Head Trauma

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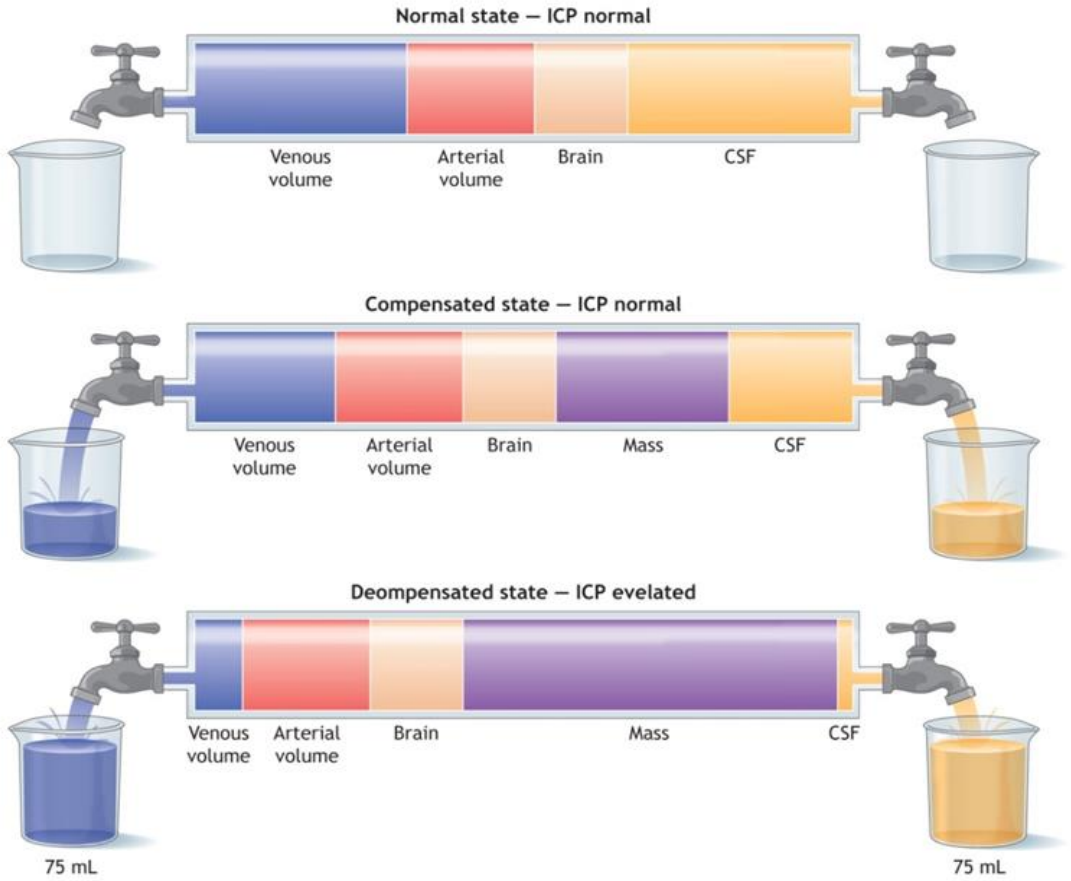
Objectives

1. Cerebral Anatomy & Physiology
2. The importance of limiting 2ry brain injury
3. Classification of Head Injury
4. Management of Head Injury

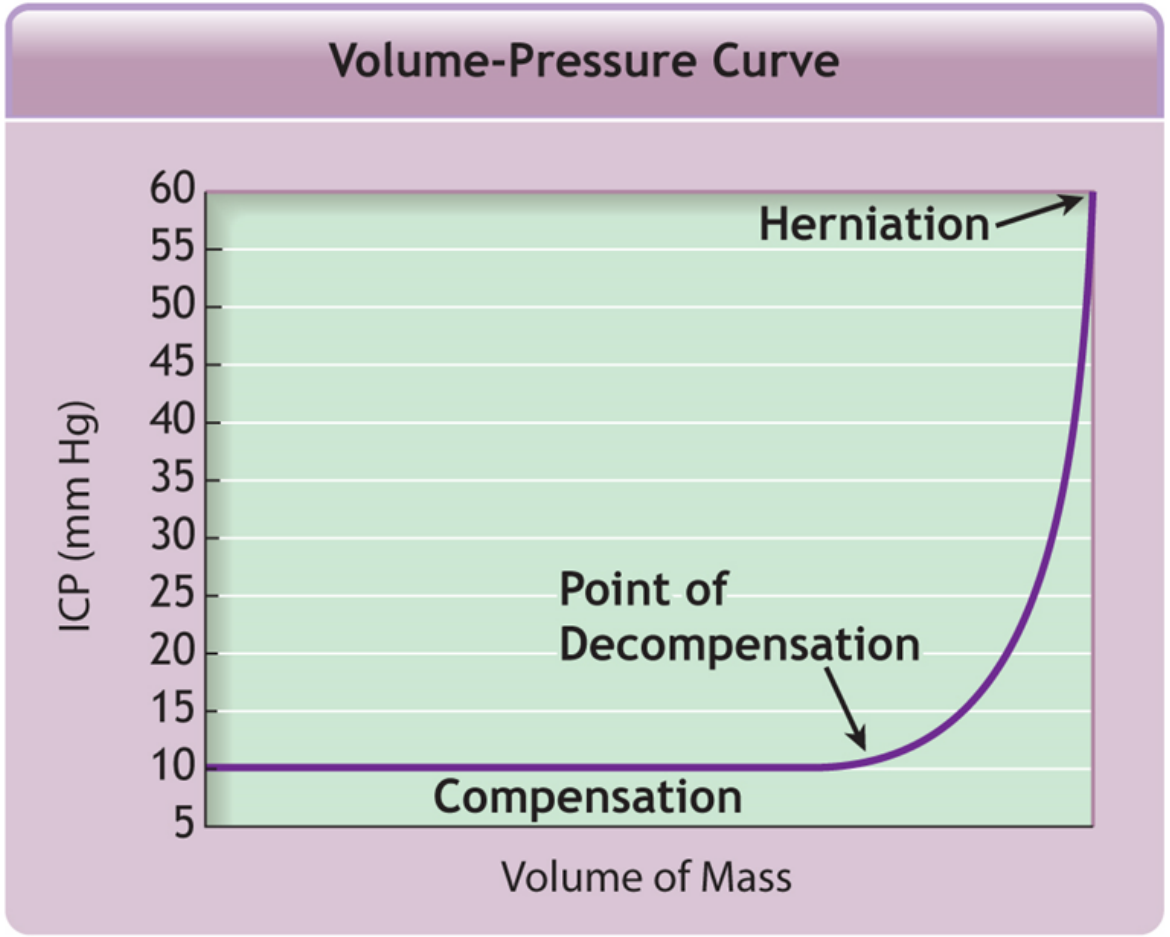
Anatomy & Physiology

- Rigid, nonexpansile skull
- Skull contents: brain, CSF, and blood
- Cerebral blood flow (CBF) usually autoregulated
- Autoregulatory compensation disrupted by brain injury
- Mass effect of intracranial hemorrhage

Monro-Kellie Doctrine



Volume-Pressure Curve



Intracranial Pressure (ICP)

Sustained increased ICP leads to decreased brain function and poor outcome

10 mm Hg	Normal
> 20 mm Hg	Abnormal
> 40 mm Hg	Severe

Cerebral Perfusion Pressure (CPP)

	MAP	– ICP	= CPP
Normal	90	10	80
Cushing's Response	100	20	80
Hypotension	50	20	30



CPP ≠ Cerebral Blood Flow

Mean Arterial Pressure (MAP)

- MAP = Diastolic + 1/3 Pulse pressure
- Pulse pressure = Systolic - Diastolic

Cerebral Autoregulation (MAP & CBF)

- With intact autoregulation, CBF is maintained constant as long as MAP is in the range of 50 to 150 mm Hg.

- In moderate or severe brain injury, autoregulation is impaired, so CBF varies with MAP.

- The injured brain is more vulnerable to episodes of hypotension, causing secondary brain injury.

Classification of Head injury

- Types
- Severity
- Morphology

Classification of Head injury

Types

- Blunt
- Penetrating (more risk of infection & seizures)

Classification of Head injury

Severity

Classified based on Glasgow Coma Scale “GCS” Score:

- Mild (13-15)
- Moderate (9-12)
- Severe (3-8)

Classification of Head injury

Severity (Glasgow Coma Scale GCS)

Points	Best Eye	Best Verbal	Best Motor
6	-	-	Obeys
5	-	Oriented	Localizes
4	Spont.	Confused	Withdraws
3	To speech	Inappropriate	Flex/Decort.
2	To pain	Incomprehens.	Ext/Decerebr.
1	None	None	None

Classification of Head injury

Severity (Pediatric GCS for age < 2 years)

Points	Best Eye	Best Verbal	Best Motor
6	-	-	Normal spont. movement
5	-	Coos, Babbles	Withdraws to touch
4	Spont.	Irritable cries	Withdraws to pain
3	To speech	Cries to pain	Abnormal Flex
2	To pain	Moans to pain	Abnormal Ext.
1	None	None	None

Classification of Head injury
Morphology (Skull fractures)

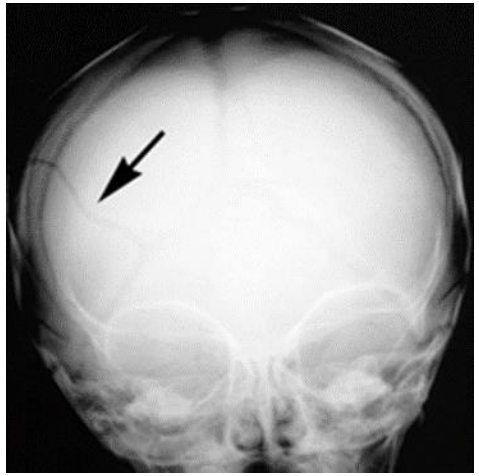
- Vault fractures
  - Linear (nondepressed)
  - Depressed (might cause pressure on the brain or laceration)

  - Closed (simple, scalp intact)
  - Open (compound, scalp wound, higher risk of infection)

- Basilar fractures
  - With or without CSF leak (Rhinorrhea, Otorrhea). Leak → risk of infection
  - With or without cranial nerve palsy (1st,7th,8th)

Classification of Head injury

Morphology (Linear Skull fractures X-ray)

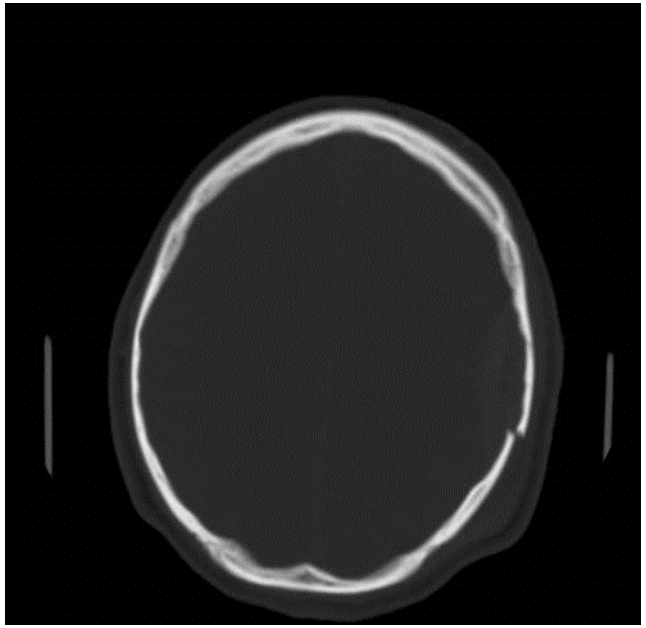


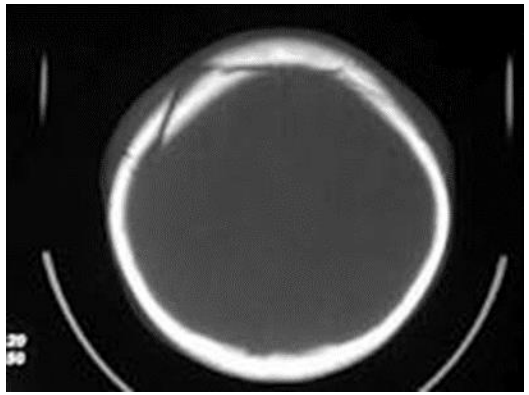


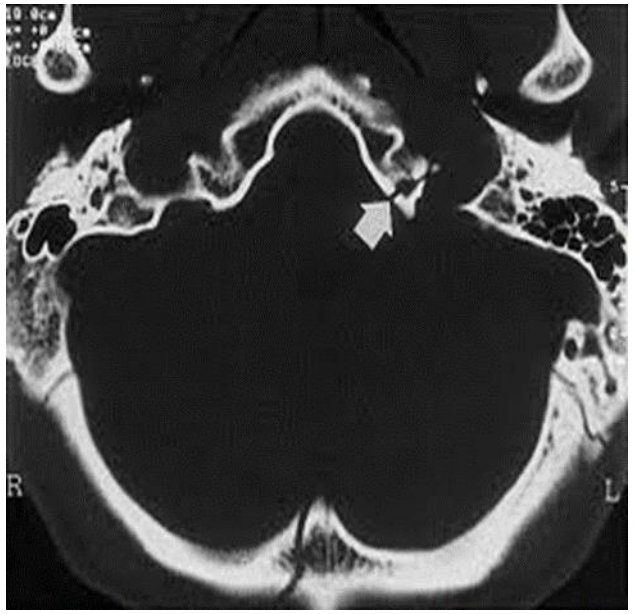


Classification of Head injury

Morphology (Linear Skull fractures CT, bone W.)

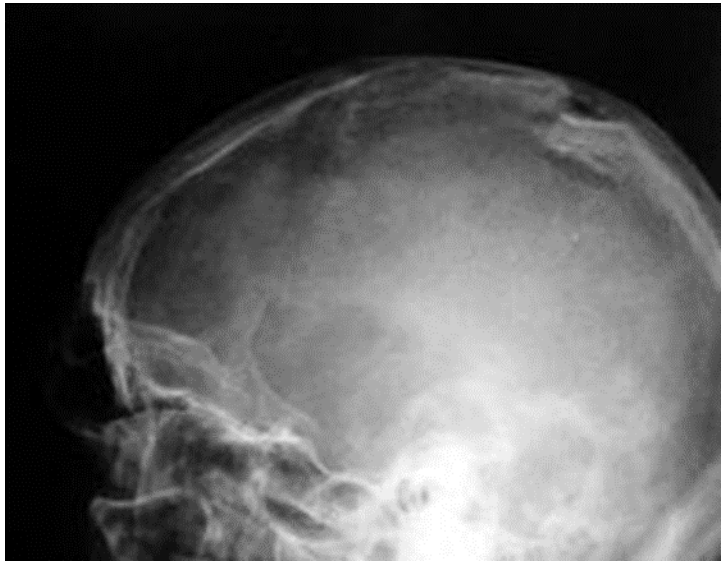


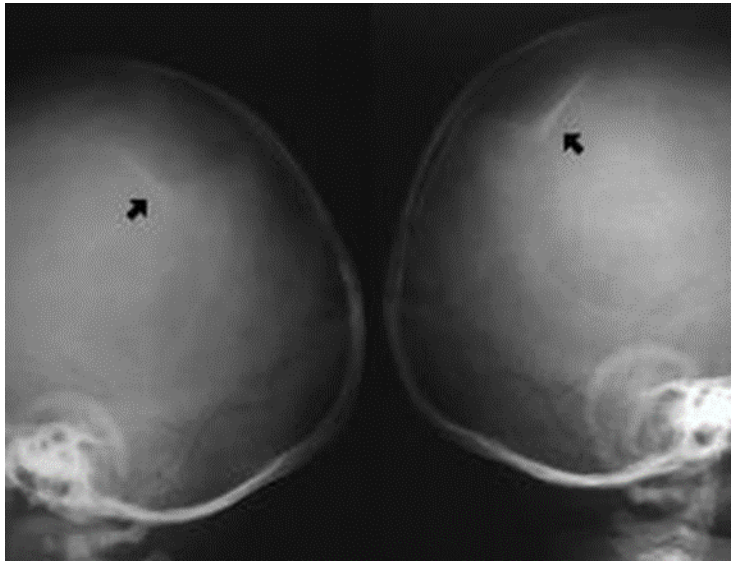




Classification of Head injury

Morphology (Depressed Skull fractures X-ray)



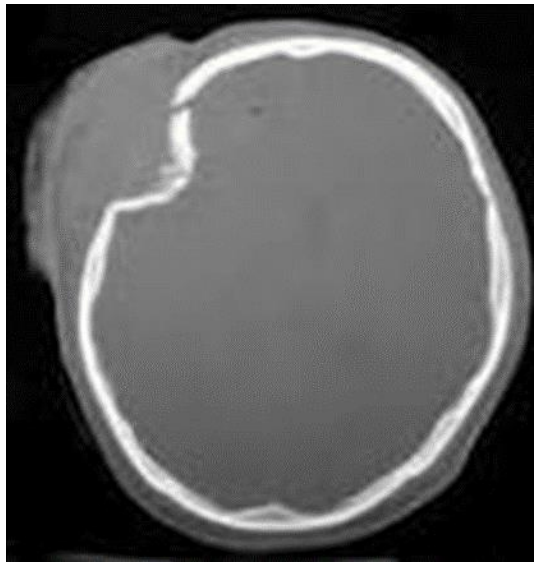




Classification of Head injury

Morphology (Depressed Skull fractures CT)







Classification of Head injury

Morphology (Depressed Skull fractures CT)



Clinical signs of skull base fracture

Raccoon eyes & Rhinorrhea (anterior skull base fracture)





Clinical signs of skull base fracture

Battle sign & Otorrhea





Clinical signs of skull base fracture

Facial nerve palsy: UMN or LMN? Rt or Lt?



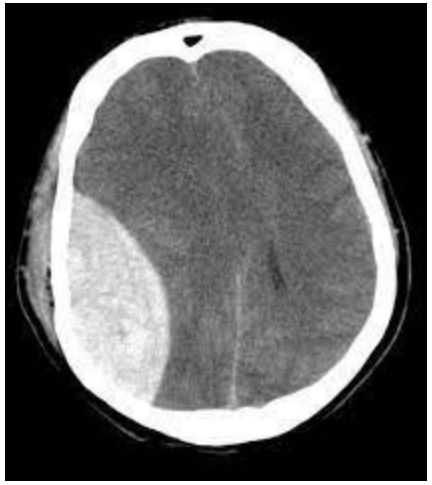
Classification of Head injury
Morphology (Intracranial injuries)

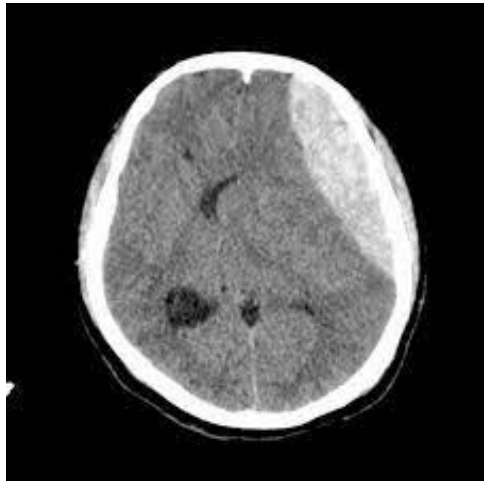
Focal injuries	Diffuse injuries
• Epidural hematoma • Subdural Hematoma/air • Intracerebral contusion/ hematoma	• Concussion / Diffuse axonal injury • Multiple contusions • Hypoxic / ischemic injury

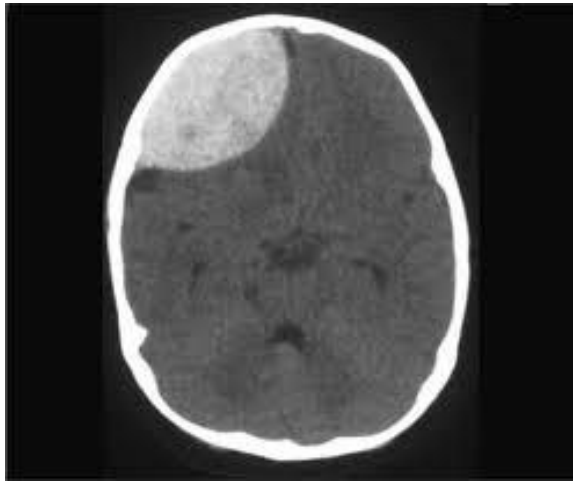
Epidural hematoma (EDH)

- Usually associated with skull fracture
- Classic source: middle meningeal artery tear
- Lenticular/ biconvex shape
- Lucid interval
- Can be rapidly fatal
- Early evacuation essential

Epidural hematoma CT







Temporal EDH

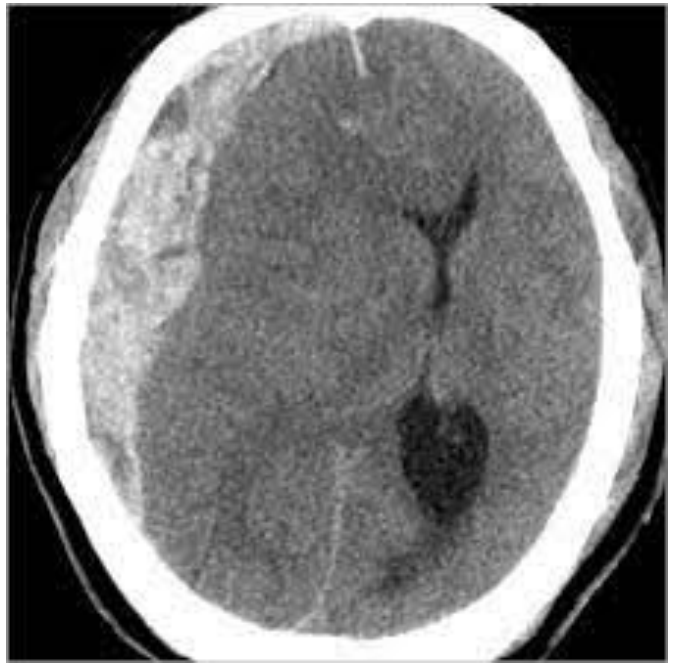


Subdural hematoma (SDH)

- Venous tear/ brain laceration
- Covers cerebral surface/ Crescent shape
- Morbidity & mortality due to underlying brain injury
- Rapid surgical evacuation recommended, especially if > 5 mm shift of midline

Acute Subdural hematoma (0-3 days)

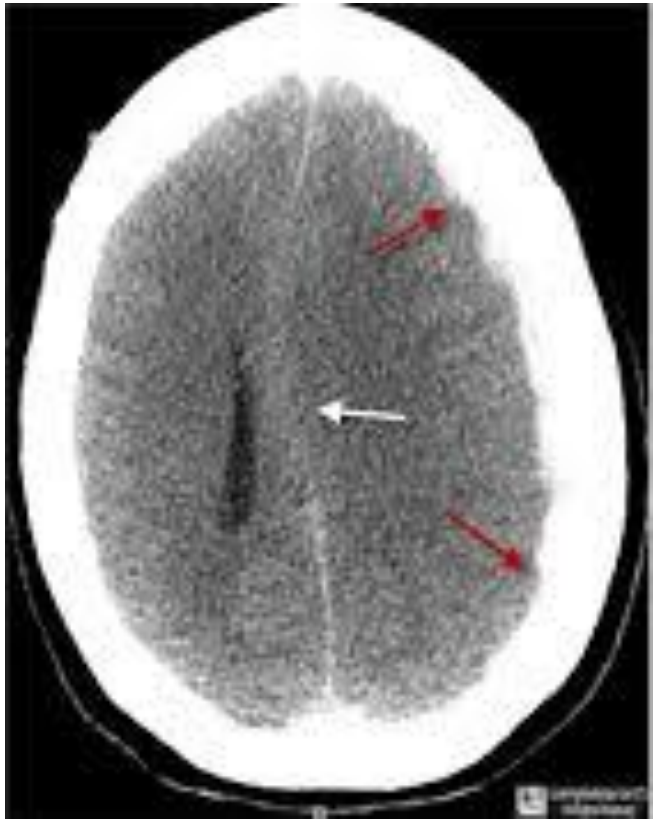
Hyperdense to brain





Subacute Subdural hematoma (3 days - 3wks)

Isodense to brain



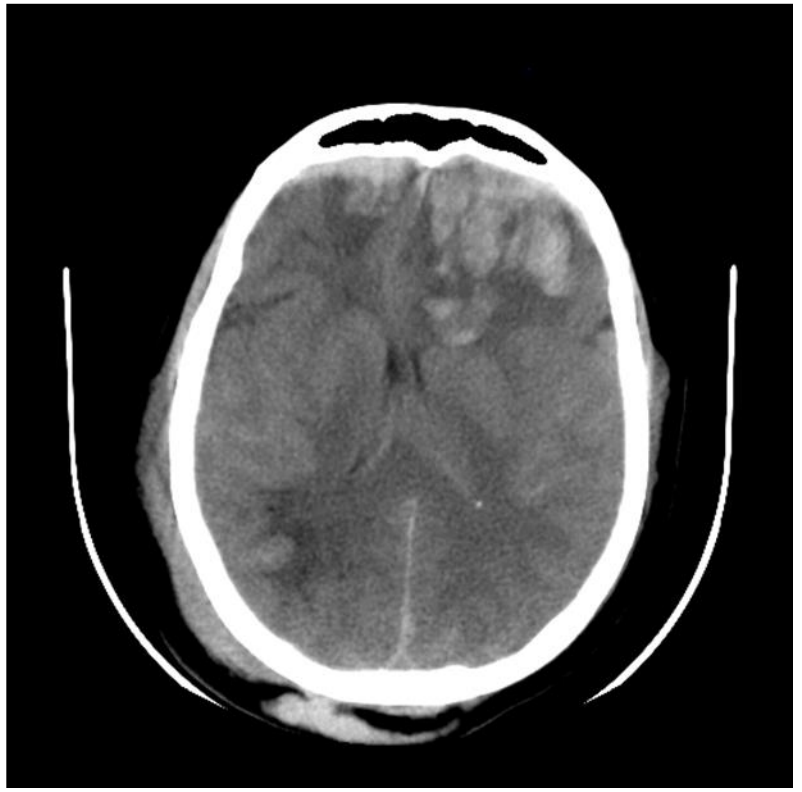
Chronic Subdural hematoma (>3wks)

Hypodense to brain



Intracerebral Hematoma/ Contusion

- Coup/ contrecoup injuries
- Most common: frontal & temporal lobes
- CT changes usually progressive
- Most conscious patients: no operation



Diffuse Brain Injury
Ranges from mild concussion to severe ischemic insult

Normal Brain



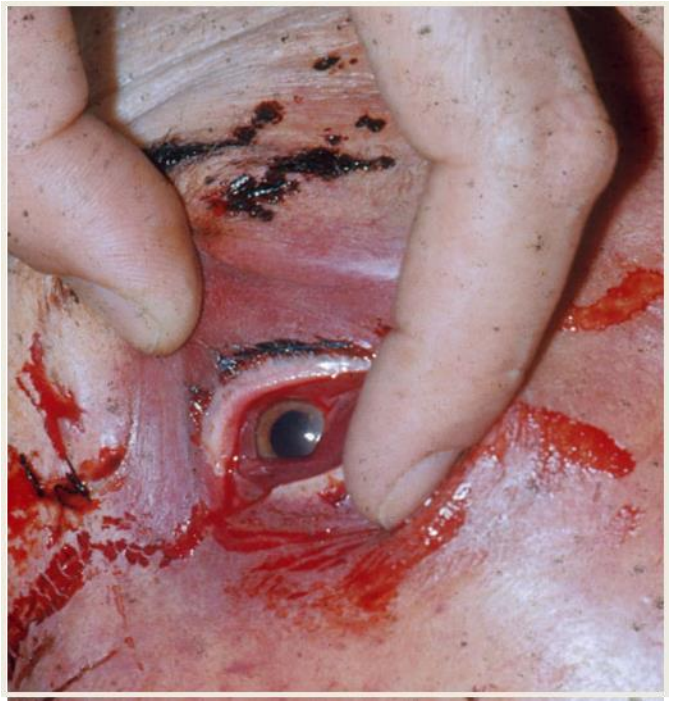
Severe diffuse brain injury



Management of Head Injury

Focused Neurological Exam

- GCS score
- Pupils
- Lateralizing signs



Management of Head Injury

Management Priorities

- ABCDE
- Minimize secondary brain injury:
  - Administer oxygen
  - Maintain adequate ventilation
  - Maintain blood pressure (systolic > 90 mm Hg

Indications for CT scan

<u>High risk</u>

- GCS score still < 15 two hours after injury
- Neurologic deficit
- Open skull fracture
- Sign of basal skull fracture
- Extremes of age

Indications for CT scan

Moderate risk

- Dangerous mechanism
- Retrograde amnesia > 30 minutes in duration
- Severe headache
- Vomiting > 2 episodes

Management of Mild Head Injury (GCS 13-15)

- Take detailed history
- Perform neurologic exam
- Exclude systemic injuries
- Alcohol/ drug screens as indicated
- Liberal use of head CT
- Observe or discharge based on the findings
- Analgesics & Antibiotics as indicated

Management of Moderate Head Injury (GCS 9-12)

- Initial evaluation same as for mild injury
- CT scan for all
- Admit and observe
- Analgesics & Antibiotics as indicated
- Frequent neurologic exams
- Repeat CT scan as indicated
- Deterioration: Manage as severe head injury

Management of Severe Head Injury (GCS 3-8)

- Evaluate and resuscitate. Ensure adequate oxygenation.
- Maintain MAP > 90 mm Hg
- Focused neurologic exam (before sedation). Frequent reevaluation
- Intubate for airway protection. ICU admission. Keep head of bed 30^{o}
- Identify associated injuries
- Controlled ventilation (Goal: Paco2 at 35 mm Hg)
- Intravenous fluids (Euvolemia, Isotonic)
- Mannitol (Use with tentorial herniation: 0.25 to 1.0 g / kg IV bolus)
- Anticonvulsants, Sedatives & Paralytics as indicated
- Keep normal glucose, sodium & temperature

Management of Head Injury
Scalp wounds

- Possible site of major blood loss esp. in children
- Direct pressure to control bleeding
- Occasional temporary closure (staples or sutures)

Management of Head Injury
Depressed Skull # (Indications for surgery)

Any one of the next:

- Depression > 1 cm/ or full bone thickness
- Gross wound contamination
- Significant intracranial hematoma
- Gross cosmetic deformity
- Frontal sinus involvement
- Dural penetration (clinical or radiological)

Management of Head Injury
Depressed Skull # (When to conserve?)

1. All the following are present (No indications):
   - No depression > 1 cm/ or full bone thickness
   - No gross wound contamination
   - No significant intracranial hematoma
   - No gross cosmetic deformity
   - No frontal sinus involvement
   - No dural penetration (clinical or radiological)

2. Or if the fracture is over a venous sinus & the patient is stable

Management of Head Injury
EDH – Indications for surgery

- GCS score ≤ 8 and anisocoria
- Hematoma volume ≥ 30 cm3
- Effaced cisterns
- Deteriorating neurologic status
- Hematoma volume < 30 cm3 but:
  - Thickness ≥ 15 mm
  - Midline shift ≥ 5 mm
  - GCS ≤ 8
  - Focal motor deficit

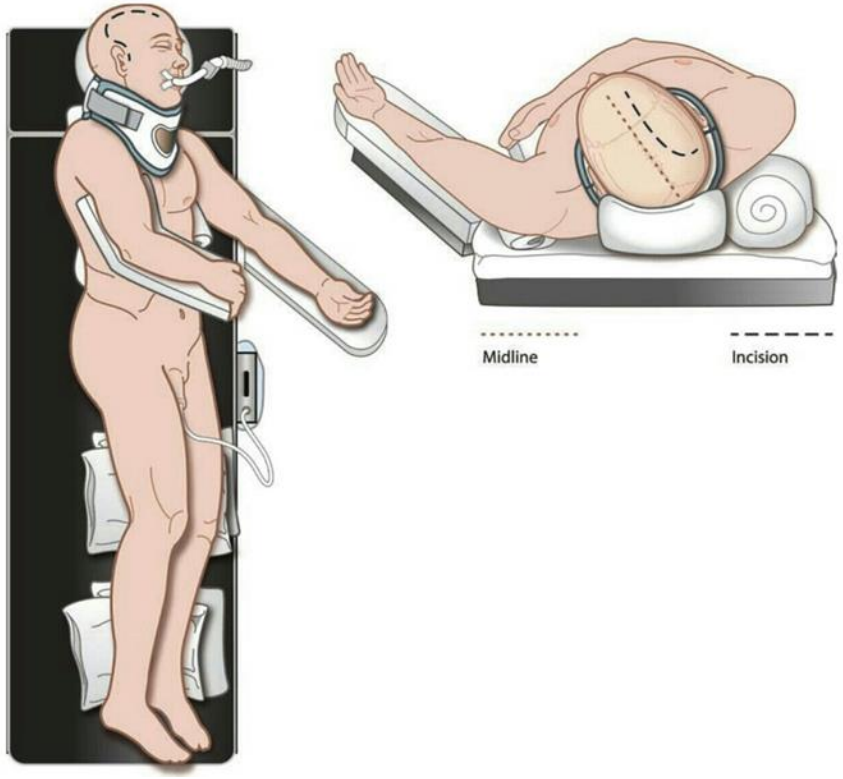
Management of Head Injury
Acute SDH – Indications for surgery

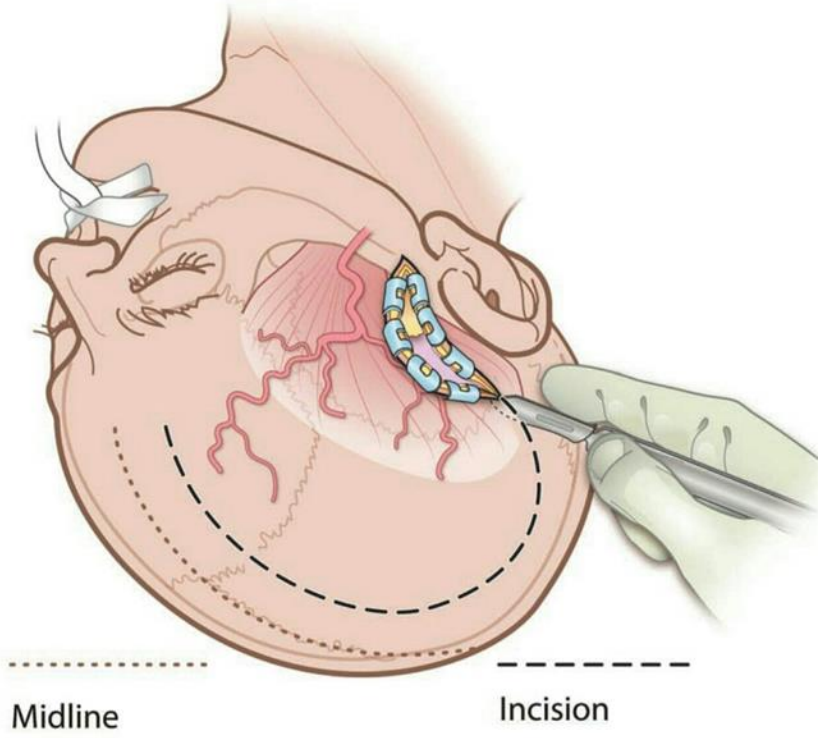
- Thickness > 10 mm, regardless of GCS
- Midline shift > 5 mm, regardless of GCS

- If thickness < 10 mm & shift < 5 mm, then operate if any of the following is present:
  - GCS drops by ≥ 2 points
  - Anisocoria
  - ICP > 20 mmHg

Standard Trauma Craniotomy

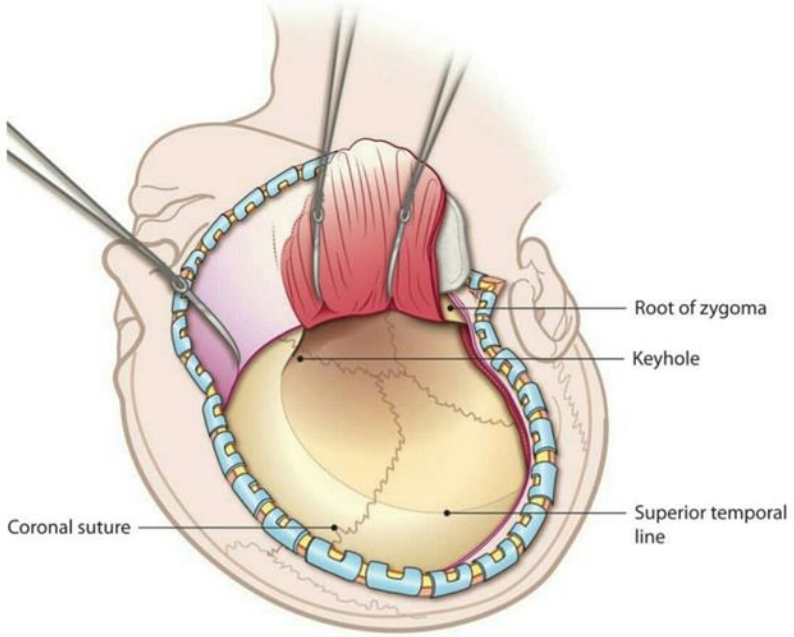
Positioning & Skin incision

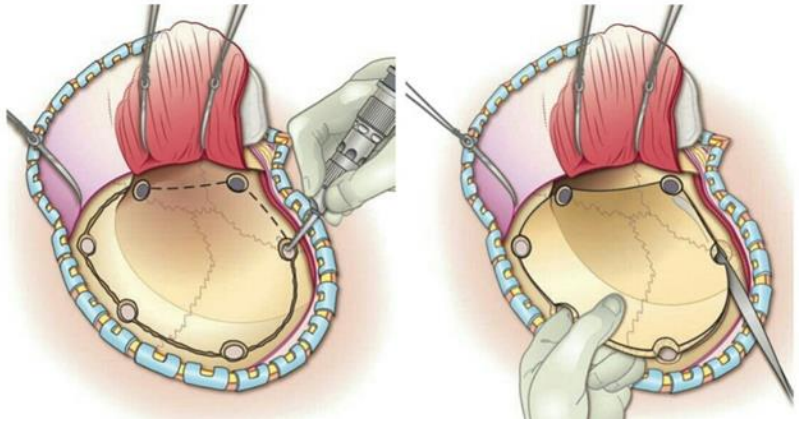




Standard Trauma Craniotomy

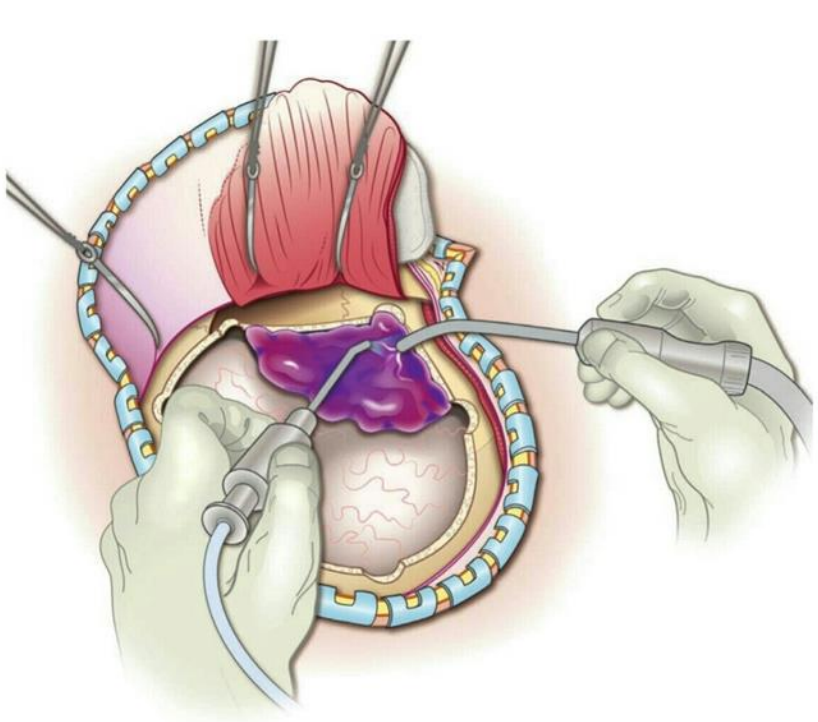
Skin & bone flab

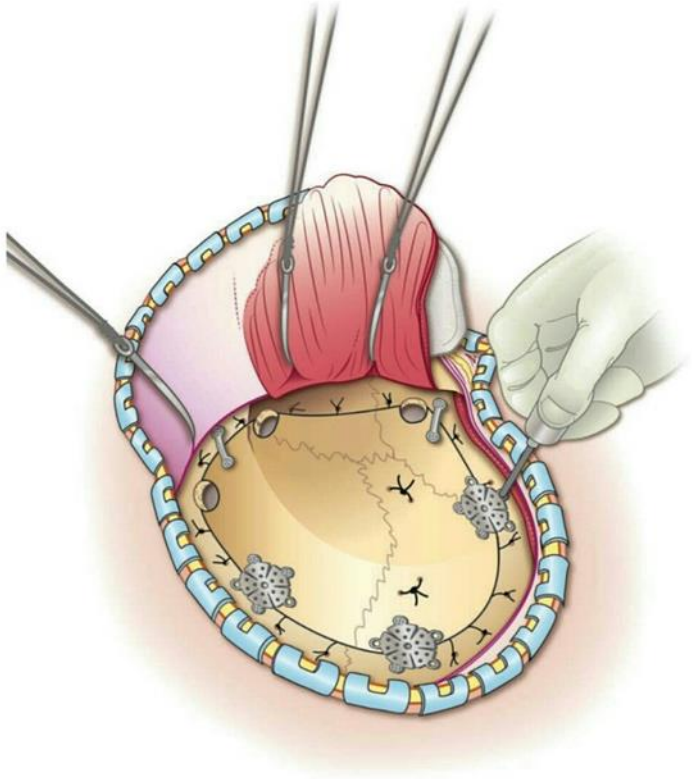




Standard Trauma Craniotomy

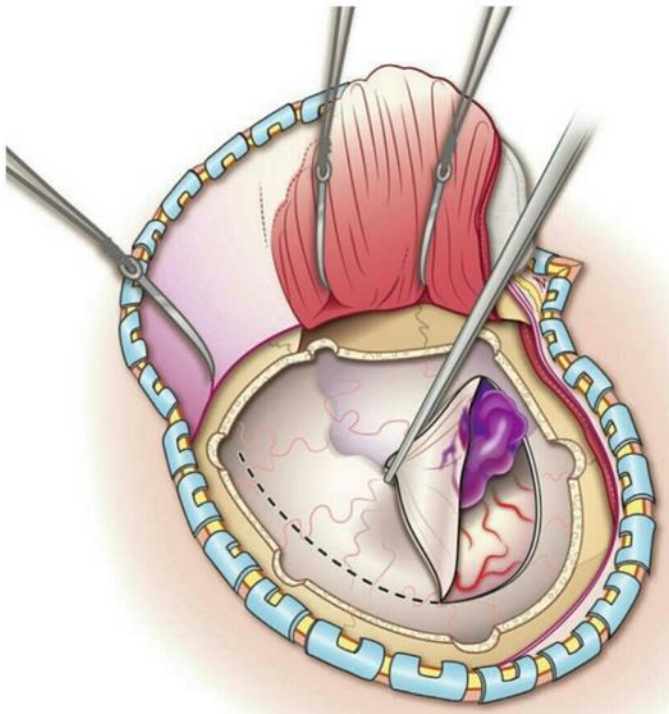
Evacuation of EDH & Replacement of bone flab

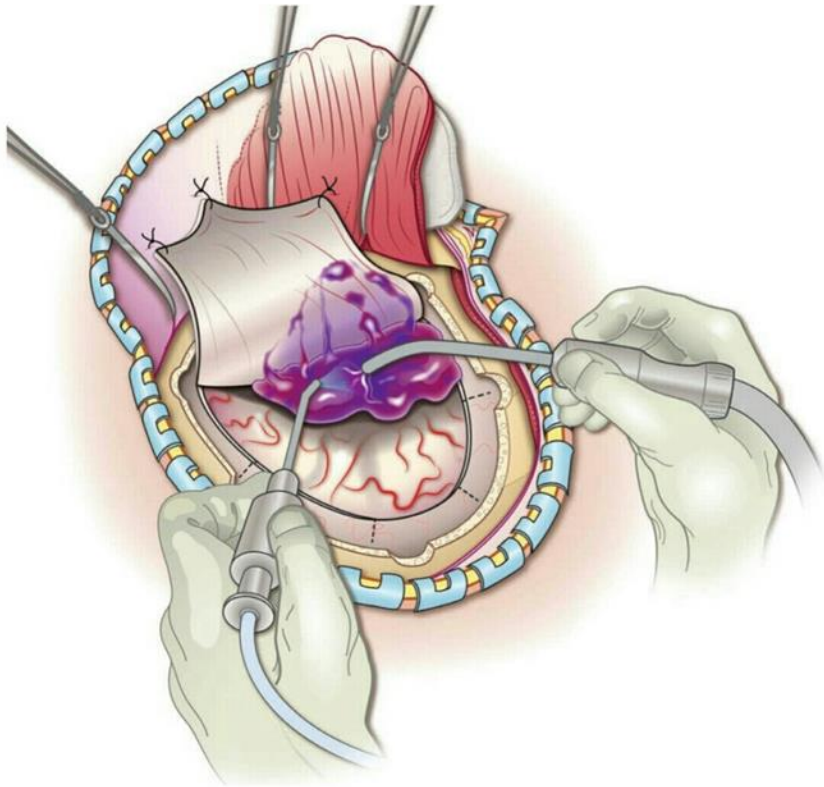




Standard Trauma Craniotomy

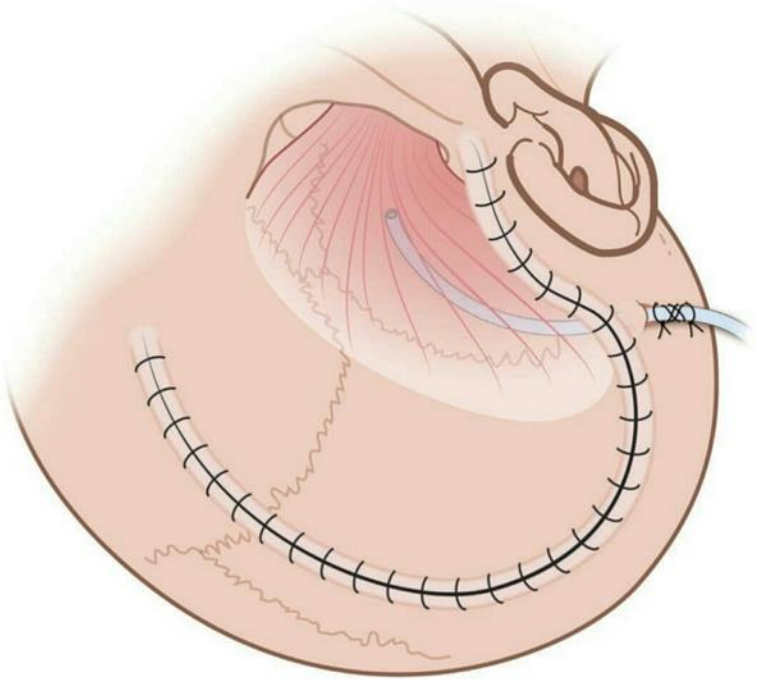
Evacuation of ASDH





Standard Trauma Craniotomy

Skin closure over a drain



Burr holes for Subacute or Chronic SDH



Standard Trauma Craniotomy
Equipment & instruments

High speed drill



Perforator & Bone cutter



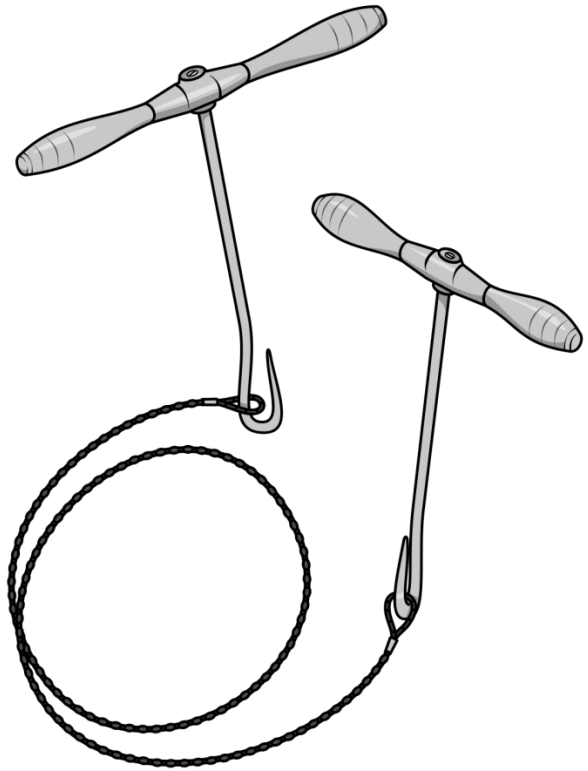


Standard Trauma Craniotomy

Hudson brace







Thanks



Any Questions?