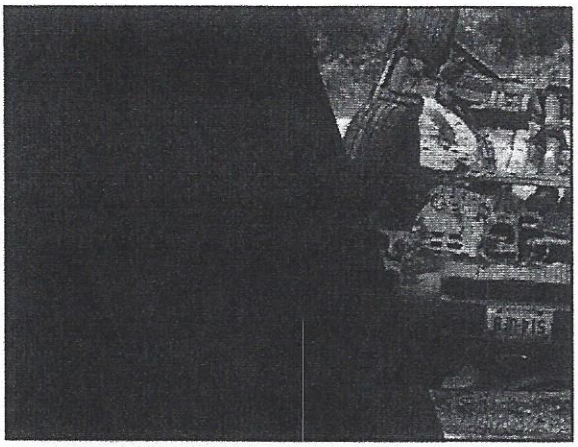
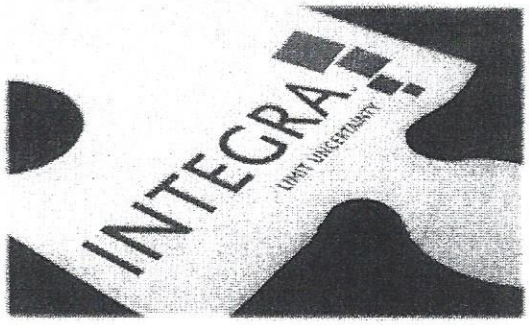


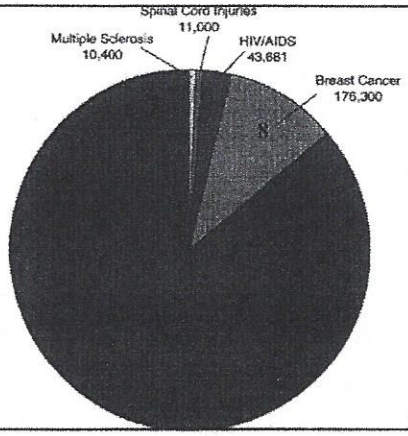
Disclosures

Integra Neurosurgery - Clinical Specialist

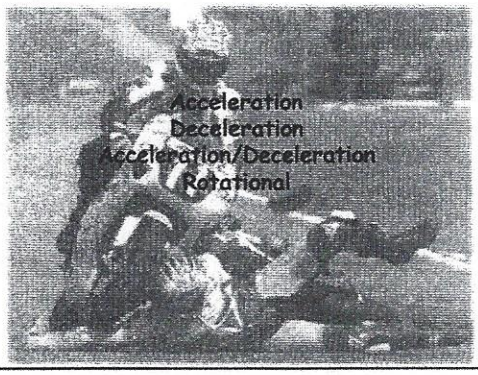


Brain Injury Statistics

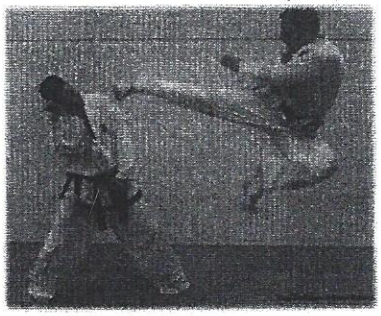
- Approximately 1.7 million Americans experience a TBI/year
- A brain injury occurs every 15 seconds
  app 50% of these result in short-term disability
- 50,000 die each year
- Cost - $48.3 billion/year



Mechanism of Injury

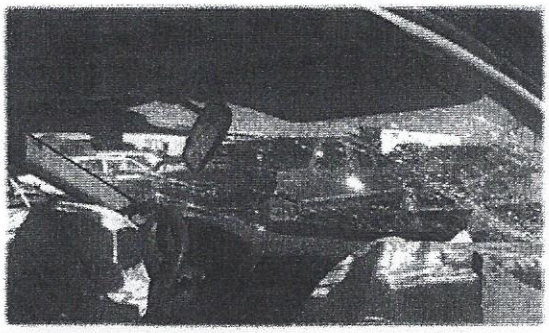


Acceleration Injury



A stationary head...
is hit by a moving object

Deceleration Injury



Moving head...hits a stationary object

Acceleration/Deceleration

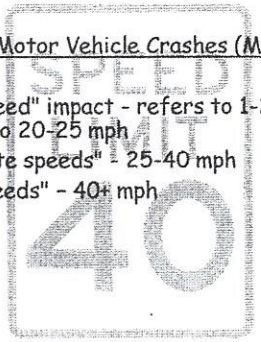
Moving head...hits a moving object

Rotational Injury

A force that is slightly oblique causing the head to rotate around its point of articulation at the top of the spine as it is hit

"Torsion Force"

Mechanism of Injury

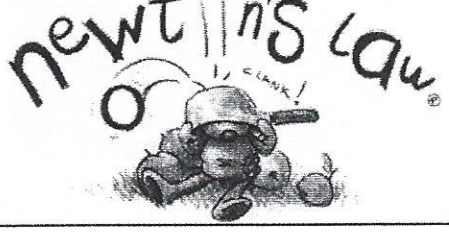


Motor Vehicle Crashes (MVC)

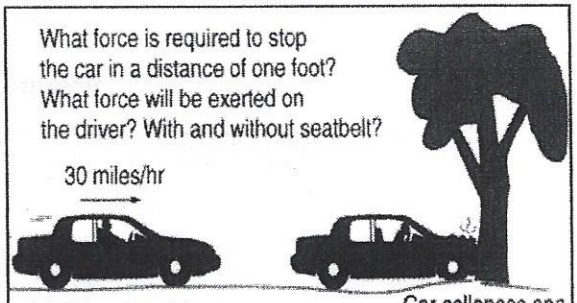
- "Low-speed" impact - refers to 1-2 mph and goes up to 20-25 mph
- "Moderate speeds" - 25-40 mph
- "High speeds" - 40+ mph

Basic Laws of Motion

- "Energy cannot be created or destroyed, but it can change in form and be absorbed"
- Motion injury is basically caused by the body's absorption of energy



What force is required to stop the car in a distance of one foot? What force will be exerted on the driver? With and without seatbelt?



Initial kinetic energy $\frac{1}{2}mv^2$

Work required to stop the car $F_{avg}d = -\frac{1}{2}mv^2$

Question #1

What force is required to stop the car that is going at 30 mph at a distance of 1 foot?

Answer = 48.4 tons

Question #2

What is the force exerted on the restrained driver?

Question #2

Answer...

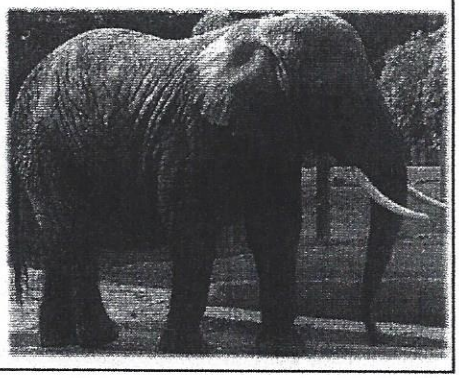
Stretching seatbelt = 1.4 tons
Non stretching seatbelt = 2.4 tons

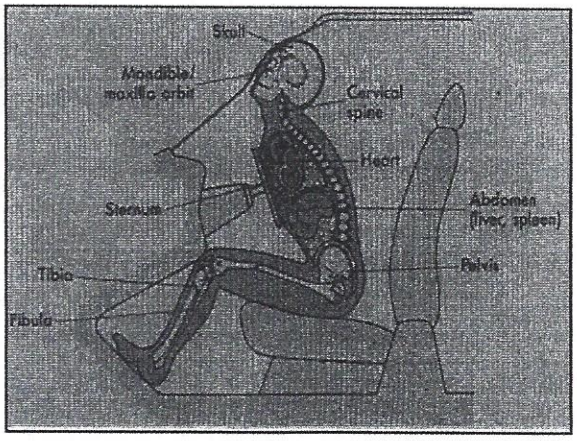
Question #3

What will the force of a crash be on an unrestrained driver?

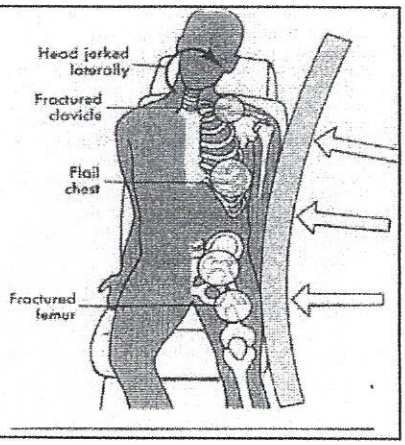
Answer...

12 Tons!





T-Bone Collision



Mechanism of Injury-Ejection

- Victims ejected from the vehicle are **25 times** more likely to be killed
- Distance between the victim and the vehicle usually indicates how fast the car was traveling and, therefore, how much energy was absorbed by the patient
- One out of 13 ejected victims sustain spinal injuries

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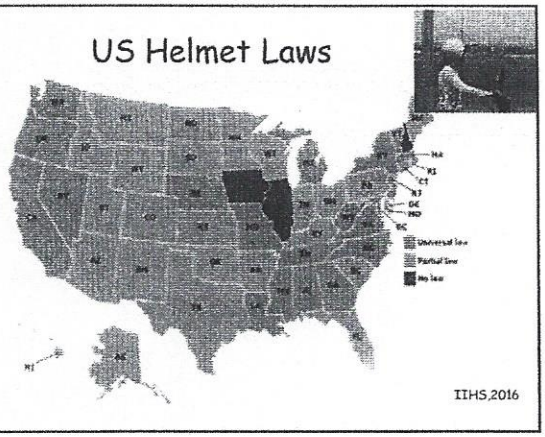
- One out of 13 ejected victims sustain spinal injuries

Mechanism of Injury-Motorcycle

- **75%** of motorcycle **DEATHS** are due to severe head trauma
- Helmets help to prevent head trauma, but do not protect against spinal injury
- Motorcycle injuries are similar to victims that are ejected from vehicles; high frequency of head, neck, and extremity trauma

US Helmet Laws



Mechanism of Injury-Pedestrian vs Auto

- With an adult, the first impact is made by the bumper to the lower extremities; in children contact is usually to the upper legs or pelvis
- As the victim folds forward, the second impact occurs when the adult's upper legs and trunk hit the hood of the car; for the child, it is usually the abdomen and thorax (if the victim continues forward, their head may strike the hood or the windshield of the car)
- Finally, the third impact occurs when the victim falls off the car and hits the pavement usually head first

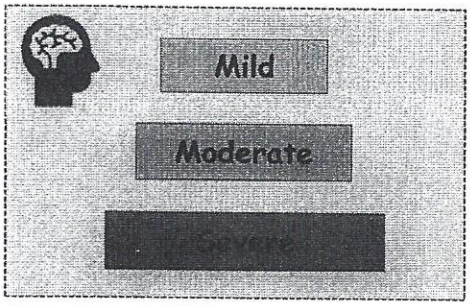
Mechanism of Injury-Rapid Vertical Deceleration (Falls)

Injury pattern that results with this mechanism is dependent upon three factors:

-distance of the fall
-body part that impacts first
-type of landing surface

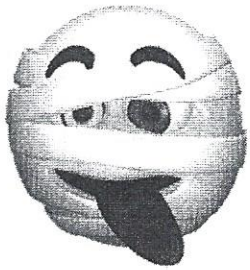
Mechanism of Injury-Rapid Vertical Deceleration (Falls)

- Falling from greater heights increases the incidence of trauma because velocity increases as they fall
- Falls are considered severe if greater than three times the height of the victim
- If the landing surface is more resilient, thereby increasing the stopping distance, the kinetic energy will be absorbed by the surface instead of the victim's body

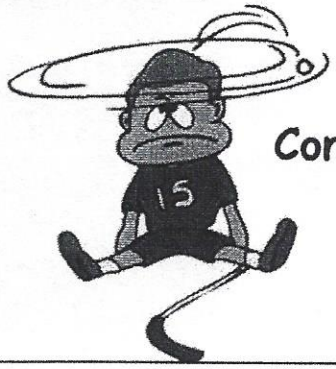


Injury Severity

Mild - GCS 13-15
Moderate - GCS 9-12
Severe - GCS 3-8



Mild Head Injury =



Concussion

Criteria	mTBI
Structural imaging	normal
LOC	0-30 min
Alterations in consciousness/mental status	A moment up to 24 hours
Post traumatic amnesia (PTA)	0-1 day
GCS (best available score in 24 first hours)	13-15

(VA-DOD, CPG 2009)

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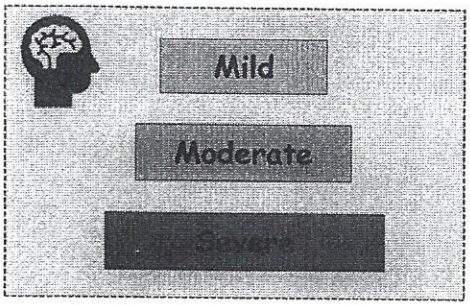

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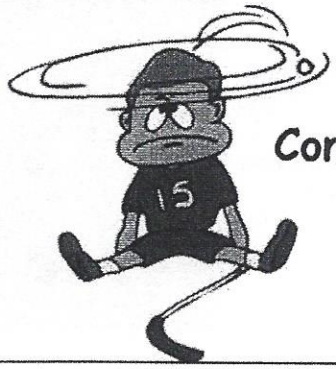

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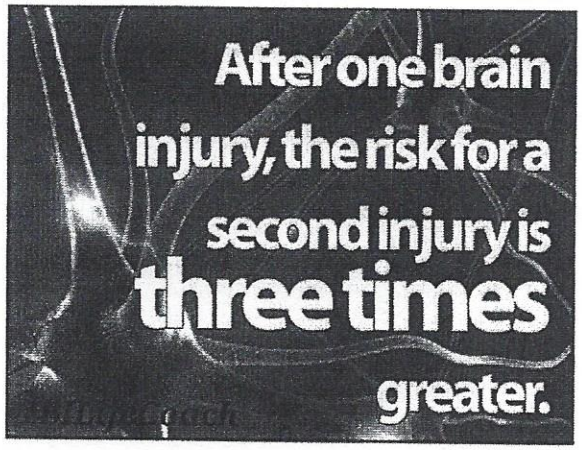


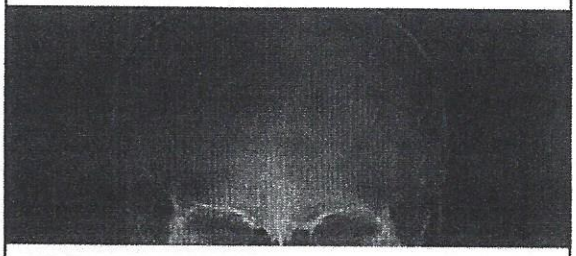
Chronic Traumatic Encephalopathy (CTE)

A progressive, degenerative disease found in individuals who have been subjected to multiple concussions and other forms of head injury

New Helmets - NFL

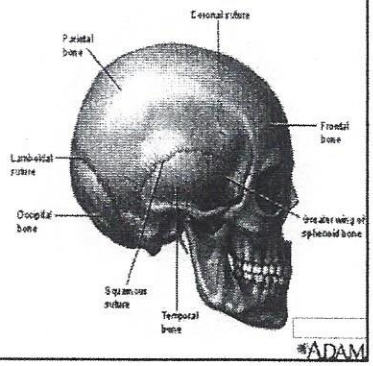
- Most notable feature- cutout at the front
- Thick padding behind movable area
- Chin strap changes less likely to forget "snap" closed
- Face mask – new construction
- InSite sensor system- alerts amount of impact

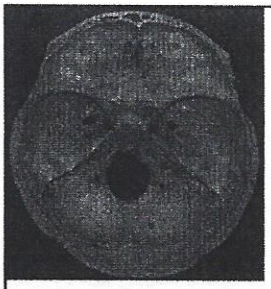
Head Trauma

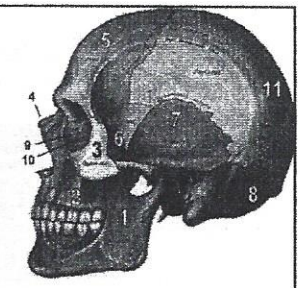


Skull Fractures

Linear
Comminuted
Depressed
Basilar

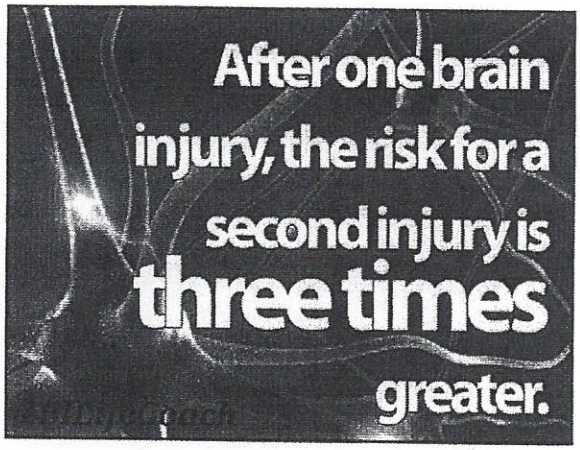






Sphenoid bone
Temporal bone
Base of the skull (middle fossa)

(Bones more prone to fracture)



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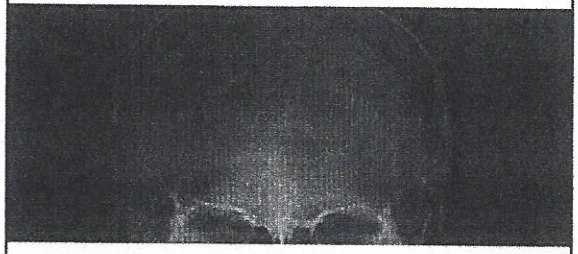

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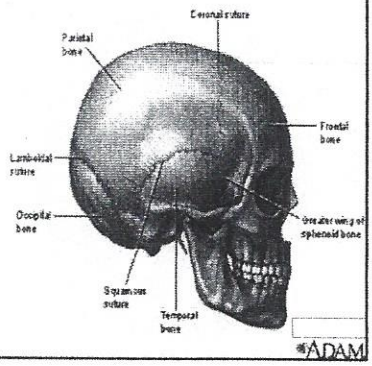
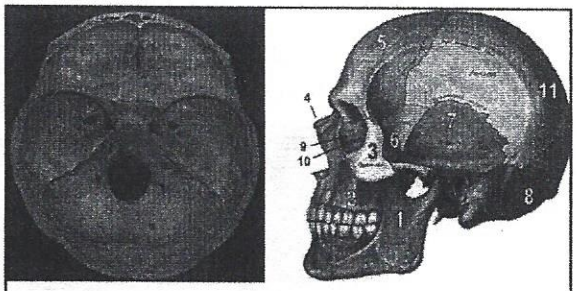




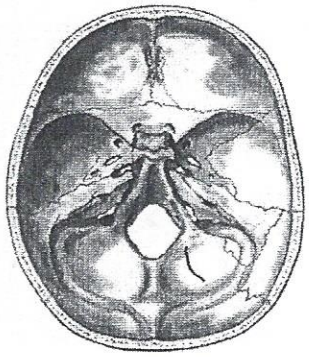
Sphenoid bone
Temporal bone
Base of the skull (middle fossa)

(Bones more prone to fracture)

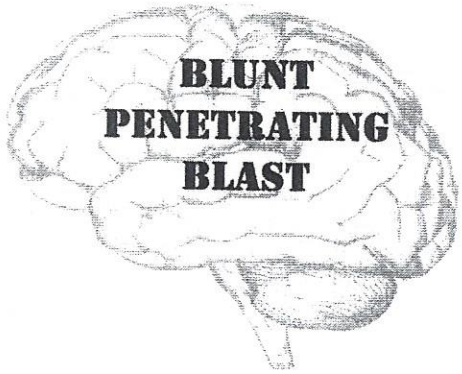
Basilar Skull Fracture
Middle Fossa

- "Battle's sign"
- Bruising over the mastoid process
- Unilateral
- Observe for otorrhea (CSF)

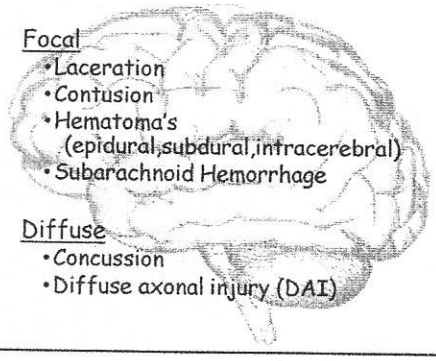
Basilar Skull Fracture



Posterior fossa fx

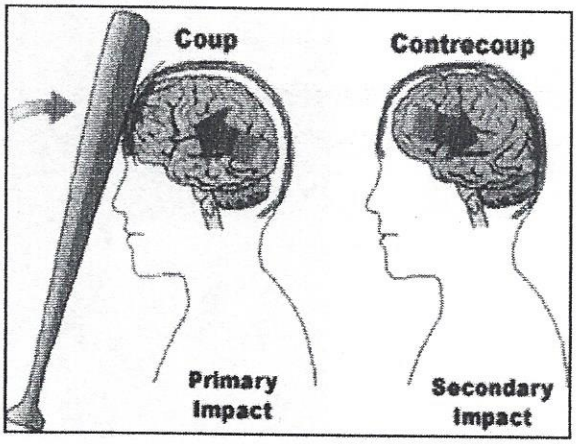


Blunt



Focal
- Laceration
- Contusion
- Hematoma's (epidural,subdural,intracerebral)
- Subarachnoid Hemorrhage

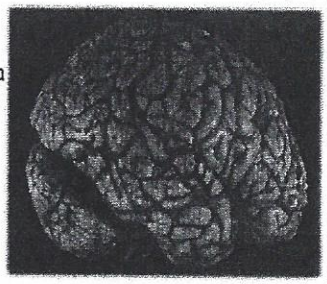
Diffuse
- Concussion
- Diffuse axonal injury (DAI)



Laceration

Tear in parenchyma due to mechanical stress

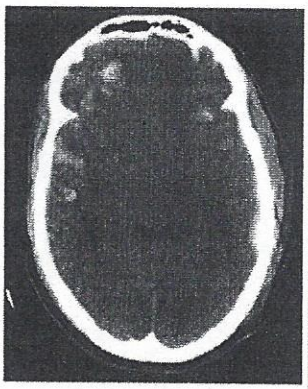
Pia-arachnoid torn



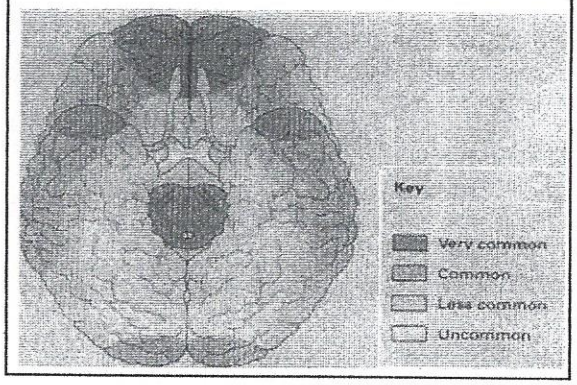
Contusion

Bruising of the cortex of the brain

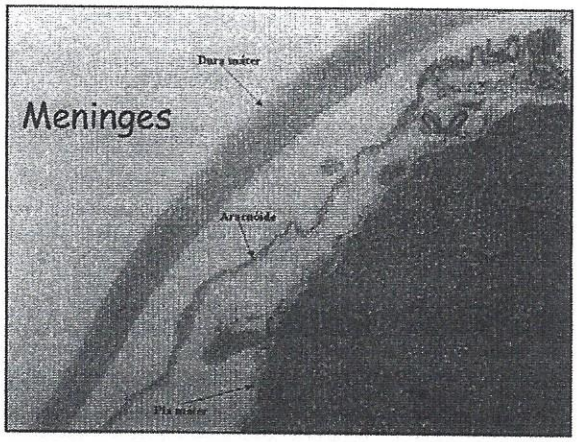
Usual location at the frontal and temporal lobes, less commonly at the parietal and occipital lobes



Frontal and Temporal Lobes



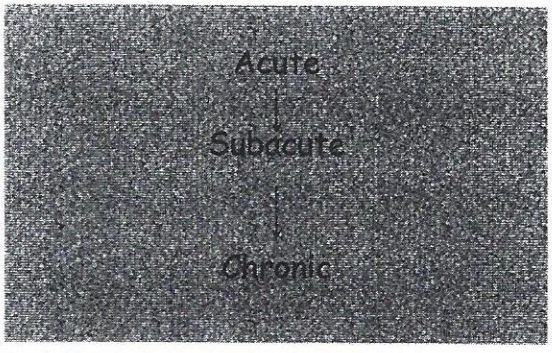
Meninges



Subdural Hematoma

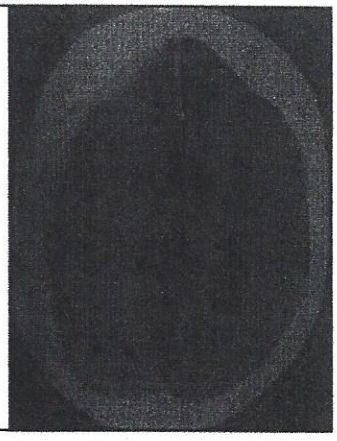
- An accumulation of blood between the dura and arachnoid membrane
- Typically venous bleeding
- Due to tearing of bridging veins
- Often bilateral
- 20% of pts with post-traumatic intracranial lesions

Subdural Hematoma



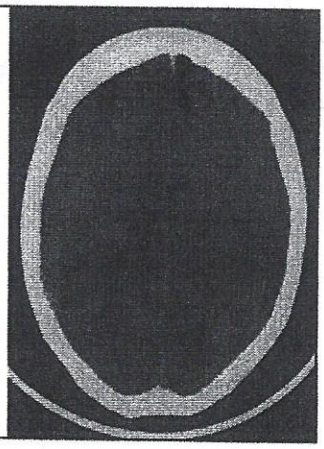
Acute Subdural

Bleeding... up to 48 hours



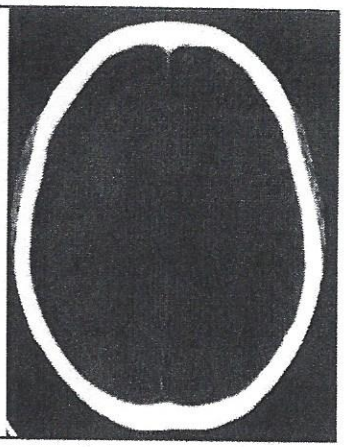
Subacute Subdural

Bleeding...
2 days-3 weeks

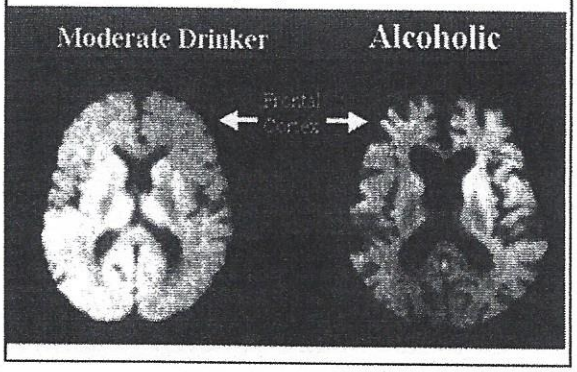


Chronic Subdural

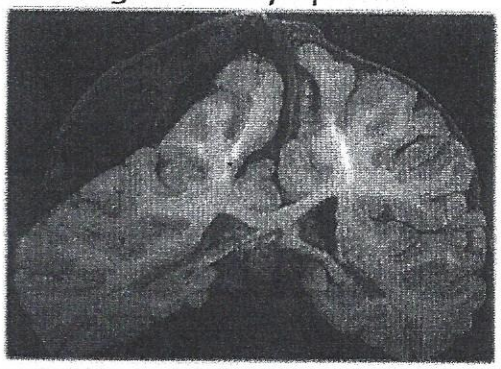
Bleeding...
3 weeks to several months after a relatively minor head injury



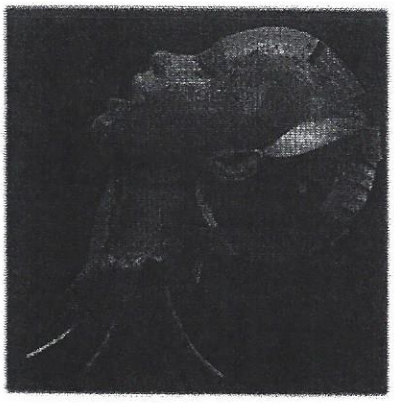
Cortical Atrophy



SDH: Signs and Symptoms

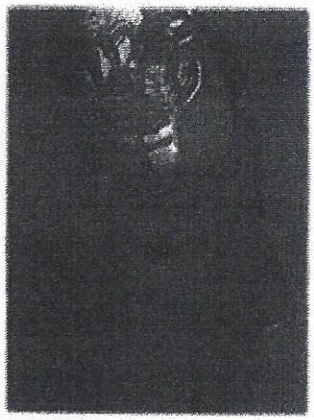


Altered Mental Status



Pupillary Changes

Symptoms will vary depending on the area of the brain



SDH: Nursing Interventions

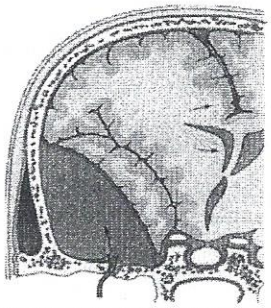
- ABC's
- Monitor neurological status frequently
- Prepare pt for surgery (evacuation of SDH- dependant on size)

SDH (Acute) Surgical Management

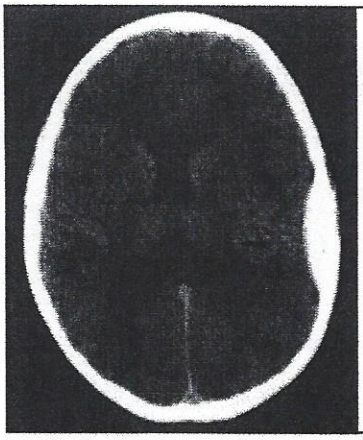
- SDH – thickness >10mm or a midline shift >5mm on CT should be surgically evacuated, regardless of GCS
- All pts with SDH in coma (GCS<9) should undergo ICP monitoring
- GCS <9 with SDH less than 10mm thick and midline shift <5mm - should undergo surgical evacuation if the GCS by 2 points between time of injury and hospitalization or if ICP>20 and/or asymmetric or fixed/dilated pupils
- Timing-SDH surgical evacuation should be done ASAP

(Neurosurgery, March 2006 Guidelines for the surgical management of TBI)

Epidural Hematoma



- 1-2% of post-traumatic intracranial lesions
- Adults: 90% skull fracture
- Bleeding into the potential space between the inner table of the skull (inner periosteum) and the dura mater
- Temporal bone fx
- Lacerated meningeal artery
- "Talk and Die" syndrome
- Uncal herniation



Epidural Hematoma

EDH: Signs & Symptoms

- "Classic sx's"-Talk and Die syndrome
- Altered mental status
- Ipsilateral pupil dilitation
- Contralateral paralysis

Nursing Interventions

- ABC's
- Monitor neurological status frequently
- Prepare patient for surgery (evacuation of EDH)

EDH: Surgical Management

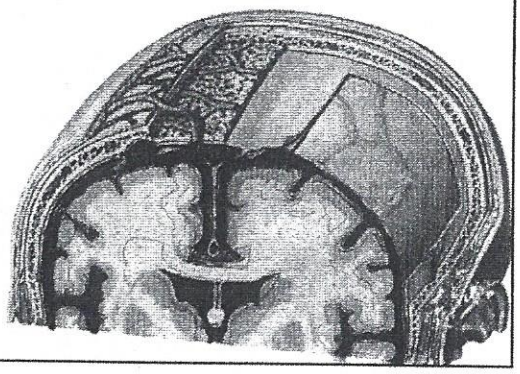
- EDH>30cm^3 – surgically evacuated regardless of GCS
- EDH<30cm^3 and with <15mm thickness and with <5mm midline shift with GCS > 8 without focal deficit can be managed non-operatively with serial CT and close neurological exam
- Timing: strongly recommended with an acute EDH in coma (GCS<9) with anisocoria -undergo surgical evacuation ASAP!

(Neurosurgery, March 2006 Guidelines for the surgical management of TBI)

Subarachnoid Hemorrhage

- Trauma - most common cause of SAH (~40%)
- Complication
  - Hydrocephalus
  - Vasospasm

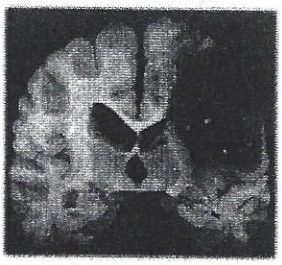
Traumatic SAH



Intracerebral Hemorrhage

Results in higher mortality (30%-40%) and worse functional outcome than any other stroke subtype

Does occur with trauma but hypertension is the most important risk factor



Concussion

Without loss of consciousness or loss of consciousness up to 6hr

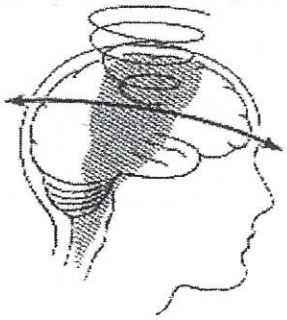
(+) retrograde and post traumatic amnesia

Sx – confusion/disorientation memory impairment, impairment of higher cognitive function (will resolve)`

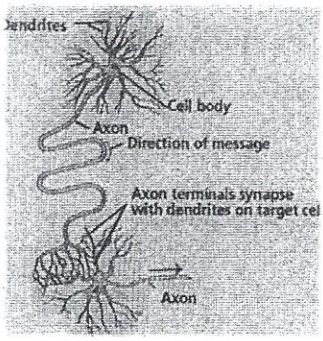
Diffuse Axonal Injury (DAI)

Pathophysiology

- Mechanism
  - -Angular acceleration/ deceleration
  - -Stress at grey-white interface



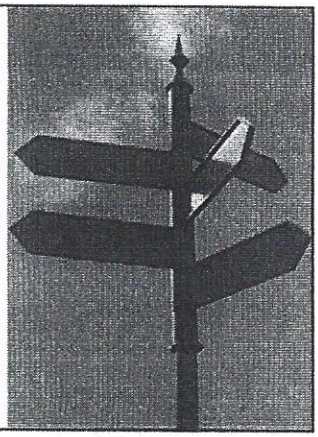
Diffuse Axonal Injury (DAI)



Neuron - cell body
Axon - "wire"
Myelin sheath - outer covering

Injury occurs at cell body and axon junction

Prognosis ?

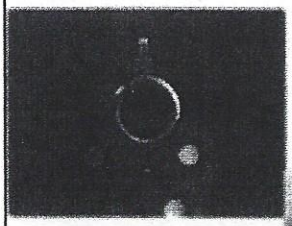


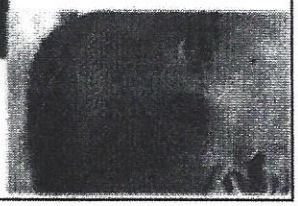
Terri vs Terry

Minimally conscious state vs Persistent vegetative state

Mayo Clinic Proceedings 9/2006

Penetrating Brain Injury (PBI)





WWI - Harvey Cushing

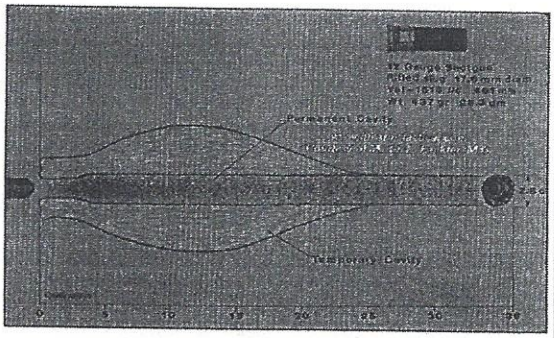
The foundation of surgical management of PBI

PBI mortality 55% to 28%

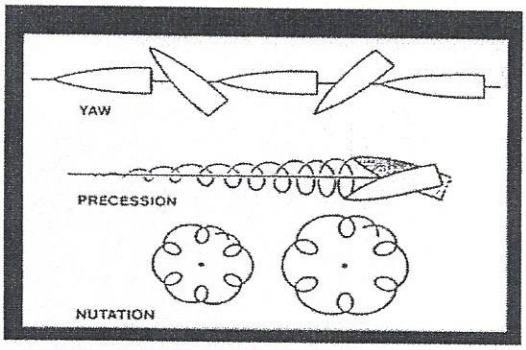
Ballistics-Pathophysiology

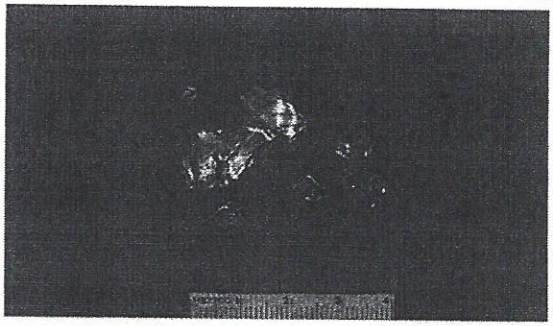
- As the bullet enters the skull there is a wave of energy that is related to the velocity of the bullet
- The closer in range the more energy involved
- A temporary cavity forms parallel to the primary track and then collapses within milliseconds
- A shock wave occurs immediately after the bullet enters the skull and is transmitted throughout the intracranial cavity

Ballistics



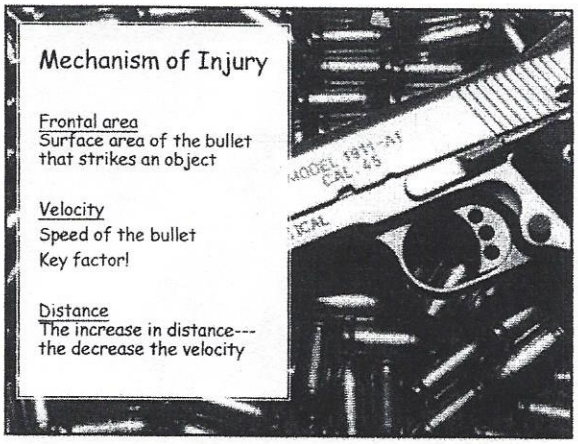
Bullets do not typically follow a straight line





- Deformation and fragmentation of a bullet
- The lead bullet has separated from the copper jacket

Mechanism of Injury



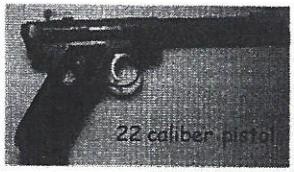
Frontal area
Surface area of the bullet that strikes an object

Velocity
Speed of the bullet
Key factor!

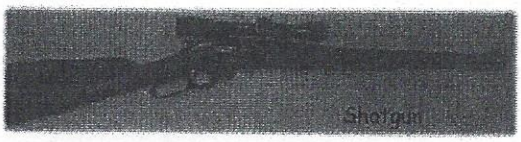
Distance
The increase in distance--- the decrease the velocity

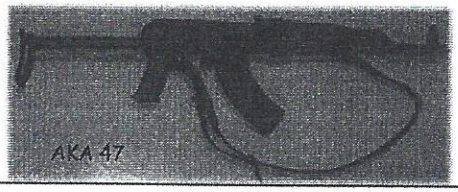
Medium Velocity Weapons

(<1500 feet/sec)



High Velocity Weapons
(>1500 feet/sec)





- Nail gun injury
- Nail entered the brain through his sinuses
- Removed via exact angle of trajectory

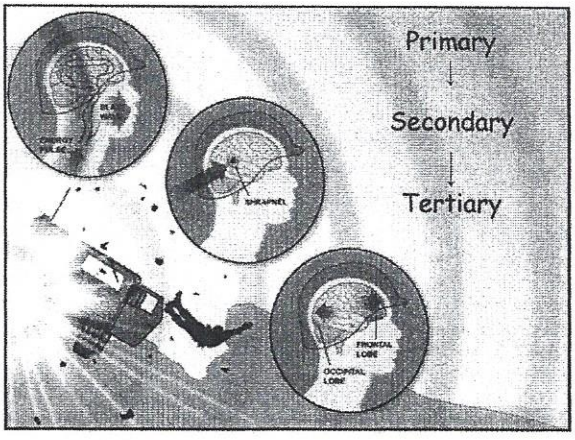
PROGNOSIS

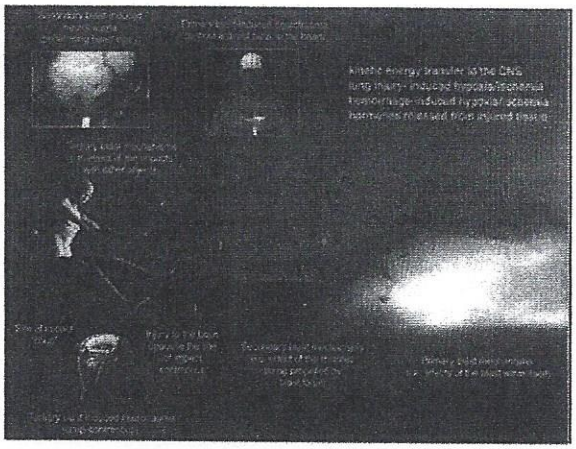
- Highest velocity injuries have the worst damage
- Mortality rate = 92% from missile injury (firearms cause most head injury-related deaths)
- Perforating injuries have an even worse prognosis

Traumatic Brain Injury... Distinguishing Injury of the Iraq and Afghanistan War

Blast Injuries

- Increased awareness due to the Iraq and Afghanistan wars
- Primary, Secondary and Tertiary
- Underdiagnosed or misdiagnosed as PTSD and not post-concussive syndrome






Questions?
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