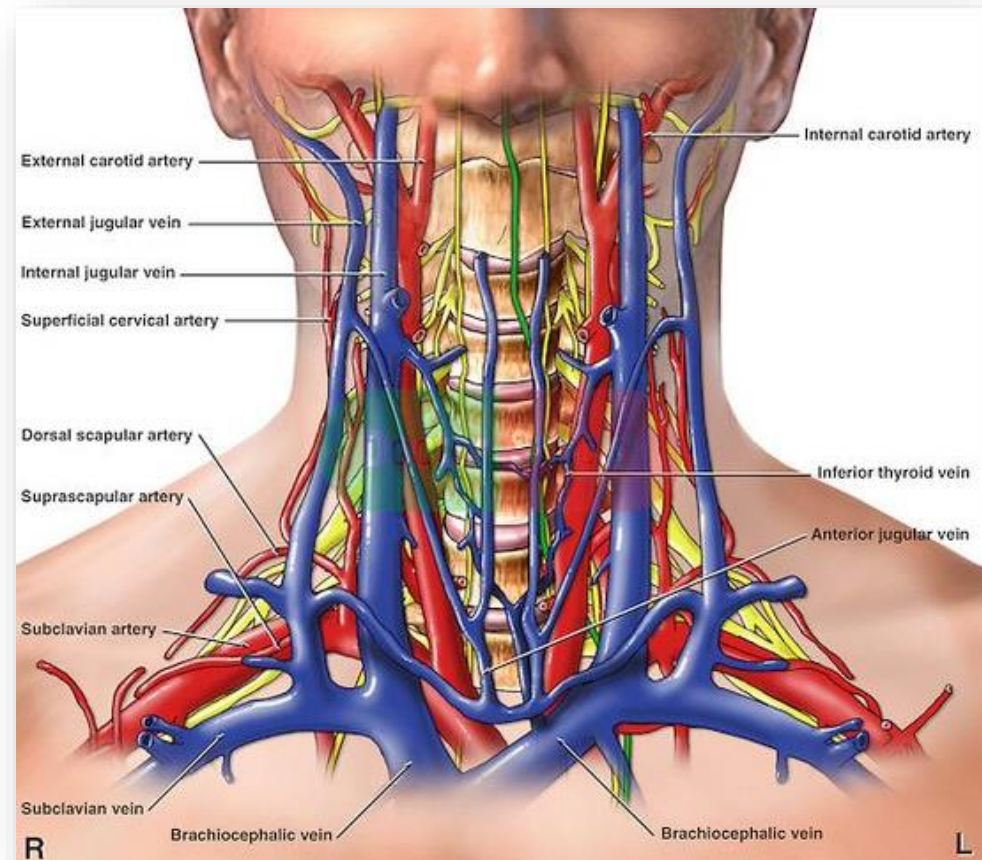
Pinch
nostrils

Breathe through
mouth

- External ear
 - Pinna is frequently injured due to trauma
 - Poor blood supply
 - Poor healing
- Pinna Injury
 - Place in close anatomic position as possible
 - Dress and cover with sterile dressing
- Internal ear
 - Well protected from trauma
 - My be injured due to rapid pressure changes
 - Diving, blast, or explosion
 - Temporary or permanent hearing loss
 - Tinnitus may occur



- Contains Important structures:
 - Major blood vessels
 - Spinal cord/nerves
 - Airway
 - Digestive tract



- Mechanism of Injury:
 - Blunt
 - Compression/ruptures of AW, esophagus, blood vessels
 - Penetrating
 - Knives, GSW, debris
 - Involve other body systems
 - Strangulation/near hanging
 - Suicide/homicide
 - “Clothes line injury”



- Dyspnea/tachypnea
- Airway obstruction
- Subcutaneous emphysema
- Hoarse voice
- Difficulty swallowing
- Impaled object
- Bubbling at open wound
- Bruising
- Swelling



- Subcutaneous emphysema
 - Sign of developing tension pneumothorax
- Penetrating trauma
 - May involve esophagus
 - Allow gastric contents to escape into mediastinum
- Deeper penetrating trauma may involve vagus nerve disruption
 - Tachycardia and GI disturbances
- More anterior injuries may affect the thyroid and parathyroid glands

- Airway trauma
 - Tracheal rupture or dissection from larynx
 - Airway swelling and compromise
- Cervical spine trauma
 - Vertebral fracture
 - Paresthesia, anesthesia, paresis or paralysis beneath the level of the injury
 - Neurogenic shock may occur

- Blood vessel trauma
 - Blunt trauma
 - Risk of serious expanding hematoma
 - May restrict jugular veins
 - Laceration
 - Large blood vessels may result in serious hemorrhage
 - Entraining of air may result in embolism
 - Cover with occlusive dressing
 - No bilateral pressure to neck

- Limit external stimulation
 - Can increase ICP
 - Can induce seizures
- Cautious about air transport
 - May save time
 - Increased risk of seizures

- Have friend or family provide constant reassurance
- Provided constant reorientation to environment if required
 - Keeps patient calm
 - Reduces anxiety

- Pathophysiology
- Assessment
- Management