MEDAVIE

HealthEd

ÉduSanté

Head, Neck and Facial Trauma

Advanced Care Paramedicine

Module: 08

Section: 07a

Introduction

- Common with major trauma
- 34 000 people admitted to hospital each year with brain injuries in Canada
- Severe head injury is the most frequent cause of traumatic death

High Risk Groups

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

Factors

- 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

Mechanism of Injury

- Blunt Injury
  - Motor vehicle collisions
  - Assaults
  - Falls
- Penetrating Injury
  - Gunshot wounds
  - Stabbing
  - Explosions
  - “Clothesline”

FIGURE 23-1 Blunt injury to the facial region can produce hemorrhage, soft-tissue injuries, internal fractures, and brain injuries.

Scalp 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
- Often difficult to assess
  - Contusion often expands outward

FIGURE 23-2 Scalp wounds can bleed heavily.

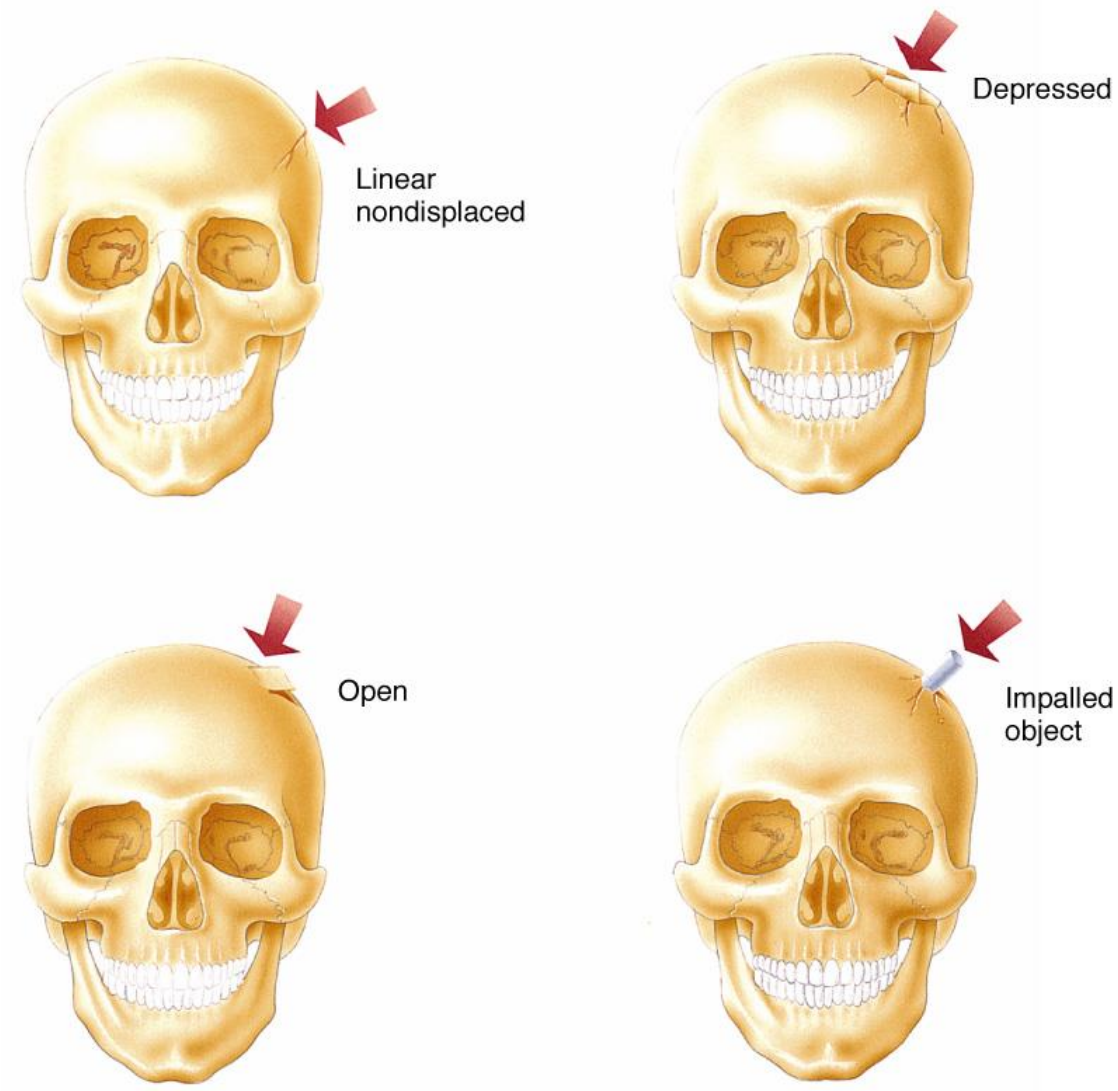
Cranial Injury

- Trauma must be severe to fracture skull
- Linear fractures:
  - Most common (80%)
  - Small cracks in the cranium
  - Usually occurs to temporal bone (thinnest)
  - If there are no intracranial injuries, poses very little danger to patient

Cranial Injury

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

Types of skull fractures



Basilar Skull Fracture

- Structure of the basilar skull
  - Permeated with foramina (openings)
  - Several hollow or open structures
  - Weaker and very prone to fracture
- Presentation varies with location of injury
  - Battle's signs
  - Raccoon eyes
  - Fluid/CSF leakage

Basilar Skull Fracture

- Both 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

Indications of a basilar skull fracture

Retroauricular ecchymosis (Battle's sign).

Bilateral periorbital ecchymosis (racoon eyes).

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Battles Sign and Raccoon Eyes

Basilar Skull Fracture

- May 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
- Halo sign
  - Blood mixed with CSF from nose, mouth or ears
  - Target sign

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The halo test can detect the presence of CSF

Cranial Injury

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

Cranial Injury

- 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

Brain Injury

- “a traumatic insult to the brain capable of producing physical, intellectual, emotional, social and vocational changes.”
  (National Head Injury Foundation definition)
- Direct or indirect injury to tissue of the cerebrum, cerebellum or brainstem

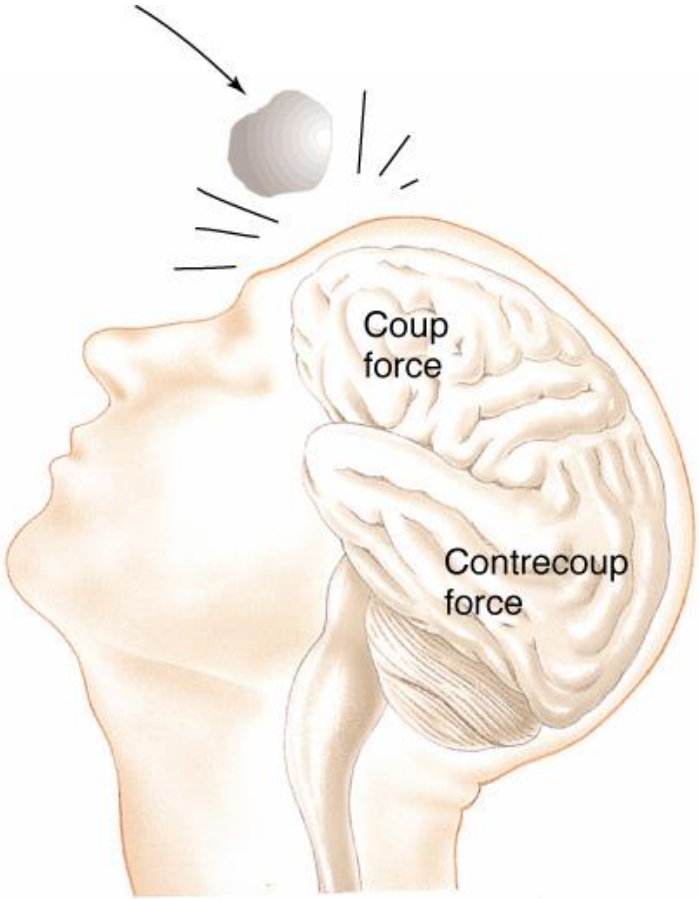
Direct Brain Injury

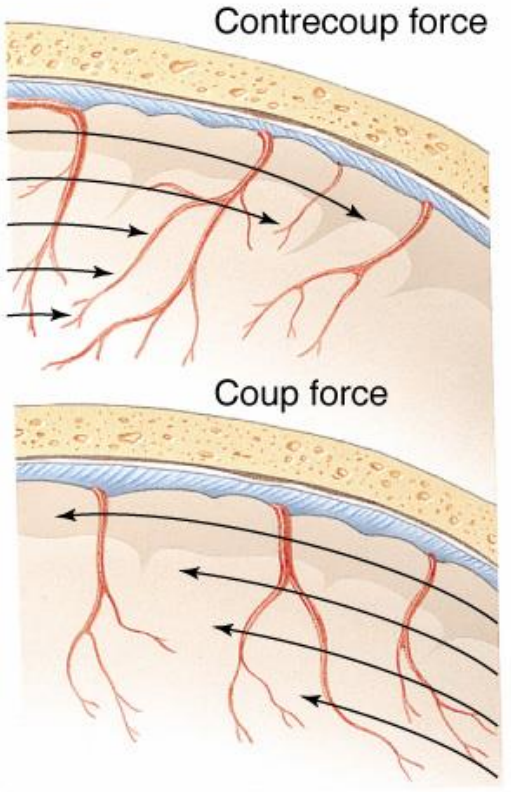
- Caused by the forces of trauma
- Focal:
  - Cerebral contusion
  - Intracranial hemorrhage
    - Epidural hematoma
    - Subdural hematoma
    - Intracerebral hemorrhage
- Diffuse:
  - Mild to moderate diffuse axonal injury (concussion)
  - Moderate diffuse axonal injury
  - Severe diffuse axonal injury

Direct Brain 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





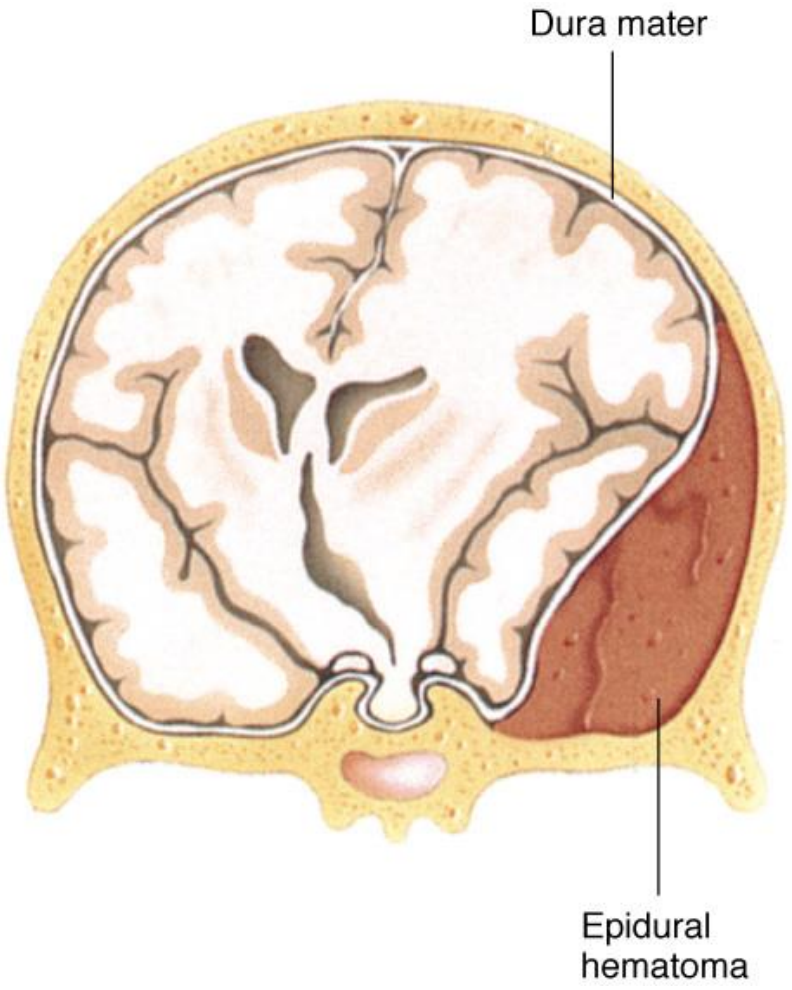
Cerebral Contusion

- 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

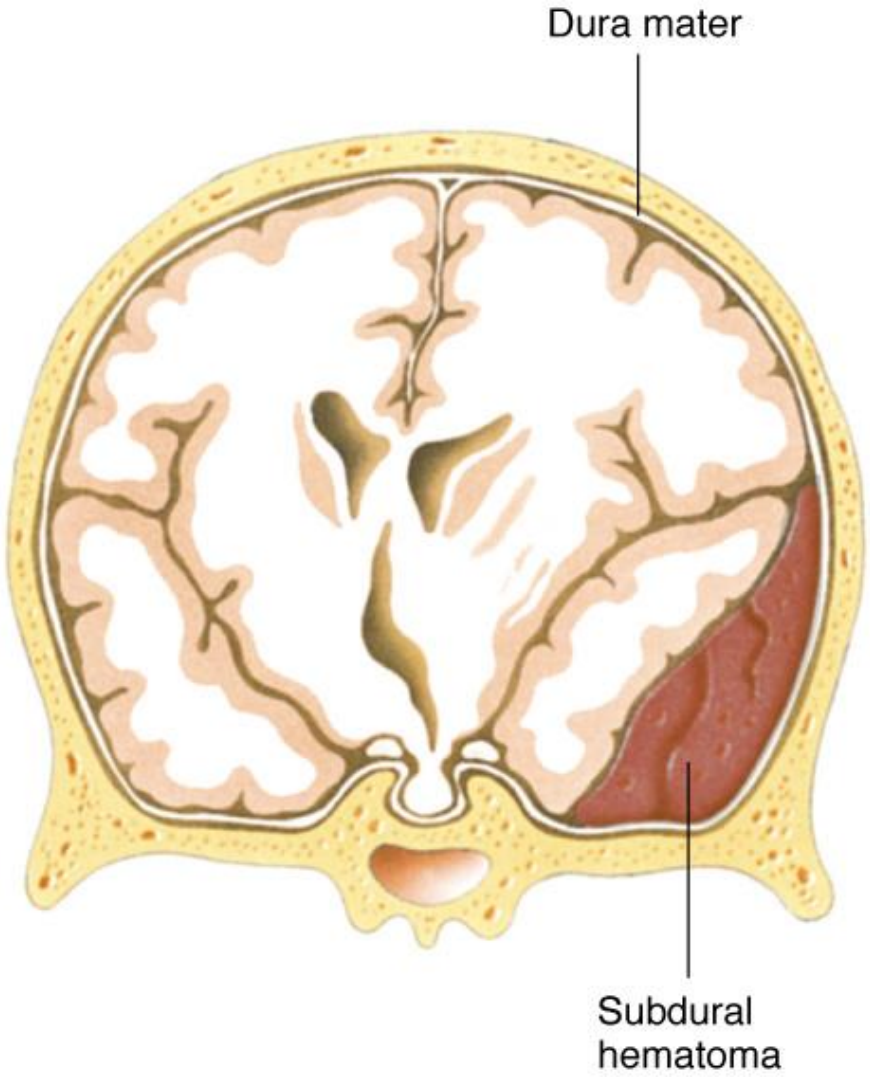
Epidural Hematoma



Subdural Hematoma

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

Subdural Hematoma



Subdural Hematoma

- 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

Intracerebral Hemorrhage

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

Diffuse Axonal Injury (DAI)

- 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

Concussion

- 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

Moderate Diffuse Axonal Injury

- "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

Moderate Diffuse Axonal Injury

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

Severe Diffuse Axonal Injury

- 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

Indirect Brain Injury

- 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

Intracranial Perfusion

- 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

Intracranial Perfusion

- 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

Role of Carbon Dioxide

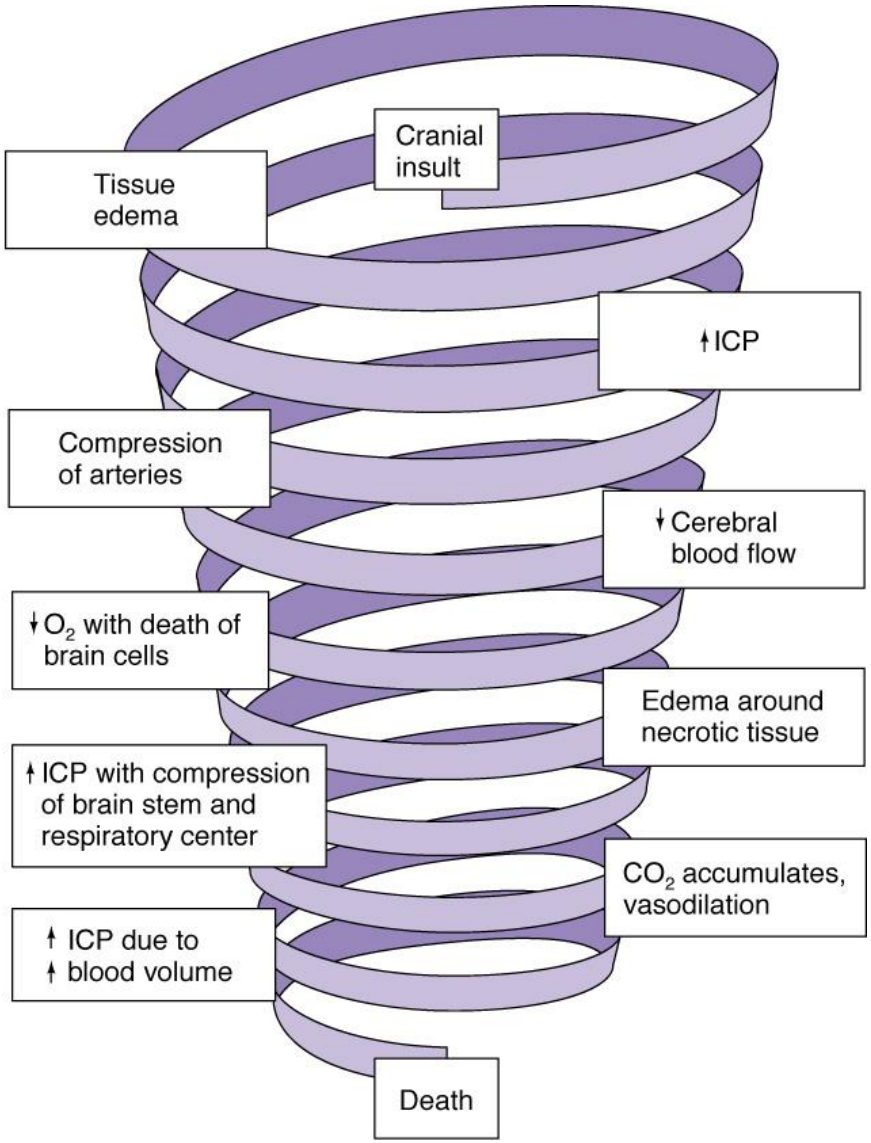
- As CO_2 levels rise in CSF:
  - Cerebral arteries dilate
  - Encourage blood flow
  - Reduce hypercarbia
- In the presence of already high ICP
  - Devastating results
  - Causes classic hyperventilation and hypertension
- Reduced levels of CO_2 in CSF
  - Cerebral vasoconstriction
  - Results in cerebral anoxia

Factors Affecting ICP

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

Systemic Problems

- 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


Cranial insult
Tissue edema
↑ICP
Compression of arteries
↓Cerebral blood flow
↓O_2 with death of brain cells
Edema around necrotic tissue
↑ICP with compression of brain stem and respiratory center
CO_2 accumulates, vasodilation
↑ICP due to ↑blood volume
Death

Pressure and Structural Displacement

- 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

Pressure and Structural Displacement

- 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

Signs & Symptoms of Brain Injury

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

Signs & Symptoms of Brain Injury

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

Cerebral Cortex Compression

- 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

Cerebral Cortex Compression

- 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

Upper Brainstem Compression

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

Middle Brainstem Compression

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

Lower Brainstem Injury

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

Pediatric Head Trauma

- 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

Pediatric Head Trauma

- 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

Eye Signs

- Very specialized body tissue
- Can indicate problems with:
  - CN-II, CN-III, CN-IV, & 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 demeanour
  - Anxiety, fear, anger, etc

Eye Signs

- 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, then dilated then fixed

Facial Injury

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

Facial Soft Tissue Injury

- 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

Facial Dislocations and Fractures

- 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

Facial Dislocations and Fractures

- 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

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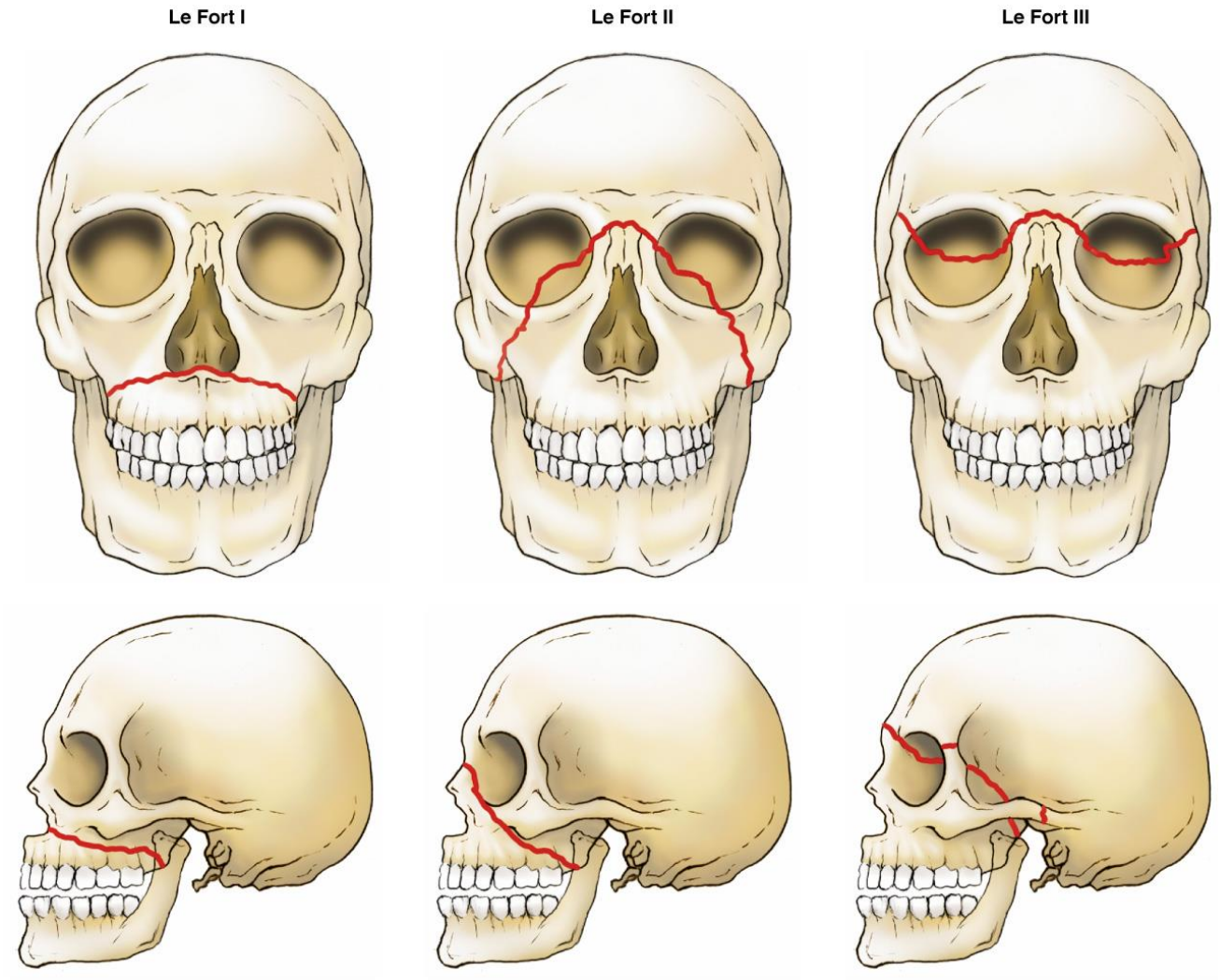
Le Fort facial fracture classification



Facial Dislocations and Fractures

- Dental injury
  - Commonly associated with blunt facial trauma
  - May become foreign objects drawn into airway
  - Broken teeth may be reimplanted if fully intact
  - Transport in milk if possible
- Orbital fractures
  - Involve Zygoma, Maxilla, and/or interior shelf
  - Reduction of eye movement
  - Possible Diplopia
  - Limitation of jaw movement

Nasal Injury

- 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

Ear Injury

- External ear
  - Pinna is frequently injured due to trauma
  - Poor blood supply
  - Poor healing
- 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

FIGURE 23-12 Blood or fluid draining from a patient's ear suggests basilar skull fracture.

Eye Injury

- 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

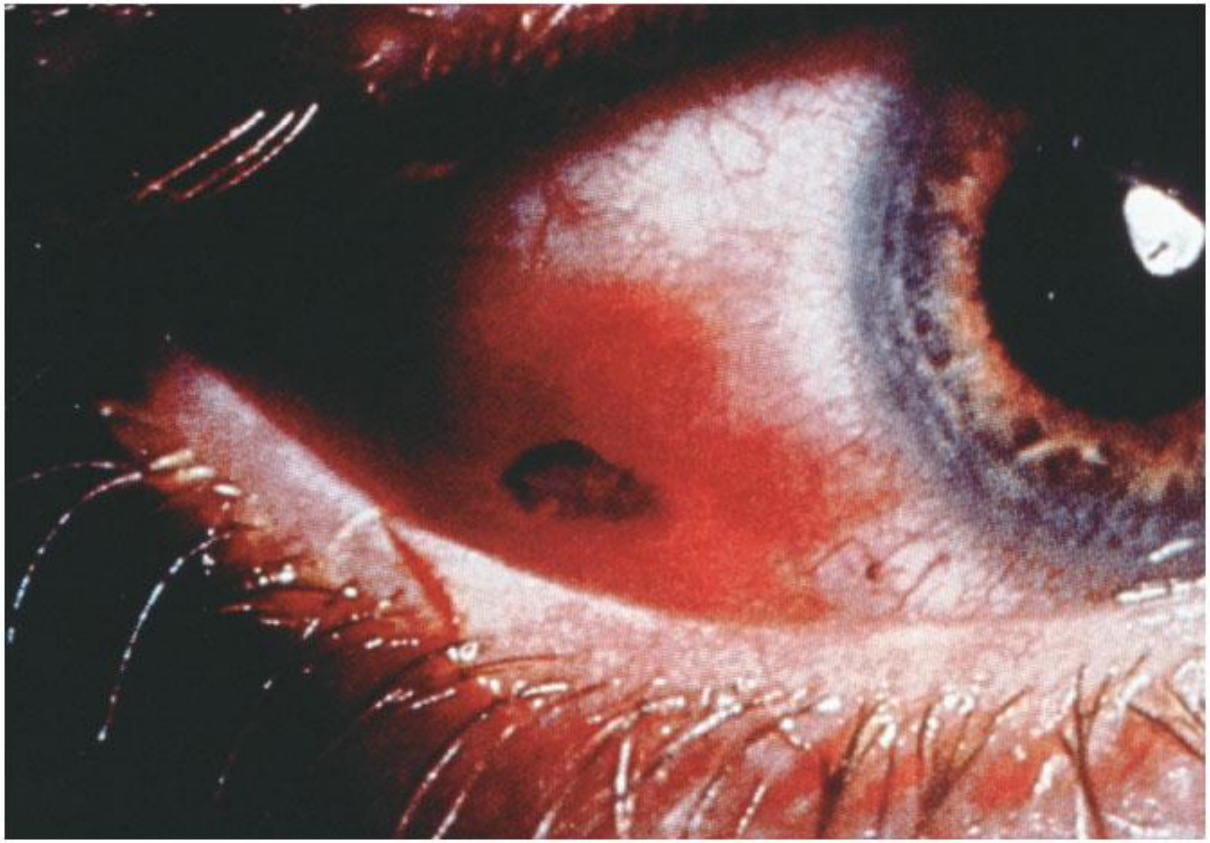


FIGURE 23-13 Subconjunctival hemorrhage.

Eye Injuries

- Acute Retinal Artery Occlusion
  - Non-traumatic origin
  - Painless loss of vision in one eye
  - Occlusion of retinal artery
- 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

FIGURE 23-14 Laceration of the eyelid.

Neck Injury

- 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

FIGURE 23-15 Laceration to the neck.

Neck Injury

- Airway Trauma
  - Tracheal rupture or dissection from larynx
  - Airway swelling & compromise
- Cervical Spine Trauma
  - Vertebral fracture
    - Paresthesia, anaesthesia, paresis or paralysis beneath the level of the injury
    - Neurogenic shock may occur

Neck Injury

- 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

Assessment

- Scene assessment
  - Good analysis of mechanism of injury
  - BSI
  - Assess helmet and vehicle as well as patient
- Primary assessment
  - Assessment of level of orientation allows for trending later

Assessment

- Airway
  - Anticipate problems
- Breathing
  - May need oxygen/ventilation to overcome effects of hypoxia and CO_2 retention
- Circulation
  - Slow, bounding pulse may be an early sign of ICP

Rapid Trauma Assessment

- Head
- Face
- Neck
- Glasgow Coma Scale (GCS)
  - Question the patient frequently to determine trends

Table 23-1 Glasgow Coma Scale

Eye Opening	
Spontaneous	4
To verbal command	3
To pain	2
No response	1
Verbal Response	
Oriented and converses	5
Disoriented and converses	4
Inappropriate words	3
Incomprehensible sounds	2
No response	1
Motor Response	
Obeys verbal commands	6
Localizes pain	5
Withdraws from pain (flexion)	4
Abnormal flexion in response to pain (decorticate rigidity)	3
Extension in response to pain (decerebrate rigidity)	2
No response	1

Airway Management

- Vigilant attention and aggressive management
  - Suctioning
  - Consider intubation early for patient with reduced LOC
  - Cricothyrotomy
- Patient positioning
  - Left lateral or head elevated if possible
- Airway adjuncts
  - Nasal often better tolerated

Breathing

- High flow oxygen
  - Must be breathing adequately with adequate tidal volumes
- Ventilations
  - 12 to 14 breaths per minute
  - Care not to hyperventilate
  - Consider intubation early to facilitate ventilations

Circulation

- Hemorrhage control
  - Usually easily controlled
  - Anticipate airway problems
- Blood pressure maintenance
  - Ensure cerebral perfusion
  - Fluid administration

Medications

- Oxygen
  - Addresses hypoxia
  - High concentration mask or overdrive ventilations
- Paralytics
  - Facilitate intubation (RSI)
  - Succinylcholine, Pacuronium and Vercuronium
- Diuretics
  - May reduce ICP
  - Mannitol, Lasix

Medications

- Sedatives
  - Pre-medication for intubation
  - Risk of respiratory depression, altered LOC
  - Diazepam, Midazolam
- Analgesics
  - Caution to avoid masking signs of ICP
  - Morphine, Fentanyl
- Atropine
  - Combat effects of compression of vagus nerve

Medications

- Dextrose
  - Must be hypoglycemic
- Thiamine
  - Facilitates processing of glucose in cell, specifically brain cells
  - Common in alcoholics and malnourished patients
- Topical anaesthetic spray
  - Anaesthetize oral and pharyngeal mucosa

Transport Considerations

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

Emotional Support

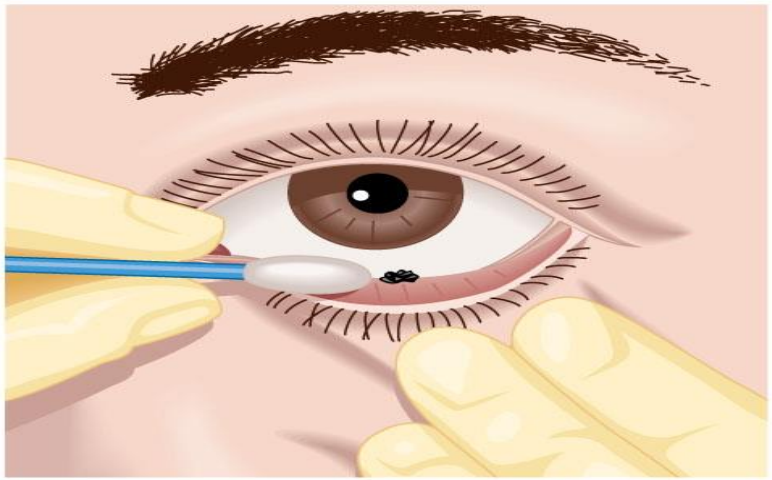
- Have friend or family provide constant reassurance
- Provided constant reorientation to environment if required
  - Keeps patient calm
  - Reduces anxiety

Special Injury Care

- Scalp Avulsion
  - Cover the open wound with bulky dressing
  - Pad under the fold of the scalp
  - Irrigate with NS to remove gross contamination
- Pinna Injury
  - Place in close anatomic position as possible
  - Dress and cover with sterile dressing

Special Injury Care

- Eye Injury
- General
  - Cover injured and uninjured eye
  - Prevents sympathetic motion
  - Consider sterile dressing soaked in NS
- Corneal abrasion
  - Invert eyelid and examine eye for foreign body
  - Remove with NS moistened gauze or Morgan's Lens
- Avulsed or Impaled Eye
  - Cover and Protect from injury



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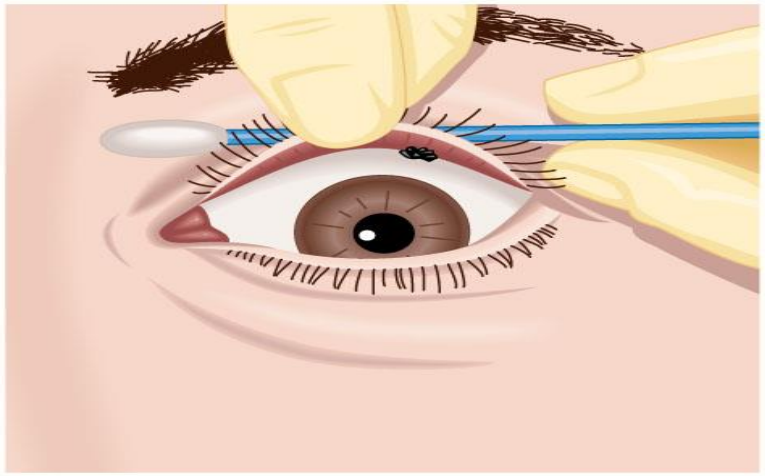

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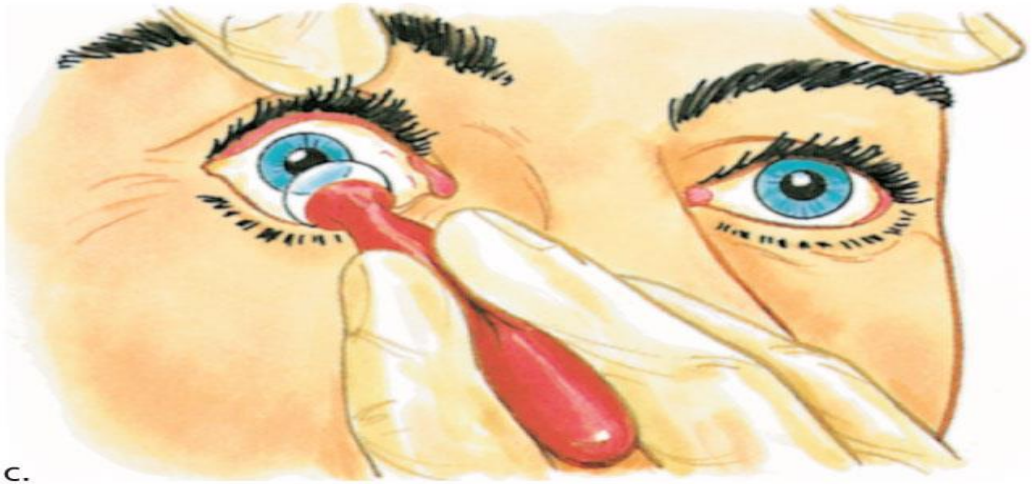

c.

FIGURE 23–20 To remove particles from the white of the eye, (a) pull down the lower lid while the patient looks up, or (b) pull up the upper lid while the patient looks down. (c) You can use a moistened suction cup to remove hard lenses.

Special Injury Care

- Dislodged Teeth
  - Rinse in NS
  - Wrap in NS soaked gauze
  - Transport in milk if available
- Impaled Objects
  - Secure with bulky dressing
  - Stabilize object to prevent movement
  - Indirect pressure around wound

Summary

- Pathophysiology
- Assessment
- Management