

Neurotrauma-TBI

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Statistics

- Trauma is leading cause of death in age 1-44
- 1-1.5 million TBI / year
- Financial burden of head injury 100 billion/yr
- 12,000 pediatric deaths /year
- Immeasurable loss of productivity



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Statistics (con't)

- MVA most common cause (teens / young adults)
- Falls 2nd (babies / geriatric)
- ETOH / drugs in 45% of TBI
- Fridays, Saturdays, Sundays
- “Trauma season” April - September

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Magnitude of Problem

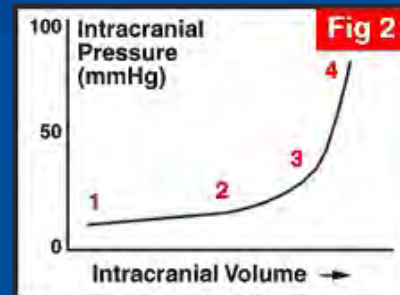
- 1969 Landmark study by National Research Council & National Academy Science
- “accidental death and disability- the neglected disease of modern society”
- 1985 Institute of Medicine- “Injury in America: a continuing public health problem

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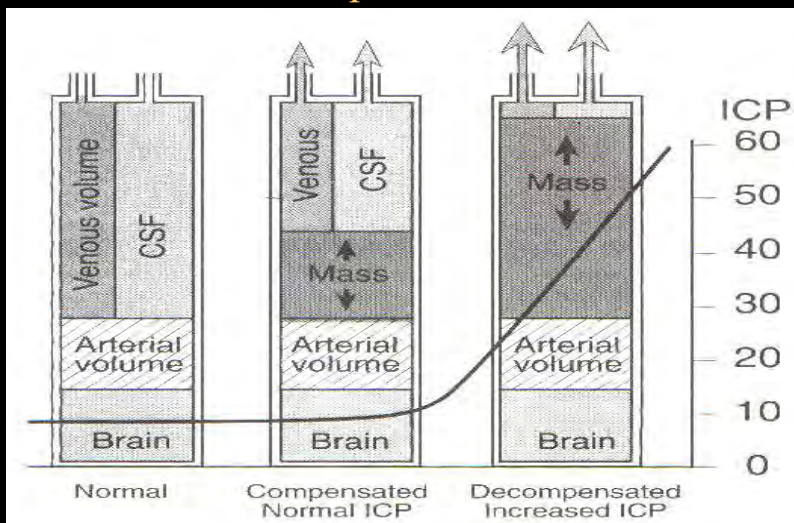
Physiology

- Total volume 1600 cc
 - Brain tissue
 - (80%)
 - Blood (12%)
 - CSF (8%)
- ICP is pressure within the skull



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Monroe- Kellie Principle



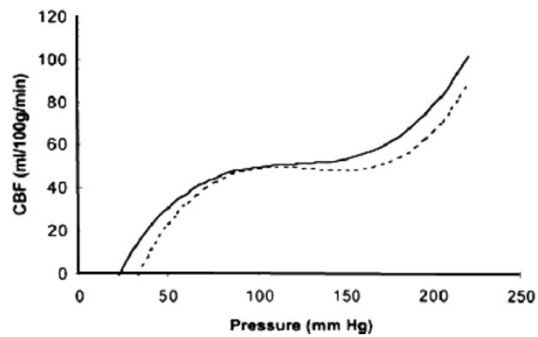
Rogers (1996) Textbook of Pediatric Intensive Care p. 646

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Physiology

- Autoregulation: CBF constant in nl brain despite BP fluctuations
- In TBI, CBF can be BP dependent

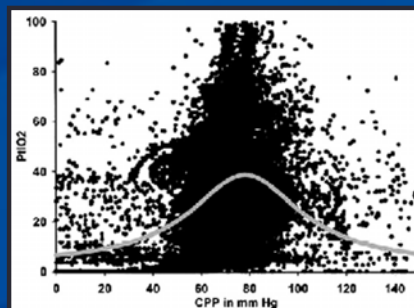


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Physiology

- CPP (Cerebral Perfusion Pressure + effective pressure driving blood through the brain (MAP – ICP))
- Normal CPP = 80mmHg
- When < 50 = metabolic evidence ischemia and reduced electrical activity -adults



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History-what is important

- Condition of patient in field and in route
- Mechanism of injury
- Witnesses
- Blood loss at the scene
- Weapons
- Events affecting neuro exam (h/o seizure, meds – not totally necessary)
- Substances? (Alcohol, Drugs)

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Exam

- ABC's –60% of TBI pts have > 1 other organ system injury find injuries with potential for rapid HD death
- GCS helpful, not totally necessary
- Pupils – “blown” helpful to know
- Scalp lac's
 - Can be major bleeding source



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Glasgow Coma Score

Eye Opening (E)	Spontaneous	4
	To speech	3
	To pain	2
	None	1
BEST Motor Response (M)	Obeys commands	6
	Localizes pain	5
	Flexion	4
	Abnormal flexion (decorticate)	3
	Extension (decerebrate)	2
	None	1
Verbal Response (V)	Oriented	5
	Confused	4
	Inappropriate words	3
	Incomprehensible sounds	2
	None	1

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Neurosurgery Consult: SHOCK

- Hypovolemic shock should never be attributed to TBI unless:
 - LARGE amount of scalp bleeding
 - HD instability 2/2 TBI is late sign

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Intracranial Hematomas That Can Result in Mass Effect

- Epidural
- Subdural
- Intracerebral

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Subdural Hematomas

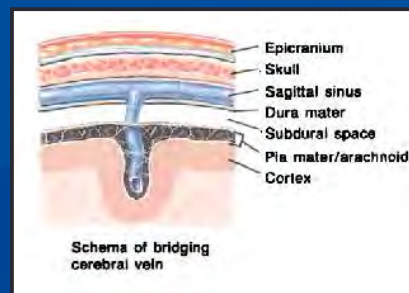
Venous tear / Brain laceration

Covers entire cerebral surface

Morbidity / mortality due to underlying brain injury

greater impact than EDH

Most common mass lesion

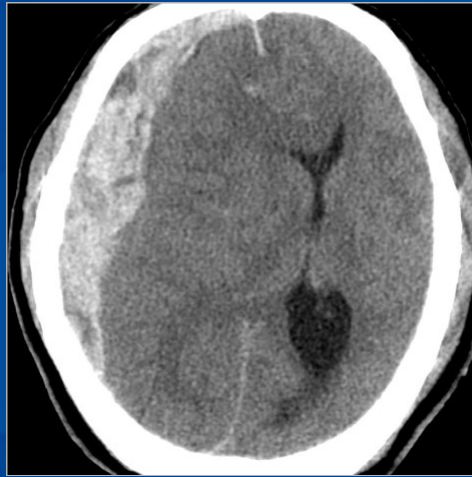


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Imaging: Subdural Hematomas

- High density on CT
- Tracks along brain
- Often midline shift



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Epidural Hematomas

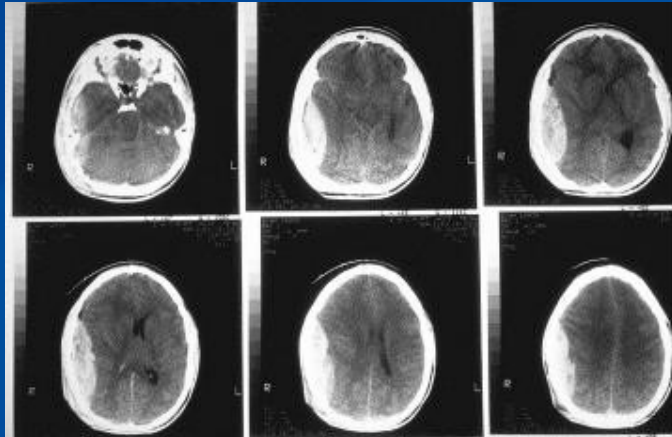
- Typically caused by laceration of dural artery
 - Can deteriorate rapidly
- Often have better outcomes than SDH
- More common in younger patients

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Imaging: Epidural Hematomas

- High density on CT
- Usually indents brain
- “Lens shaped”
- Can rapidly change
 - repeat CT soon!

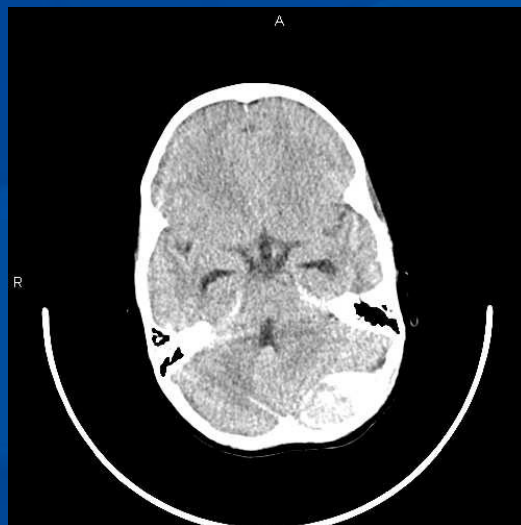


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Imaging: Epidural Hematomas

- Can sometimes be posterior fossa location



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Intracerebral Hematomas

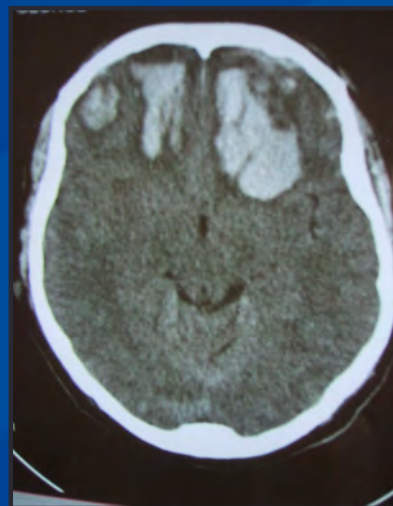
- Typically frontal or temporal lobe location
- Usually worse in patients on anticoagulation
- Often result from coalescence of contusions
- Frequently worsen after admission

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Imaging: Intracerebral Hematomas

- Example Bifrontal
- High density on initial CT – may “blossom”
- Occur where brain impacts upon skull
 - Can be “contre-coup”
- May develop significant edema over days
- Surgically remove if symptomatic

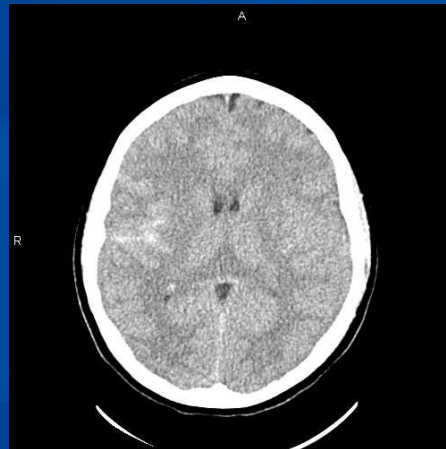


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Subarachnoid Hemorrhage

- Follows sulci and cisterns
- At most may require ICP monitor



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Other Important Imaging Findings

- Normal Basal Cisterns

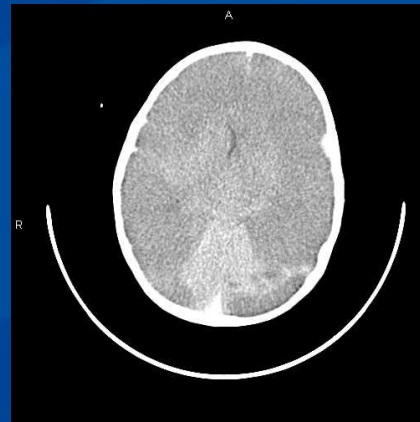


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Other Important Imaging Findings

- Junction of Grey and White Matter

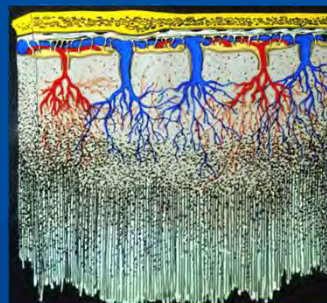
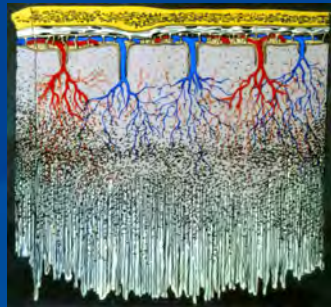


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Second Impact Syndrome

- Catastrophic brain swelling can occur if concussions happen near each other in time
- Intracranial vasodilation and cerebrovascular congestion – vascular autoregulation dysfunction



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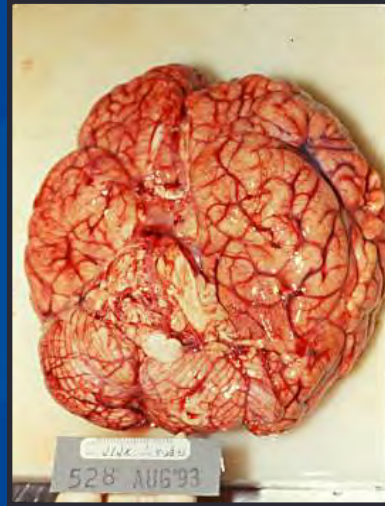
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Second Impact Syndrome

Case: 16 y/o football player lost consciousness and collapsed on the practice field following one kick-off play

He had complained of HA on the preceding night (1st day of contact drills)

Died after 3 days in ICU

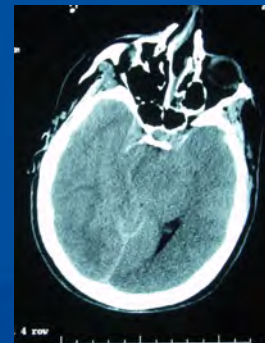
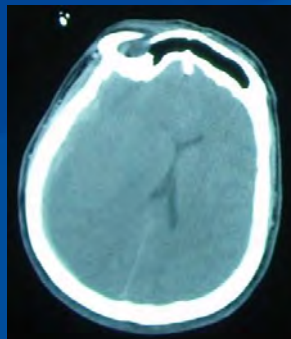


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Second Impact Syndrome

- Case: Case: boxer s/p one hit to side of head
- review of television news tapes- stopped breathing on impact
- CT Subdural Hematoma + Large amount of edema and shift



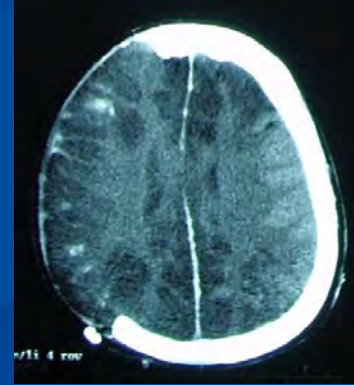
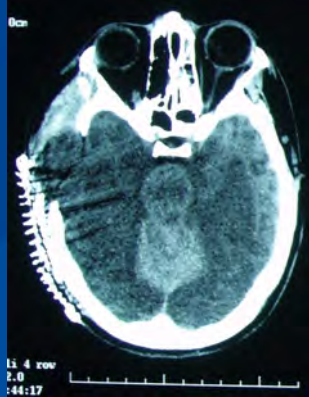
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Second Impact Syndrome

Case: Boxer S/P Decompressive Craniectomy

Result: Death



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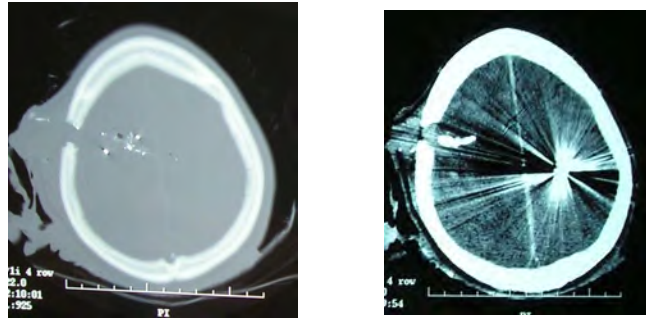
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Penetrating Injuries-Gunshots

- 2/3 dead on scene
- 94% of pts comatose on admission will die
- Damage strongly related to muzzle velocity
- Bullet that crosses midline at level of ventricle system will almost always be fatal
- Salvageable? consider debridement
 - Nearly all surgeries for this would be “cleanup & close”

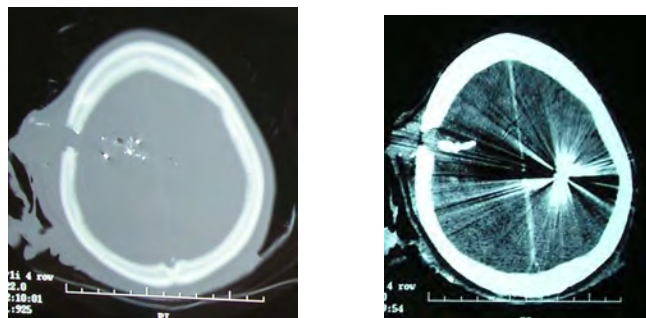
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Penetrating Brain Injury



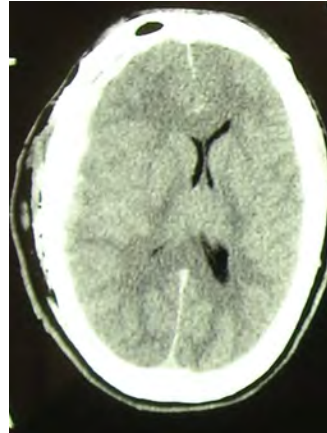
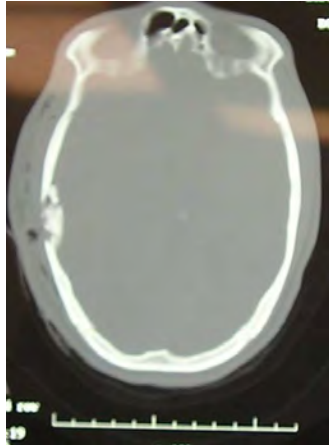
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Penetrating Brain Injury

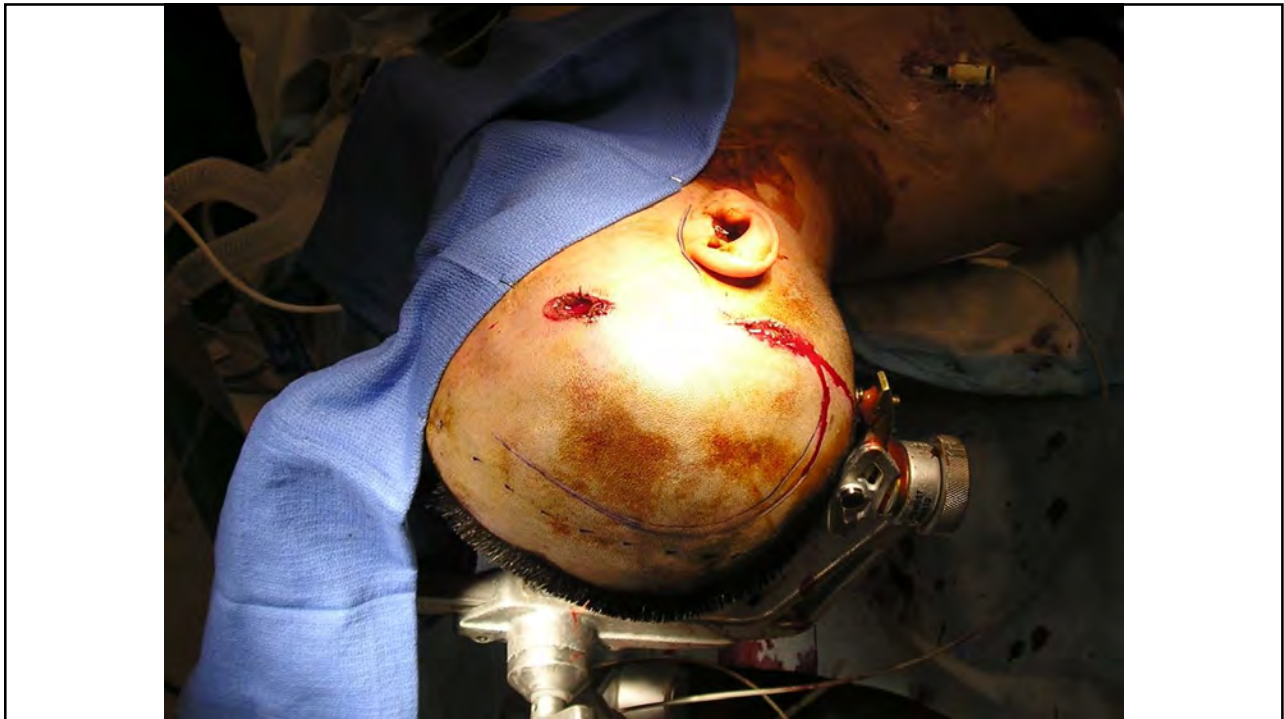


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Penetrating Brain Injury



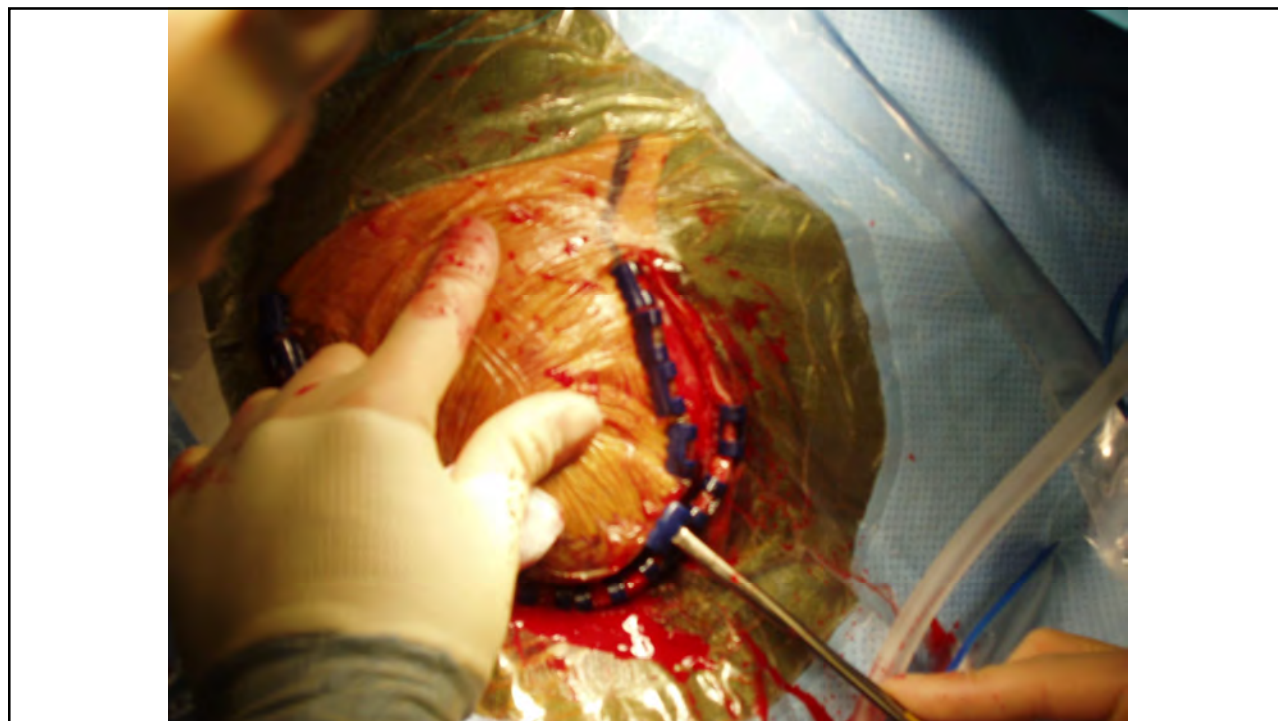
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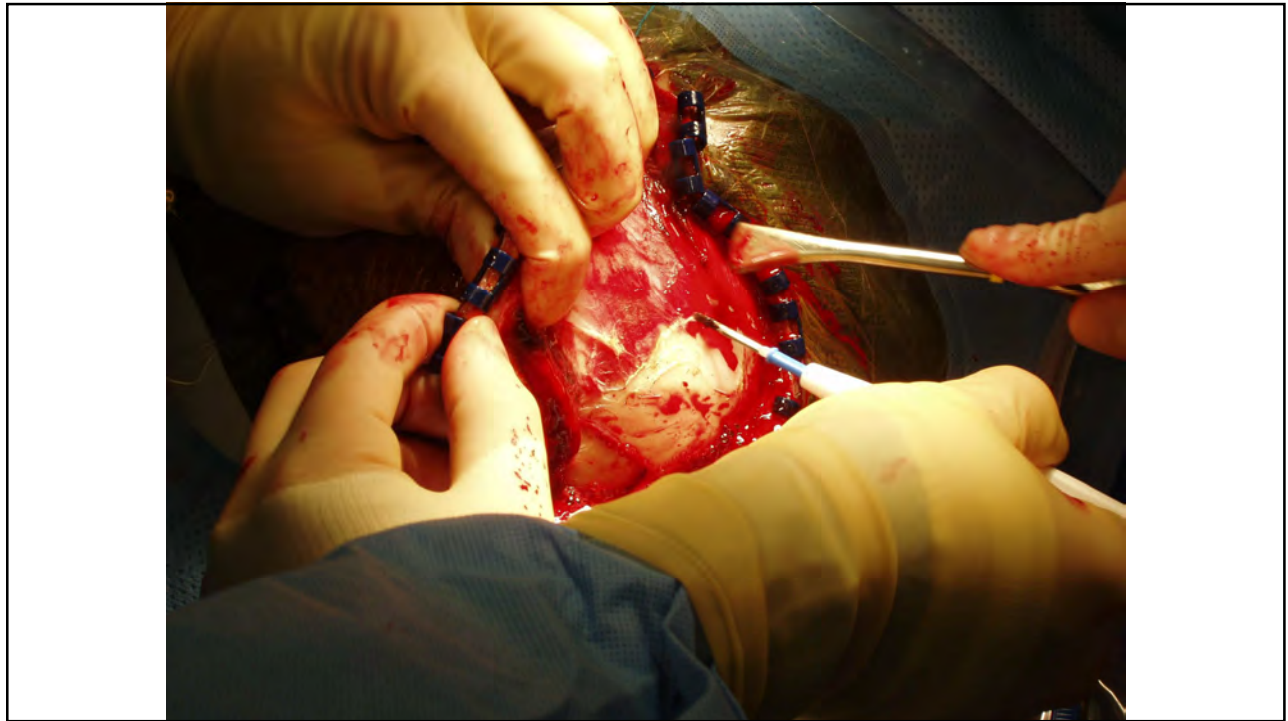
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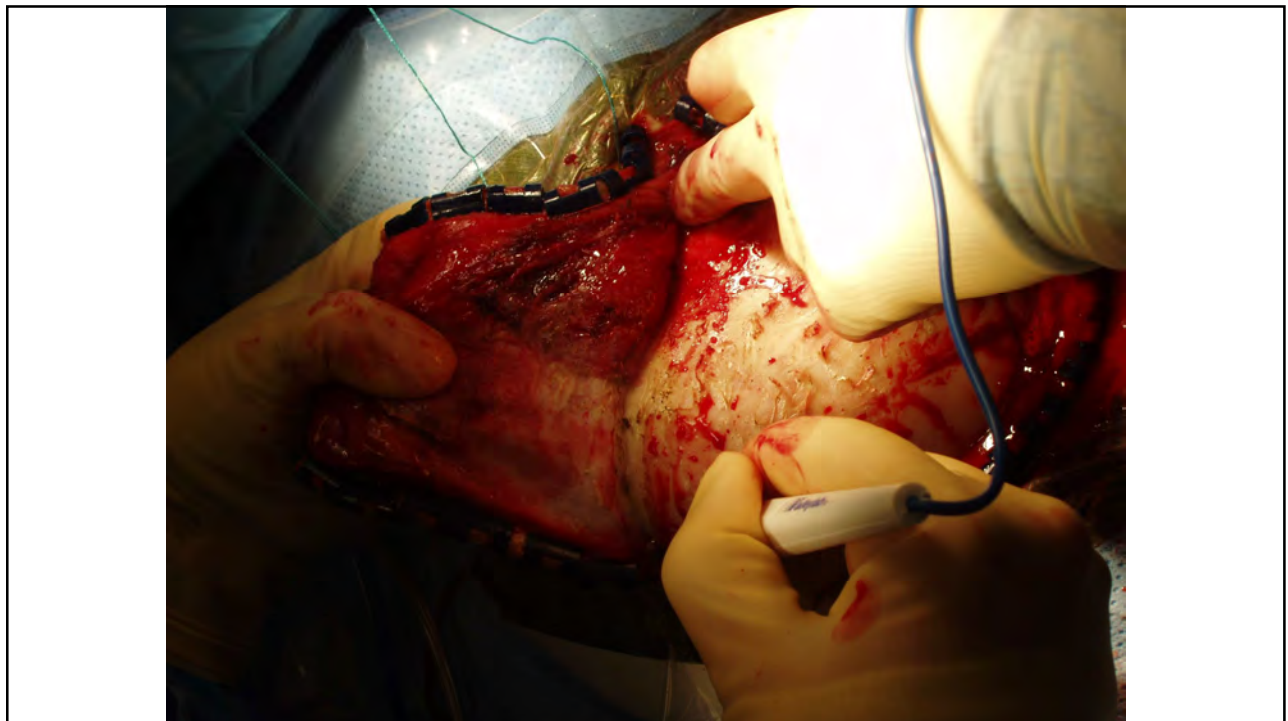
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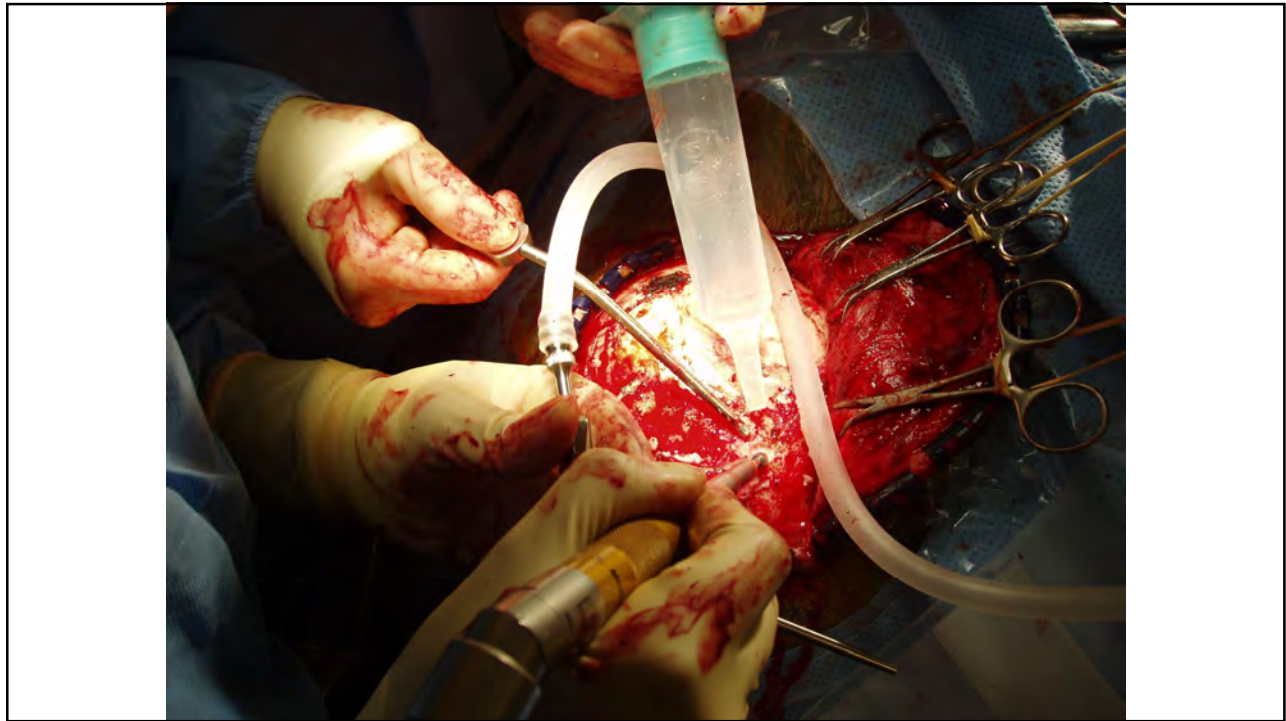
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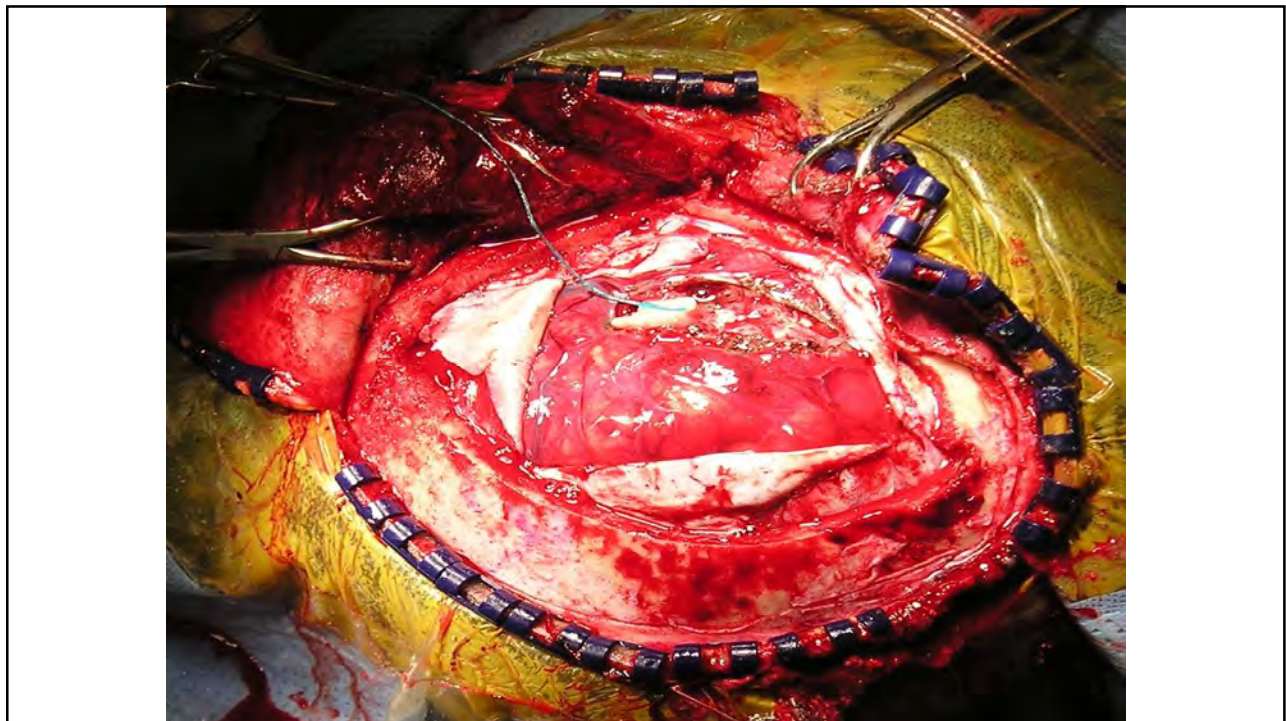
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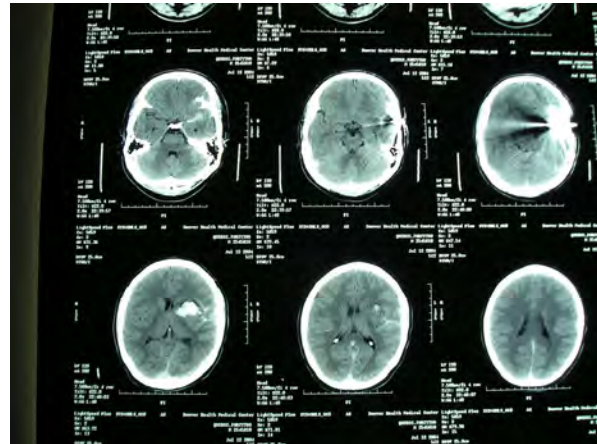


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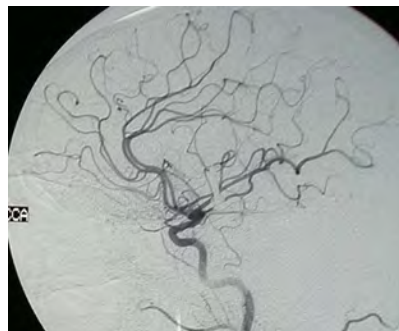
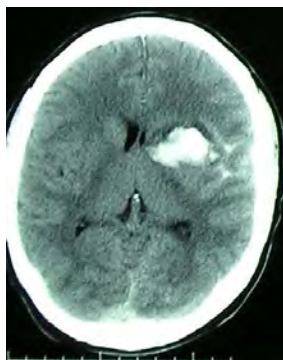


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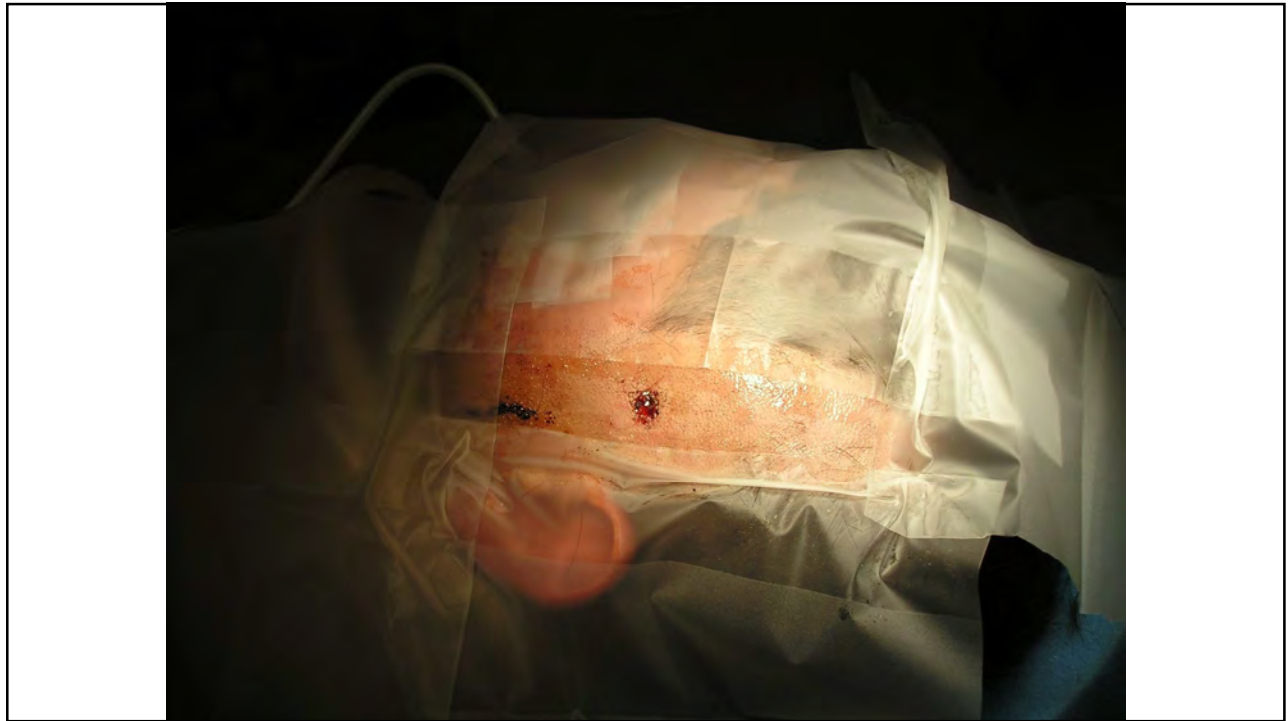
Penetrating brain trauma-Non Missile Injuries



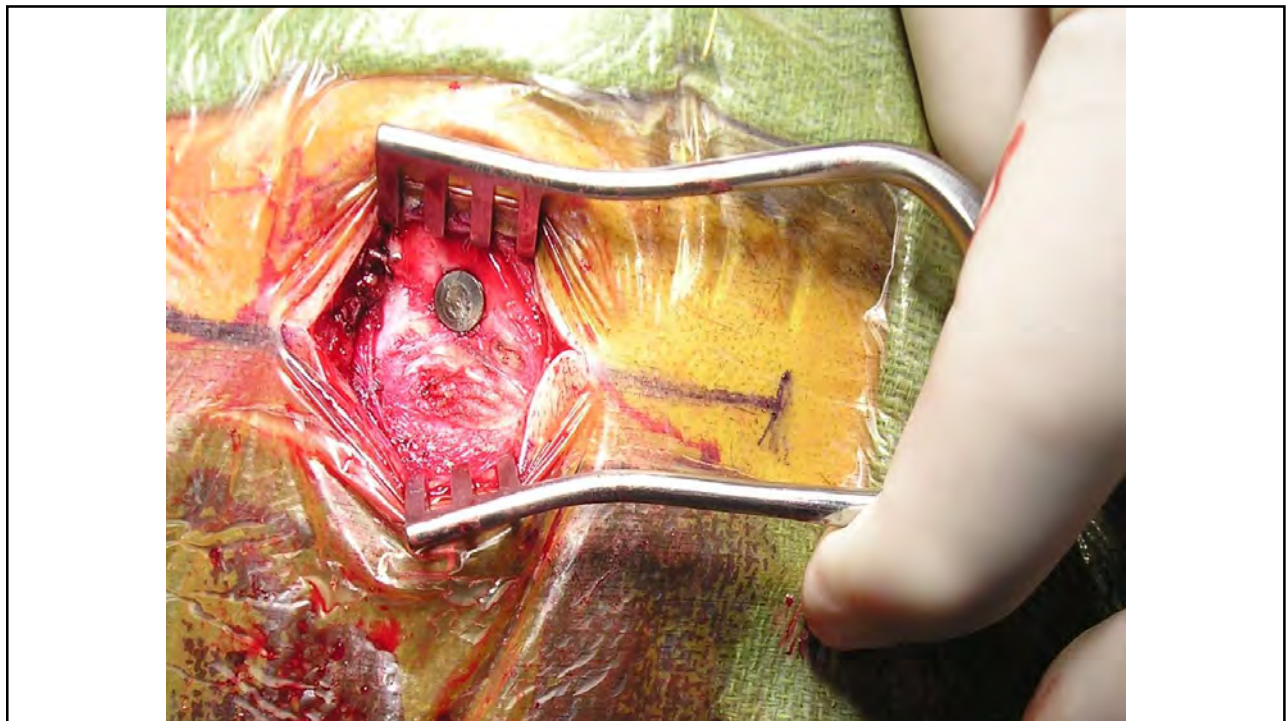
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Diffuse Axonal Injury

- *Primary* brain injury
- Unimpressive CT – Impressive exam
- Difficult for families to understand
- Rotational acceleration – deceleration
- Hemorrhage foci at g-w jxn, corpus callosum, brainstem



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Diffuse Axonal Injury

- Can occur with mass lesions
- Structural failure of the axon results in physical separation of the axon into proximal & distal segments
- Distal segment undergoes Wallerian degeneration
- More axons disrupted = more pathways disrupted = more deficits
- NO TREATMENT except prevent secondary inj – secondary insults may “seal the fate” of the axon

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Medical Management following TBI

- ICP Monitor
- Position- Elevate Head
- Diuretics- Mannitol, Hypertonic Na
- Sedation/Paralytics
- Drain CSF via EVD



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Fiberoptic ICP Monitor



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ICP Monitoring-Indications- General Rules of Thumb

- Any patient who cannot follow commands (or have a reliably followable exam for nonverbal pts) has an ICP monitor inserted
- This might include pts who can follow commands but will be without an exam for a critical period (under anesthesia, etc.)

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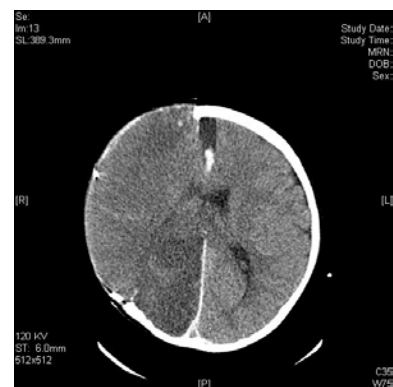
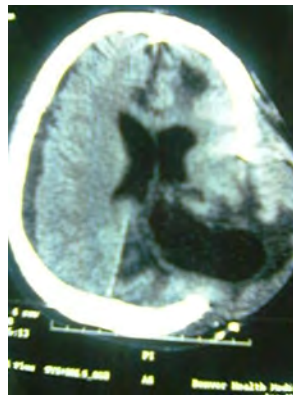
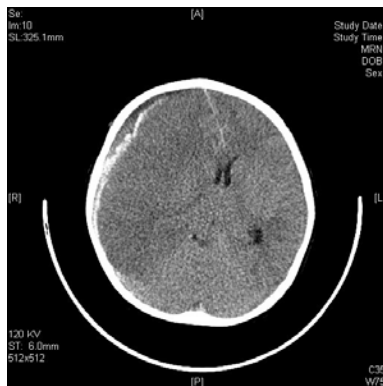
Decompressive Craniectomy



- If no mass lesion: Last resort in highly selected cases
- If mass lesion: May leave craniotomy flap off if brain is massively swollen.

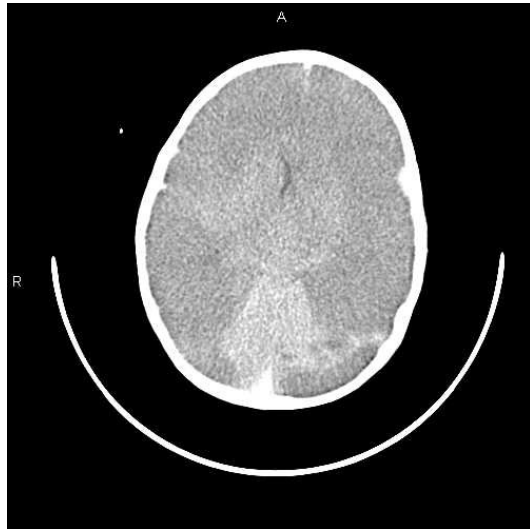
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Decompressive Craniectomy



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Contraindication to Decompressive Craniectomy?



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