General Surgery Grand Rounds

General Management and Resuscitation in Acute Brain Injury

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Severe Brain Injury: Learning Objectives

- Epidemiology
- Classifications based on severity and type
- Clinical presentations
- General outcome predictors
- On Site Hospital TX
- General conclusions
- Future directions
- Questions

Traumatic Brain Injury Definition & Epidemiology

- NIH NTCDB = GCS < 9 48 hrs post injury
- 500,000 cases of head injury per year
- 10% die before reaching the hospital
- Mortality = 17/100K pre hosp, 6/100K hosp
- 80% mild
- 10% moderate
- 10% severe
- 100,000 sig LT disability

TBI: Epidemiology (cont)

- Mechanism: MVA > Falls > Firearm > other assault
- High risk: young, male, low income, unmarried, ethnic minority, city dweller, sub abuse, prev TBI
- Male to female incidence ratio 2.8:2, mortality ratio 3.4:1
- Age: occurring most commonly age < 25 with a bi-modal distribution rising again at age > 65
- Cause of death in 45-50% of all trauma
- 40-80% association with sig systemic trauma (thoracoabdominal, ortho,)
- Alcohol: implicated in 50-70%

Classifying Brain Injury

- Based on GCS
- Mild: GCS 13-15
- Moderate: GCS 9-12
- Severe: GCS 8 or less

Glasgow Coma Scale

	Eye	Voice	Motor
6	----------	----------	obeys
5	----------	oriented	localizes to pain
4	spontaneous	confused	withdraw to pain
3	To speech	inappropriate	flexor
2	to pain	incomprehensible	extensor
1	none	none	none

TBI Exam Findings

- Depressed level of consciousness not clearly due to EtOH, drugs, metabolic, cardio-pulm abnormalities etc.
- Focal neurologic findings (pupillary changes, false localizing, not all have mass lesion eg., DAI)
- Penetrating skull injury or depressed fracture
- Raccoon eyes, Battle's sign, CSF rhinorreha an/or otorreha

TBI Presentation (con't)

- SZ
- Decorticate, deceribrate posturing
  Cushing's Triad:
  - Inc BP W/ widened PP, and proportionally greater inc in SBP over that of DBP
  - Bradycardia (SR)
  - Irregular Breathing
  - Usually heralds brain damage/herniation sec/2 inc ICP/poor perfusion.

TBI Outcome predictors

- Choi et al, correlated:

  Fixed pupil

  low GCS motor

  Age > 60

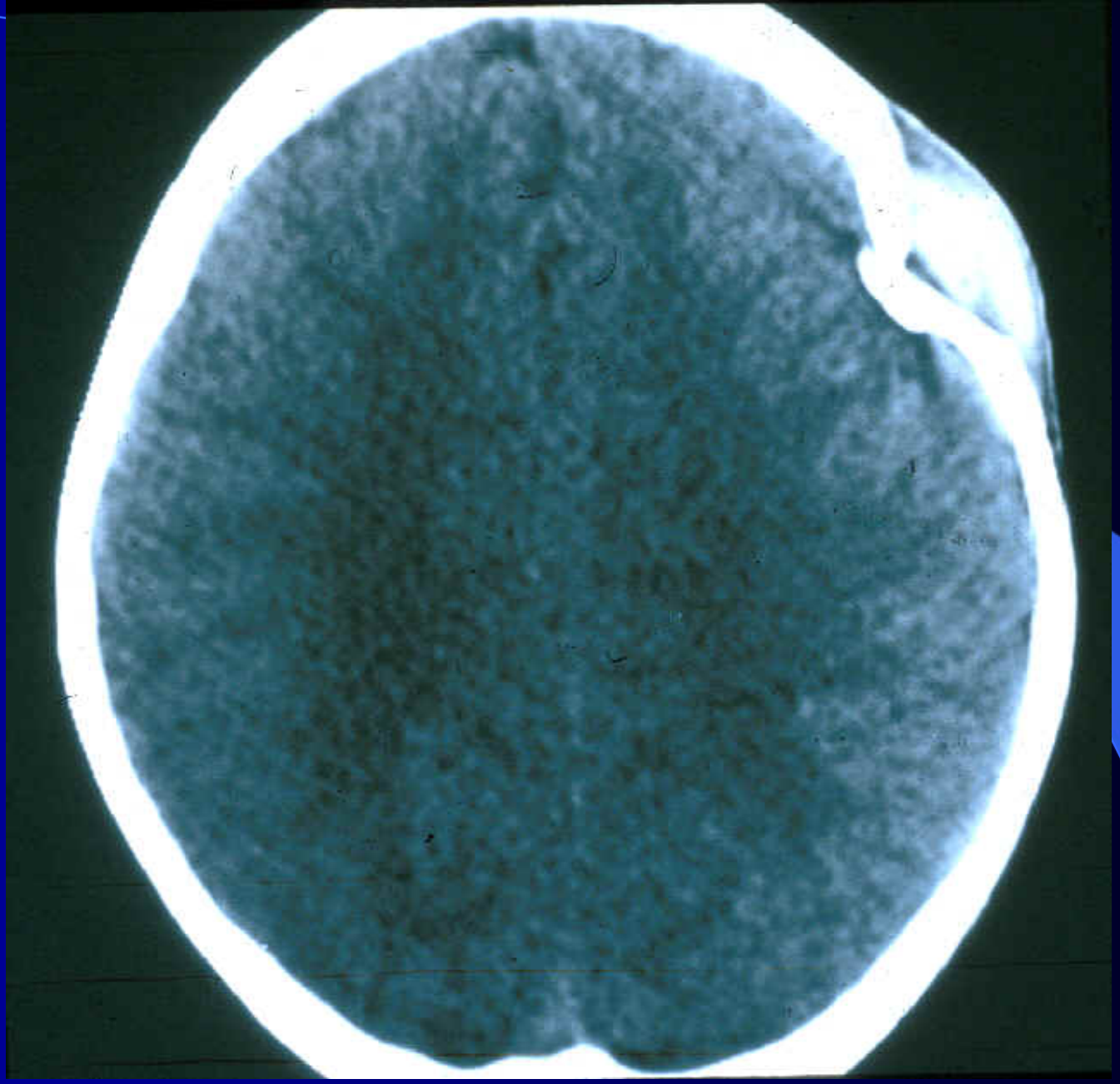
  Strongly predictive of death or significant disability

Types of Traumatic Brain Injury

- Forces = compressive, tensile (stretch), shearing (slide)
- Skull fractures
- Concussion
- Diffuse axonal injury
- Contusion
- Subarachnoid hemorrhage (SAH)
- Subdural hematoma (SDH)
- Intraparenchymal hemorrhage (ICH)
- Epidural hematoma (EDH)
- Intraventricular hemorrhage (IVH)

Skull Fractures

- Linear
- Depressed
- Comminuted
- Compound
- Basilar
- Significance: 10% of fractures have lesions requiring emergent surgical intervention

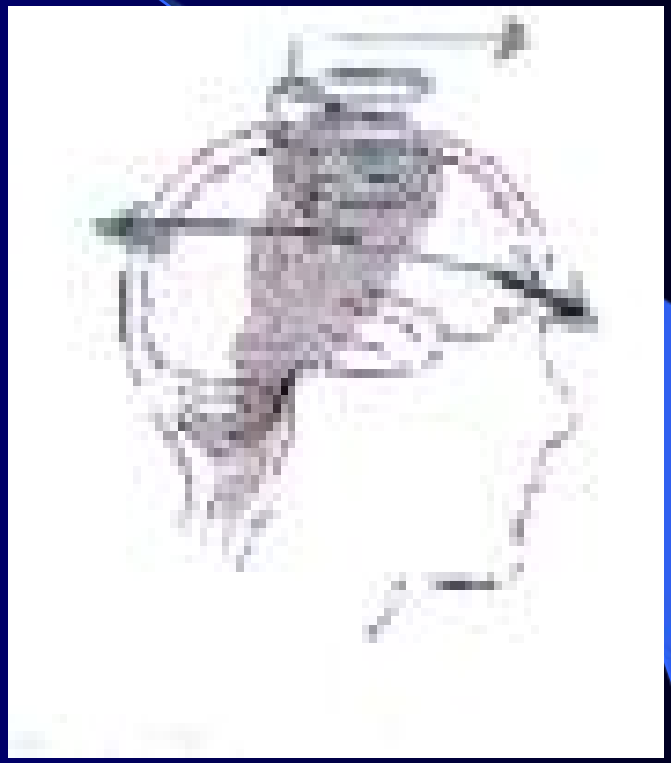


Linear Depressed Comminuted Skull Fx

Linear Depressed Comminuted Skull Fx

Concussion

- Reversible transitory neurologic deficit. Associated with rotational shear stress.
- Considered mild form of DAI
- Three grades; mild, moderate and severe, proportional to retrograde and anterograde amnesia



Diffuse Axonal Injury

- Most common traumatic brain injury
- Shearing of axons
- Temporary and permanent loss of cellular function
- Occurs as a clinical and radiographic spectrum, with 3 grades on CT
- Mortality 30-40%,
- Good outcomes 20-30%

- Grade 1: Parasagital WM
- Grade 2: Grade 1 + CC (deeper)
- Grade 3: Grade 2 + cerebral peduncle / brain stem / IVH

Diffuse Axonal Injury (con't)

- Imaging:

  CT: petechial hemorrhage (hyperdense) along gray white junctions, symetric or asymetric edema, intraventricular / cisternal hemorrhage

  MRI: hemorrhage as above, high signal on T2

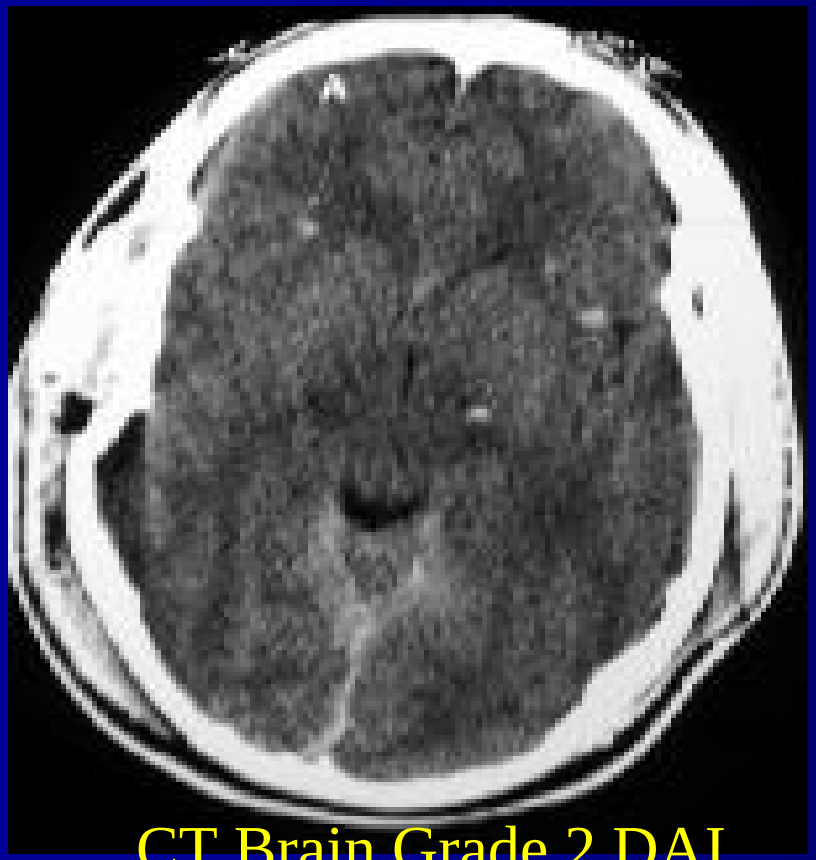
Diffuse Axonal Injury (con't)

- Overall Prognosis

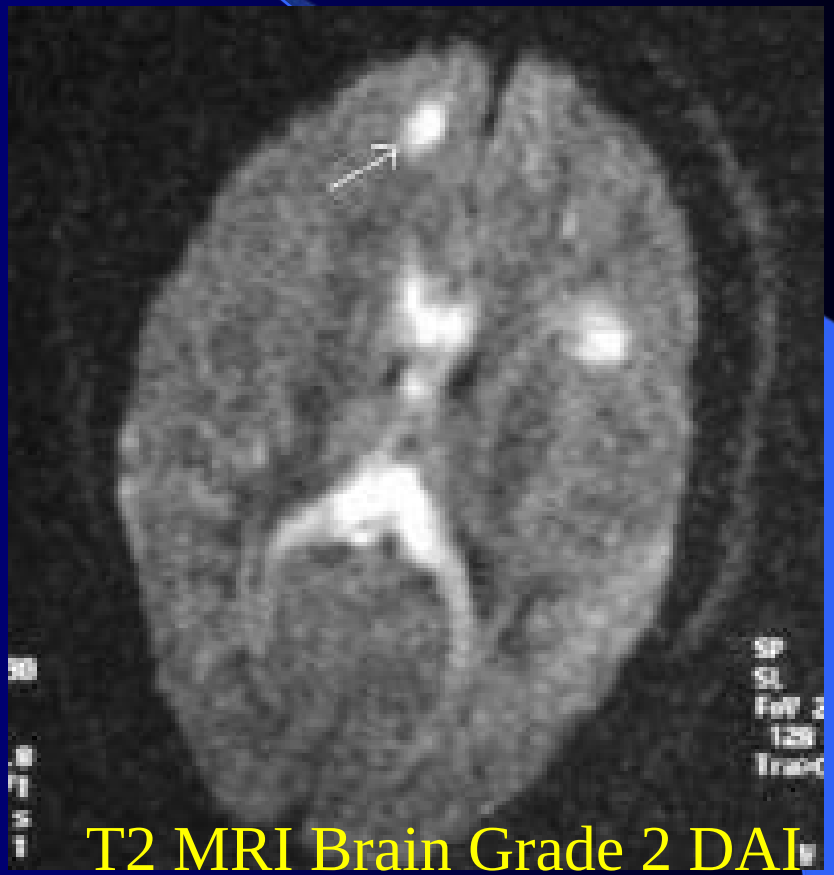
  Related to:

  - CT imaging
  - Control of intracranial pressure
  - Post resuscitation GCS

Diffuse Axonal Injury (con't)



CT Brain Grade 2 DAI

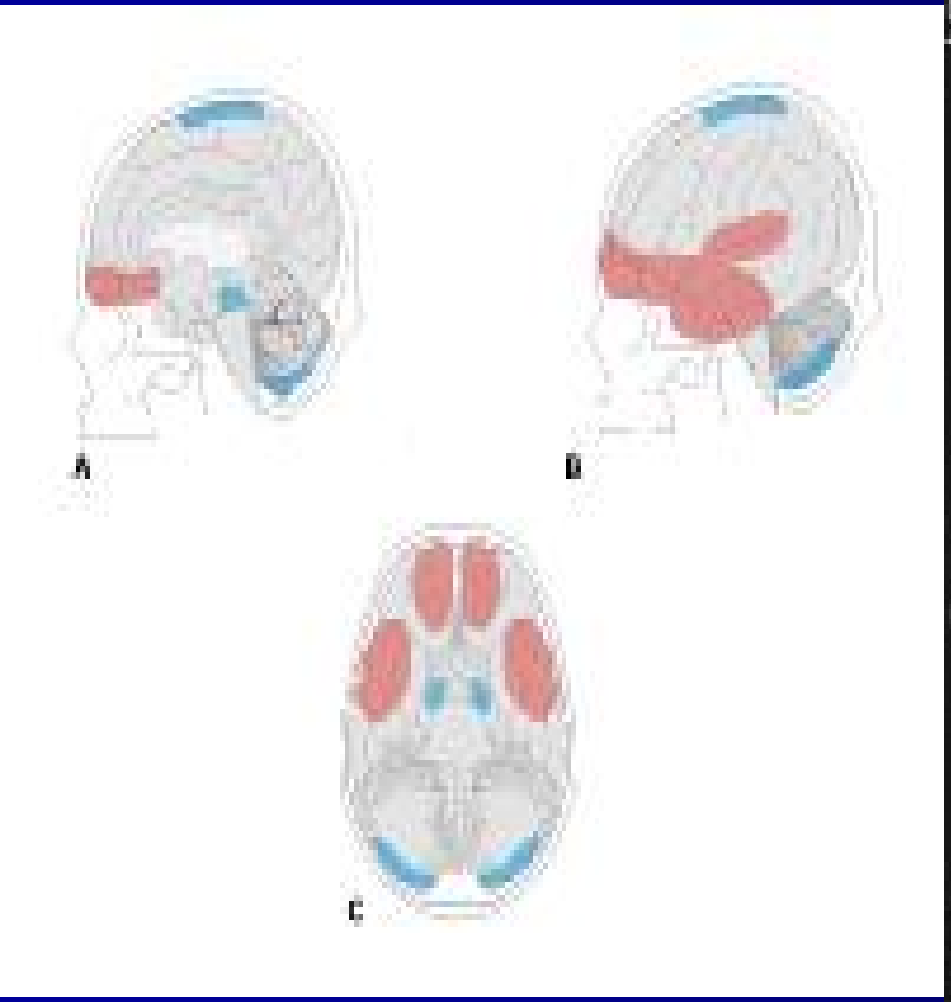


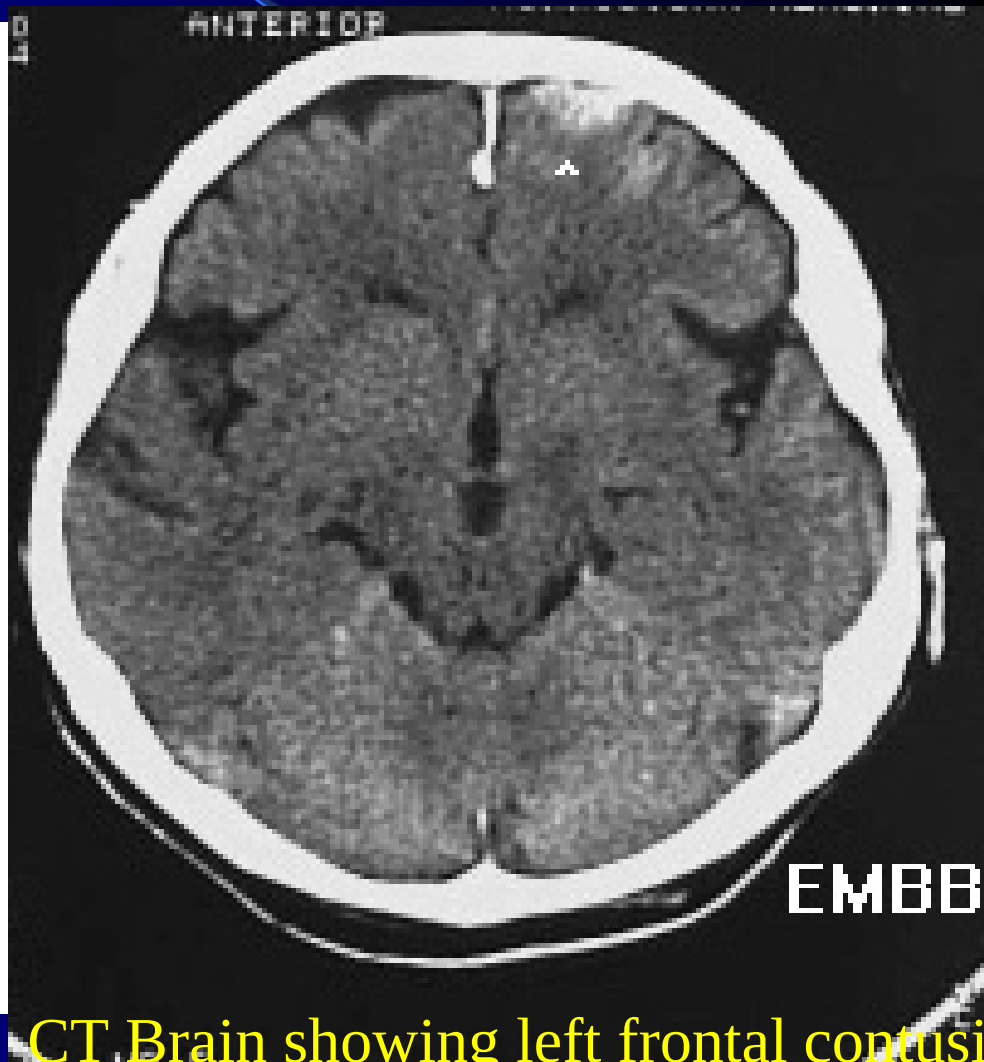
T2 MRI Brain Grade 2 DAI

Cerebral Contusion

- Second most common brain injury
- Coup = small-moderate direct impact
- Countercoup = high energy with translational dissipation of energy
- Essentially a bruise on the brain with hemorrhage from torn pial vessels, evolution of localized edema
- Location: temporal > frontal > parasagittal, > occipital (convexities)
- 20% will have delayed hemorrhage

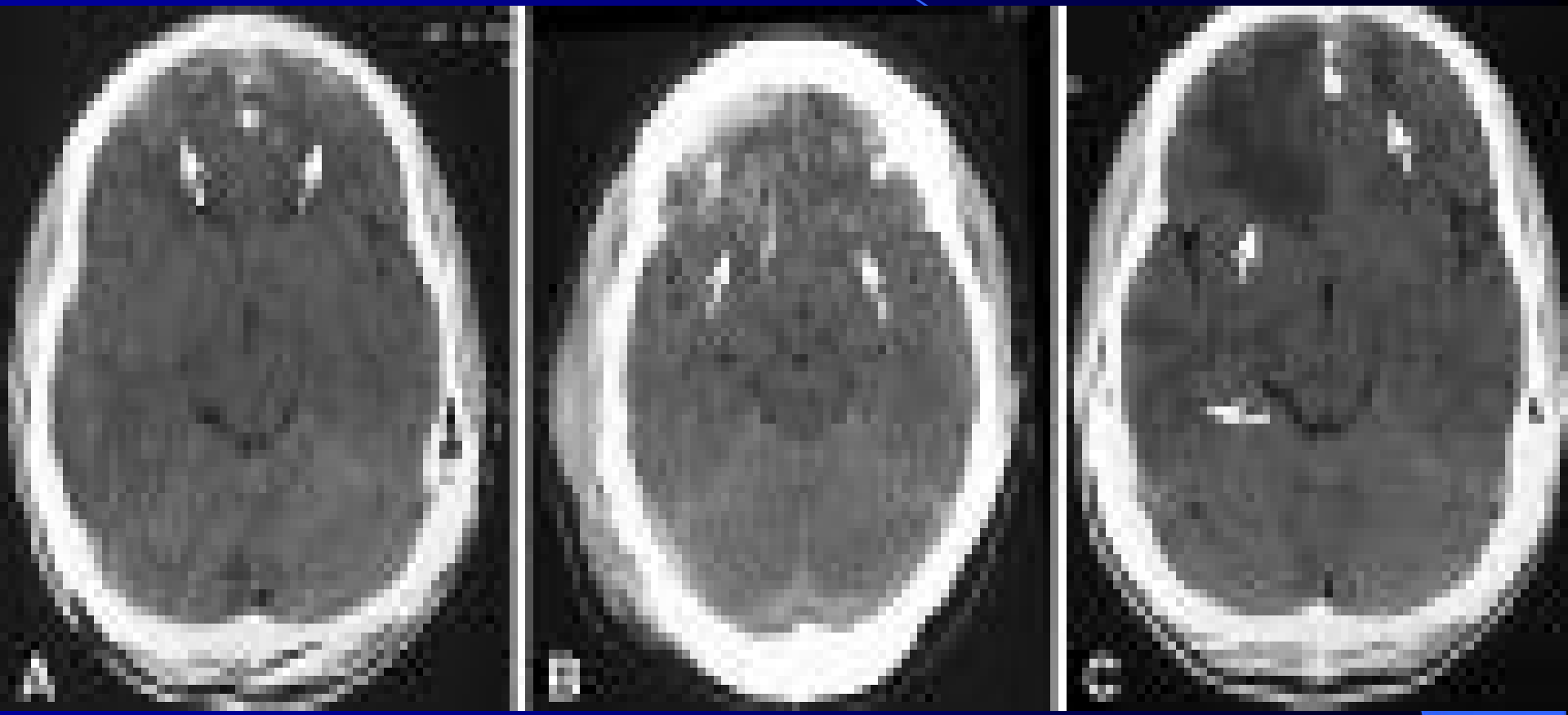
Cerebral Contusion (con't)





CT Brain showing left frontal contusi

Cerebral Contusion (con't)



Day 1 Day 2 Day 14

Subarachnoid Hemorrhage

- MC traumatic intracranial hemorrhage
- Associated with DAI when caused by trauma
- Can also result from bleeding saccular aneurysm and /or AVM, fusiform and mycotic aneurysms, fibromuscular dysplasia, coagulopathies, moyamoya disease, infection, neoplasia, psuedo aneurysm, substance abuse.
- Outcomes inversely proportional to clinical and radiographic grades

Subarachnoid Hemorrhage (con't)

Hunt and Hess grading system (predicts clinical outcomes)

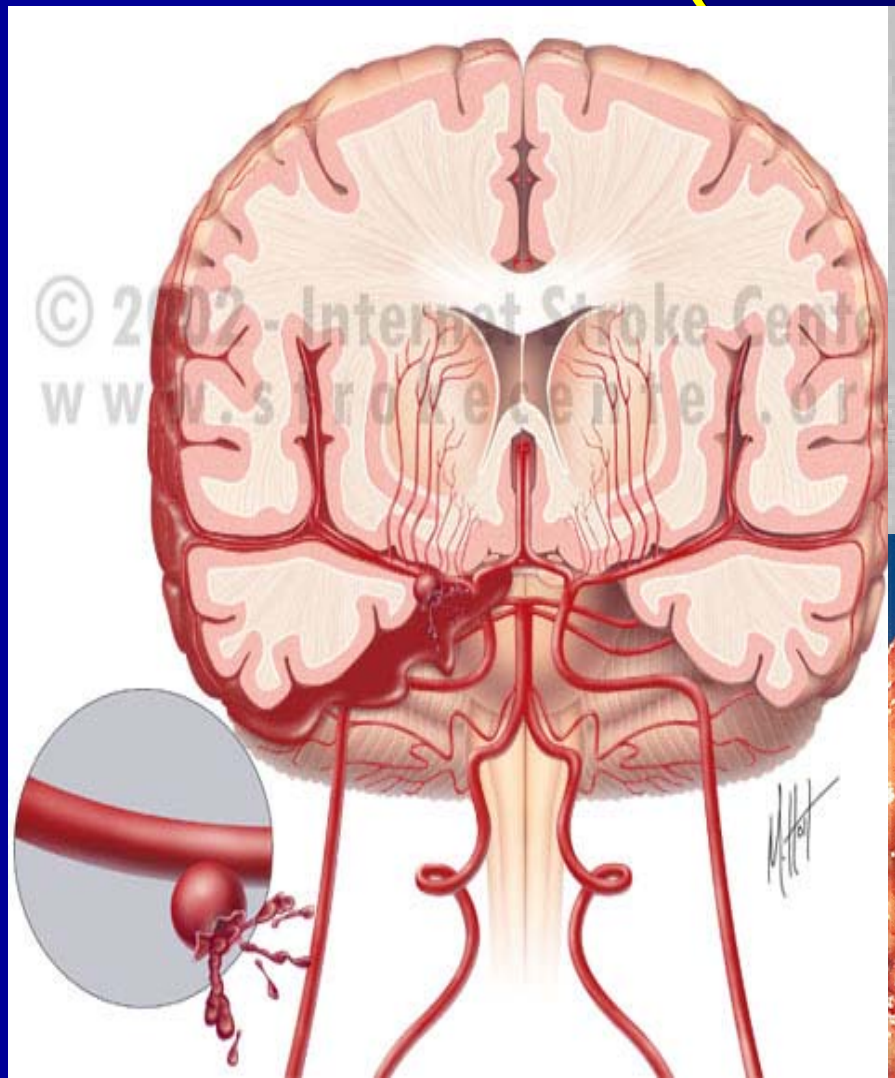
- **Grade 1 - Asymptomatic or mild headache**
- **Grade 2 - Moderate-to-severe headache, nuchal rigidity, and no neurological deficit other than possible cranial nerve palsy**
- **Grade 3 - Mild alteration in mental status (confusion, lethargy), mild focal neurological deficit**
- **Grade 4 - Stupor and/or hemiparesis**
- **Grade 5 - Comatose and/or decerebrate rigidity**

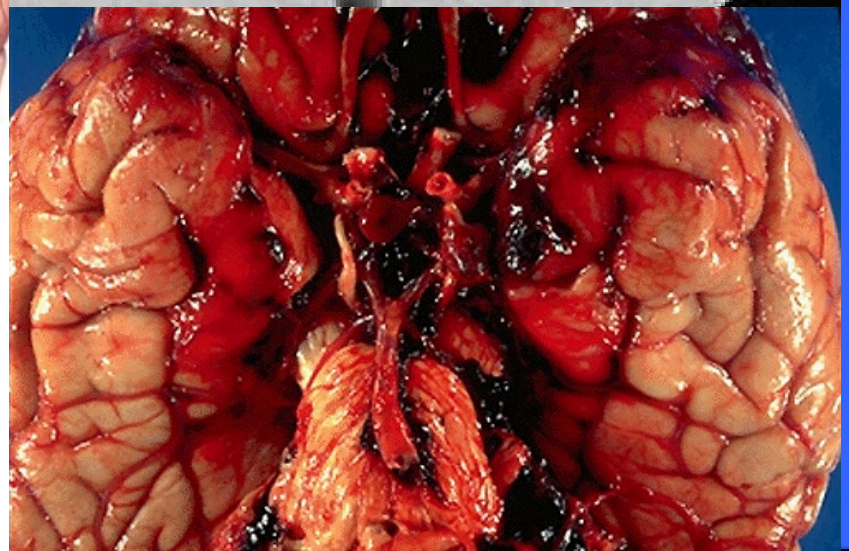
Subarachnoid Hemorrhage (con't)

Fisher scale: Radiographic Grade (predicts degree of vasospazm)

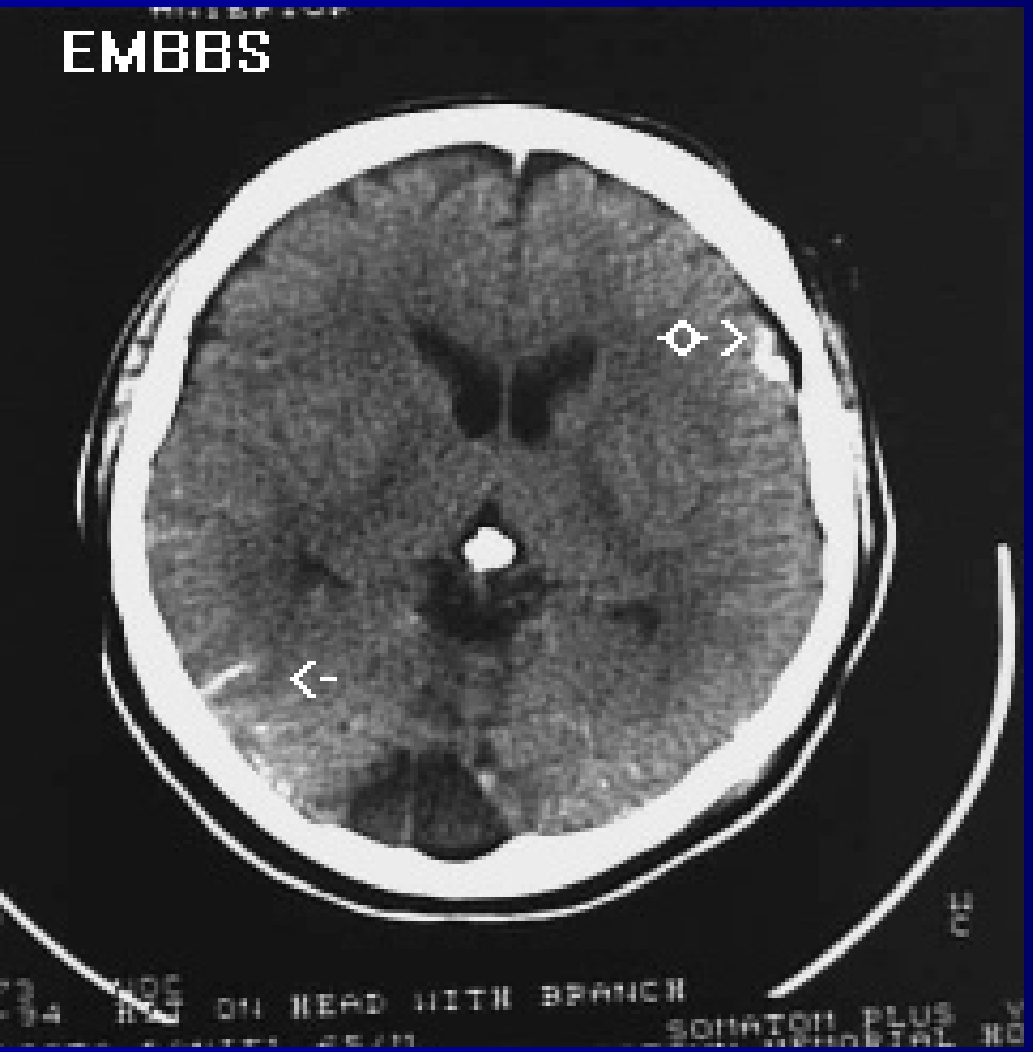
- **Grade 1 - No blood detected (LP + Xantho)**
- **Grade 2 - Diffuse deposition of subarachnoid blood, no clots, and no layers of blood greater than 1-3 mm**
- **Grade 3 - Localized clots and/or vertical layers of blood 3 mm or greater in thickness**
- **Grade 4 – Diffuse, or no subarachnoid blood, with intracerebral or intraventricular clots present**

Subarachnoid Hemorrhage (con't)





Subarachnoid Hemorrhage (con't)



CT Showing Traumatic SAH

CT Showing Aneurysmal SAH

Subdural Hematoma

- Hemorrhage under the dura
- Caused by torn bridging veins and /or bleeding contusions (pial vessels)
- Occur in 10-35% of severe head injuries
- 10-50% are associated with skull fractures
- Cortical atrophy is RF for occurrence, but Pt's with normal brain vol at higher risk for LT disability
- Also associated with coagulopathies
- Often associated with other brain injuries
- Acute, sub acute and chronic (density on CT) depending on the age of SDH

Subdural Hematoma (con't)

- Prognosis:

  Mortality is 40-70%

  Complete recovery in 8%

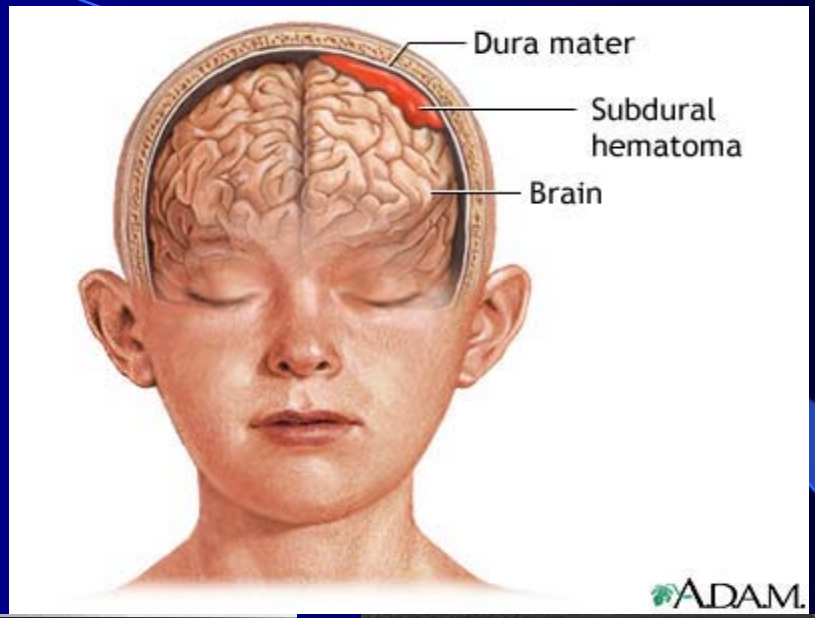
  Severe disability in 74-84%

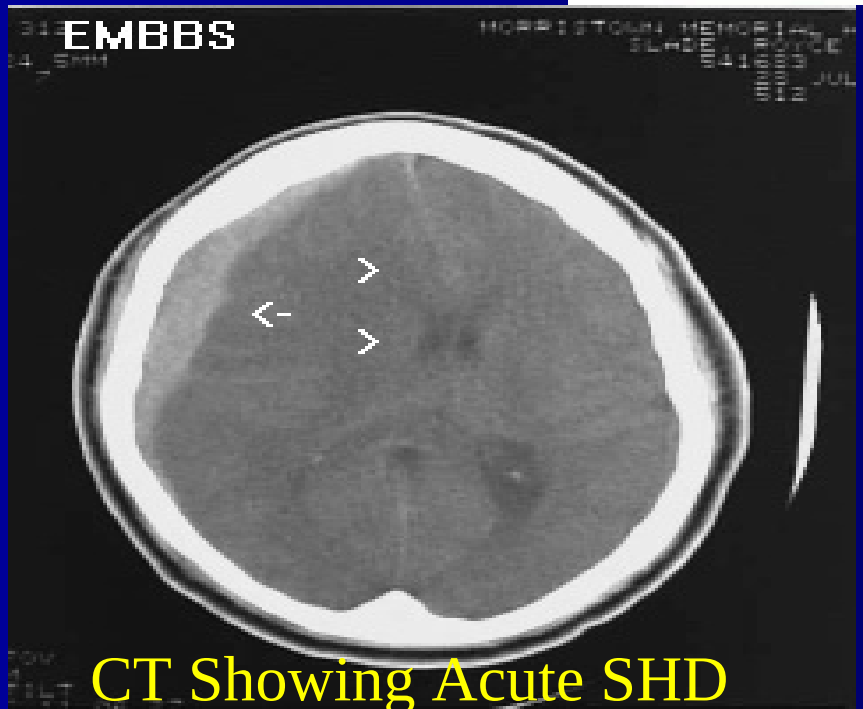
- Imaging:

  CT scan: cresentric (concaved) shaped hematoma

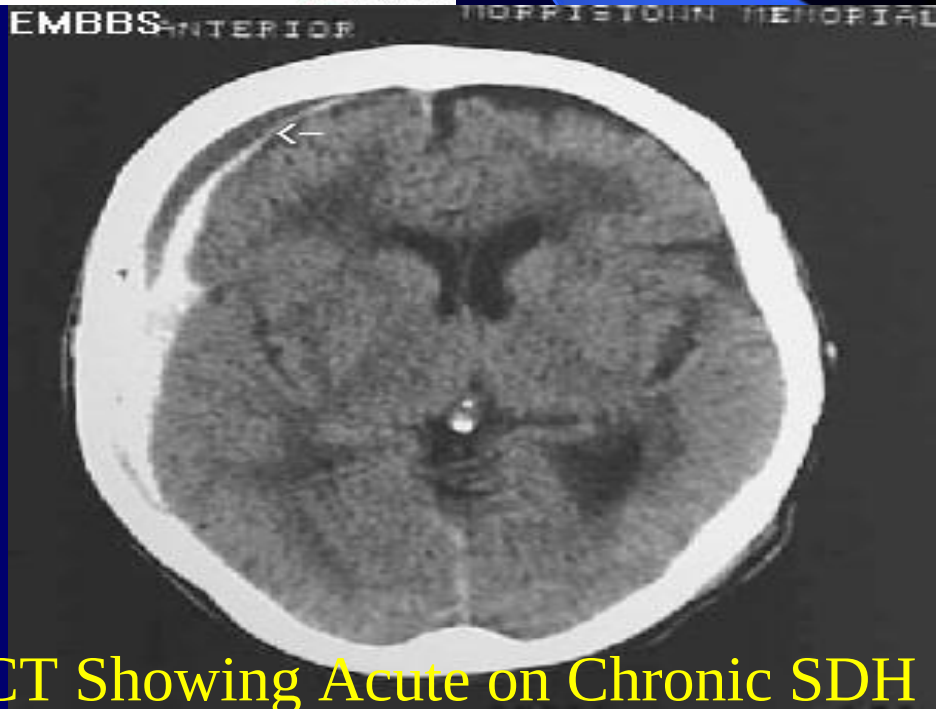
  crosses sutures but not dural insertions, mass effect with shift, edema

Subdural Hematoma (con't)





CT Showing Acute SHD

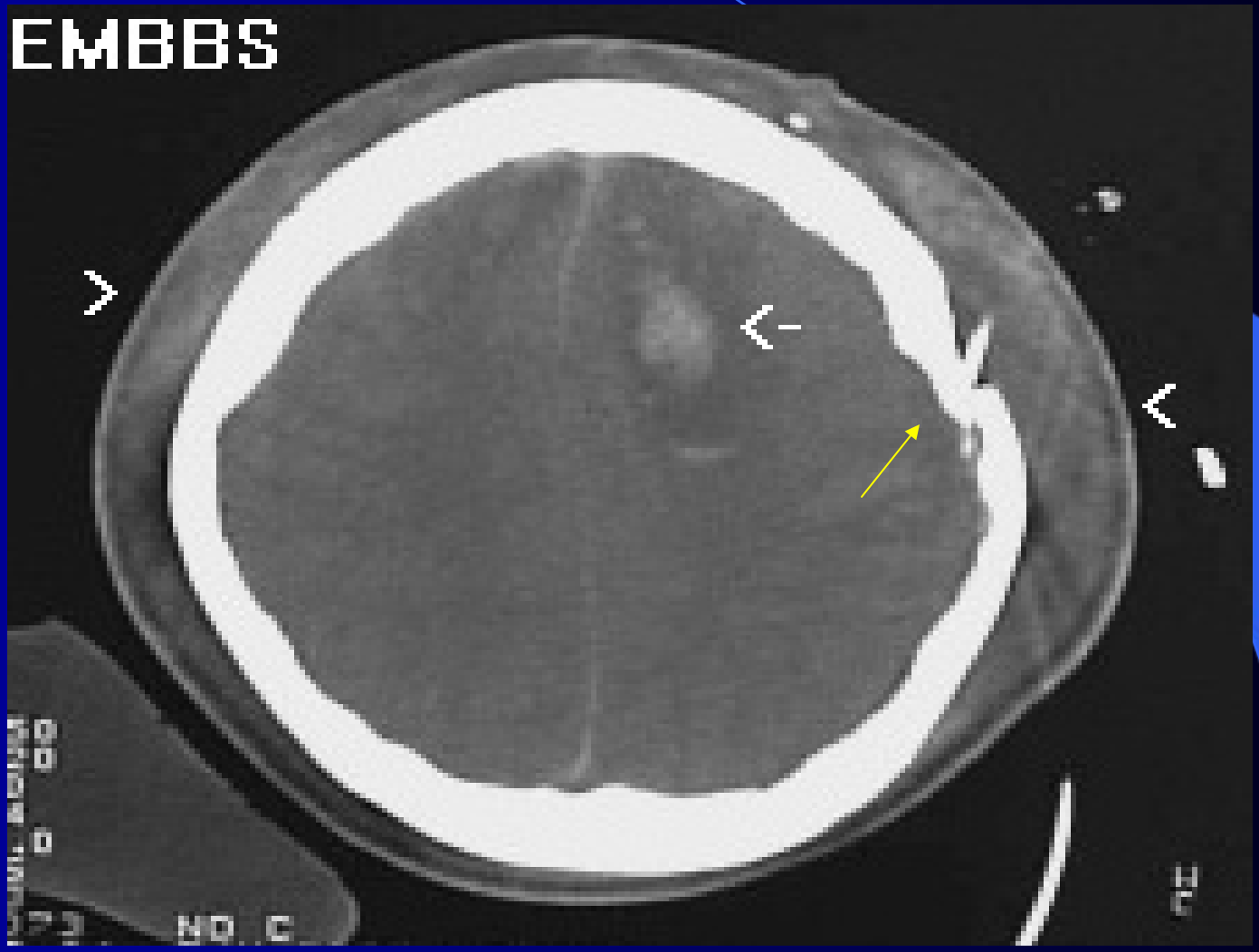


CT Showing Acute on Chronic SDH

Intraparenchymal Hemorrhage

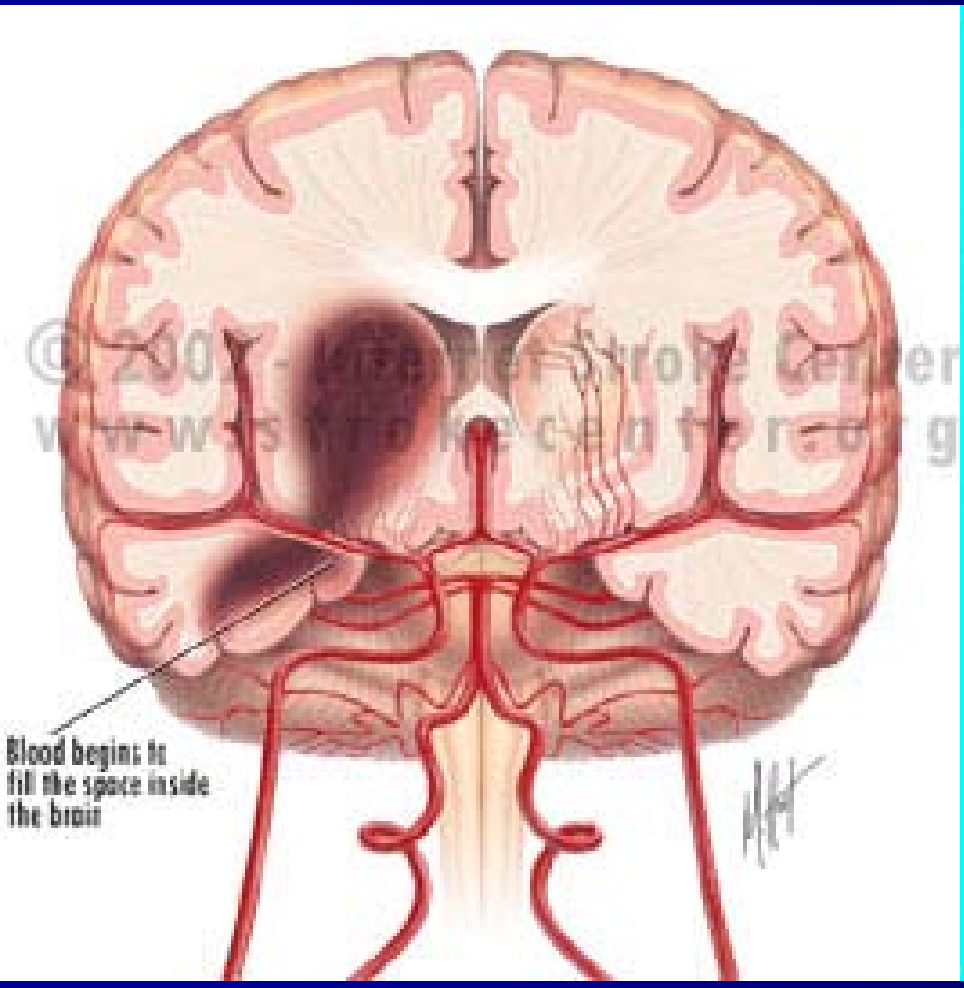
- Hemorrhage in the substance of the brain also called intracerebral hemorrhage (ICH)
- Associated with HTN, anerysmal SAH, amyloid, cerebral contusions and DAI
- Occur most commonly in frontal and gray white junctions of brain when caused by trauma, vs vascular ICH's due to HTN, which occur in distinct vascular distributions
- Commonly expand (re-bleed) within first 24 hours
- Often cause localized edema and elevated intracranial pressure
- Outcomes inversely proportional to size of ICH, and Pt age

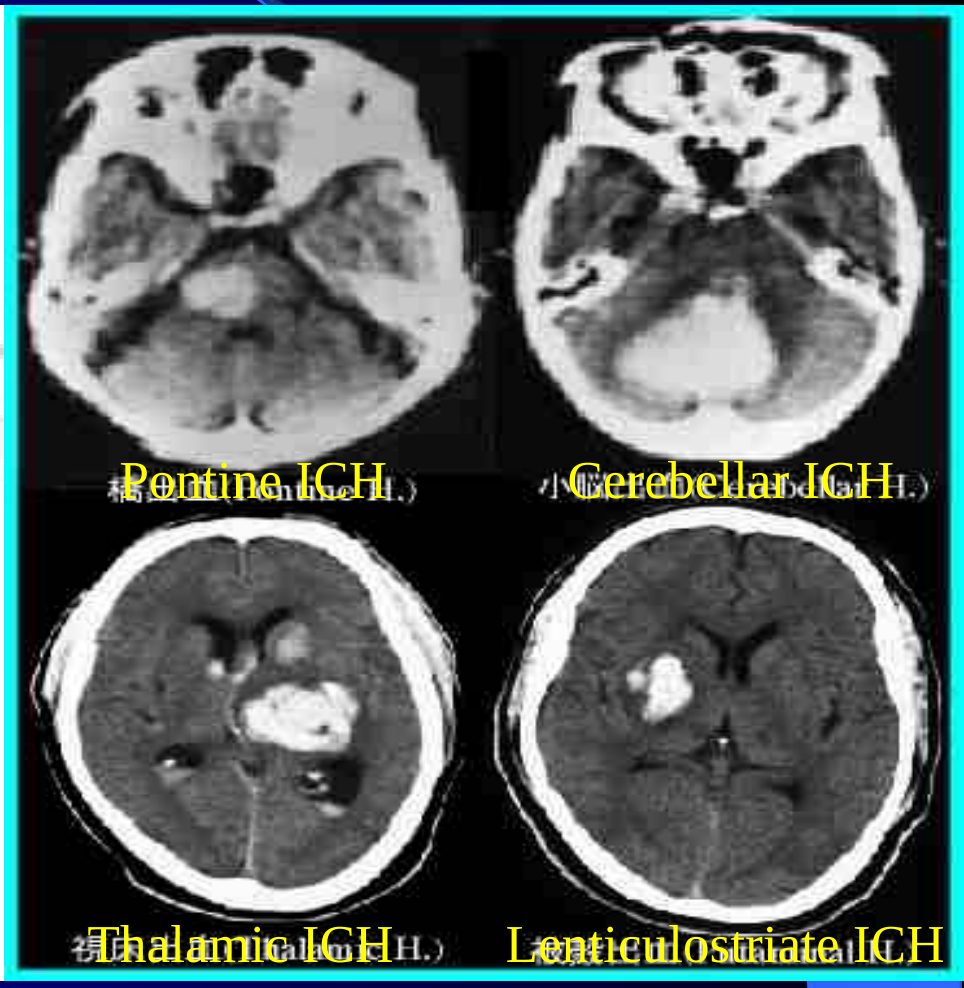
Intracerebral Hemorrhage (con't)



CT Brain Showing Traumatic ICH and Skull Fx

Intracerebral Hemorrhage (con't)





Epidural Hematoma

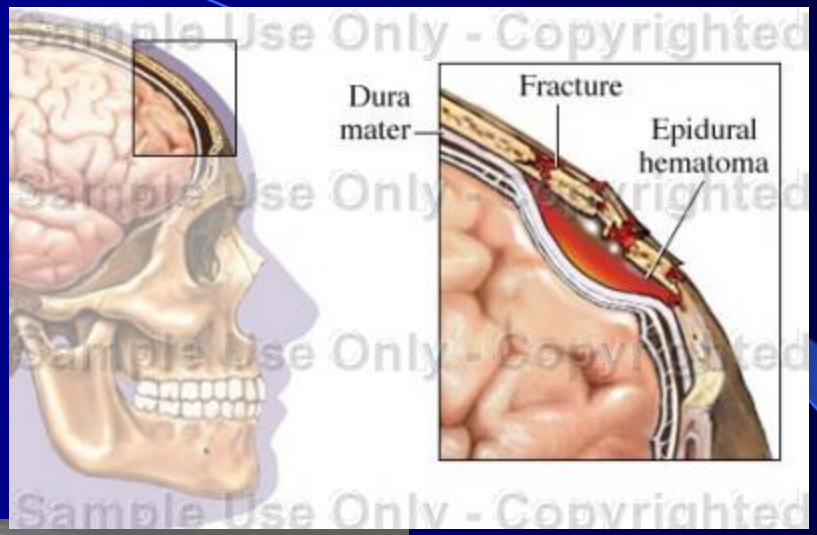
- Hemorrhage between inner table of skull and dura
- Often caused by severed meningeal artery or torn large venous sinus
- Obeys suture lines (coronal, lambdoid)
- Occur in 3-5% of head injuries
- Peak incidence 10-30 years old
- Rare in those <2yrs or > 60yrs
- 85-90% are associated with skull fractures

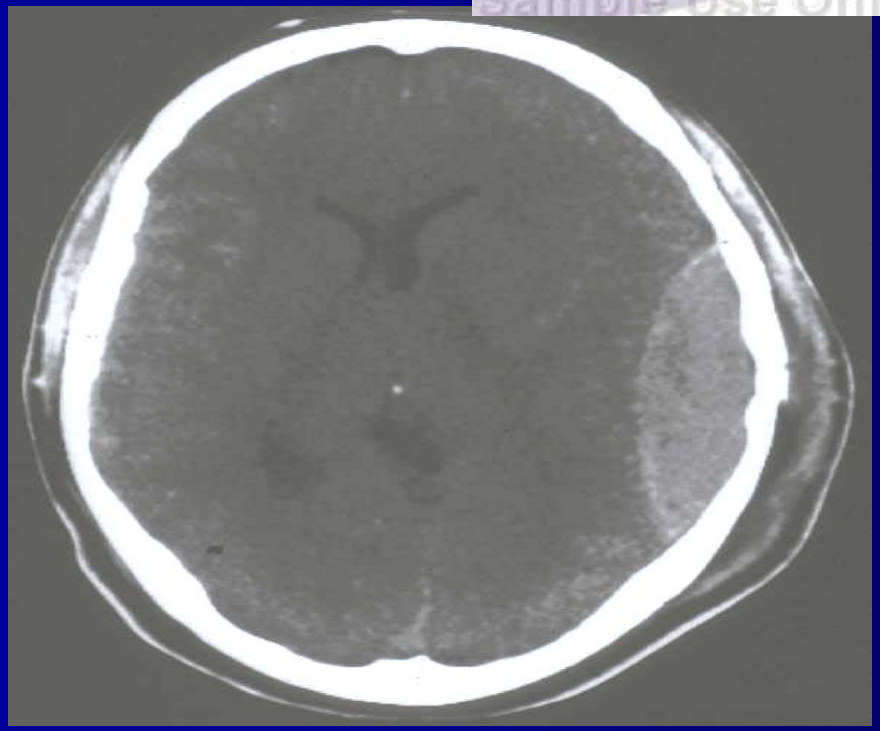
Epidural Hematoma (con't)

- Often present with lucid interval
- Commonly occur with other brain lesions
- Mortality and Morbidity 5% - 20%
- Higher rates are associated with the following:
  - **Advanced age**
  - **Intradural lesions**
  - **Temporal location**
  - **Increased hematoma volume**
  - **Rapid clinical progression**
  - **Pupillary abnormalities**
  - **Increased intracranial pressure (ICP)**
  - **Lower Glasgow coma scale (GCS)**

- **In the US:** EDH occurs in 1-2% of all head trauma cases and in about 10% of patients who present with traumatic coma.
- CT appearance: convex hyperdensity, swirl sign, obeying suture lines

Epidural Hematoma (con't)





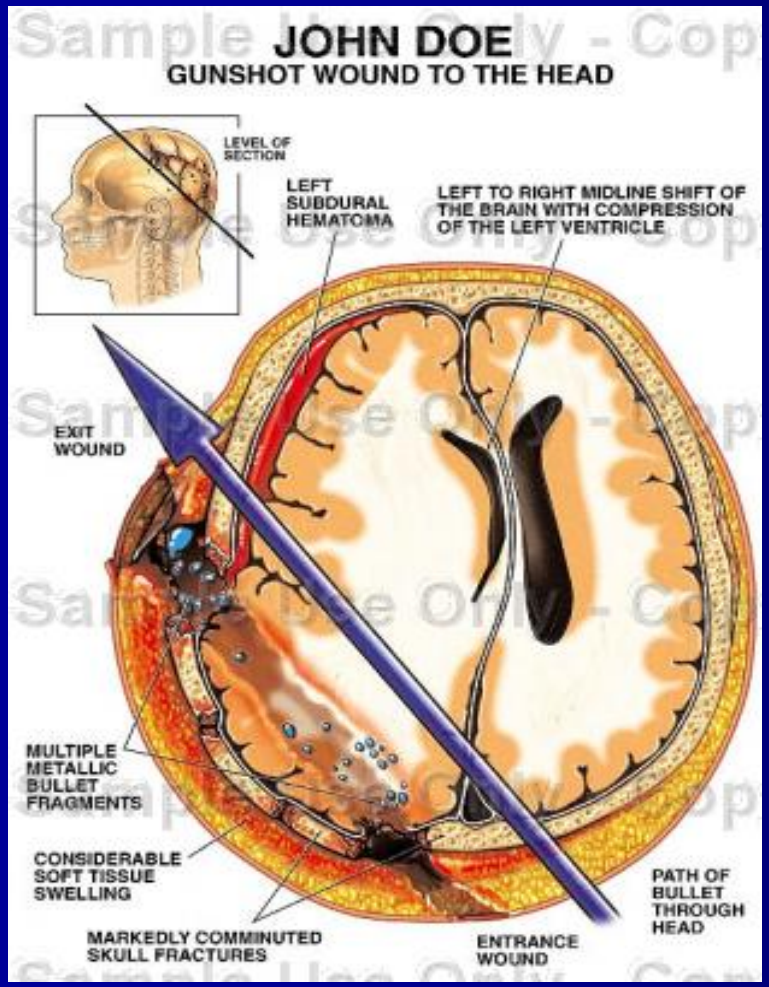
CT Brain Showing EDH

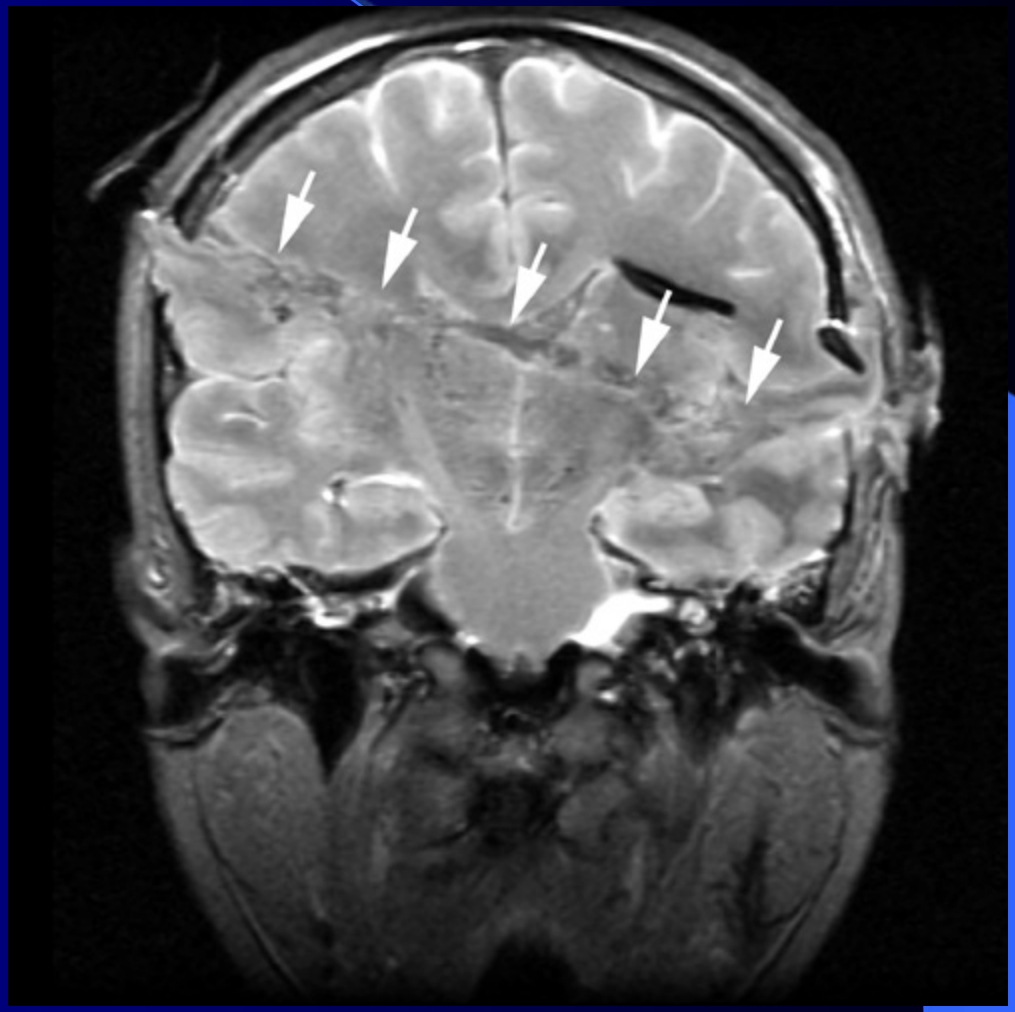
CT Brain Showing EDH with Swirl Sign

GSW & projectile TBI

- Missile vs nonmissle
- Energy dissipation = ½ progectile mass x velocity^2 (velocity and blast proximity)
- Associated with all forms of traumatic hemorrhage
- Outcomes related to velocity, location of entry and exit, post resuscitation GCS

GSW & projectile TBI (con't)





“Type A” Neuro Pt = Over-Achiever

On Site Hospital TX/RX

- Airway and breathing assessment in the awake and directable neurological patient

GCS 10-15, maintains Sao2 96-100%, NOT rapidly deteriorating neurologically, non-agitated/combative, and cardio-pulmonary status is stable:

1) Nasal Cannula, Non Re-breather

2) Bag and Mask Valve, as a bridge in some cases

3) Serial Neuro exams and Chest auscultation

4) CXR, and serial ABG's

5) "Big 3", BAT R/O, serial HCT

On Site Hospital TX/RX (con't)

- **Tracheal Intubation Criteria in the Neuro Pt:**
  - **1) Depressed LOC GCS < 8-9**
  - **2) Rapidly deteriorating neurologic exam (minutes-Hrs)**
  - **3) Immediate need for HV w/ target PCO2 30-36**
  - **4) Severe maxillofacial trauma or airway edema, w/ impending loss of airway protection &/or patency**
  - **5) Need for pharmacological sedation, SZ control &/or paralysis**
  - **6) Cardiovascular instability (MI, CHF, Sepsis, shock)**
  - **7) Primary pulmonary instability (Edema, Asp, Apnea, Stridor)**

a) In all cases, intubation should be based on emergent clinical criteria, rather than lab values and/or radiographic studies. When in doubt, elect to intubate the acute Neuro Pt., early and/or prior to any transport.

On Site Hospital TX/RX (con't)

- Difficult Airways: clinical presentations/syndromes in the Neuro Pt:

  Potential or proven cervical spine injury, also RA, Down's

  Basilar skull Fx

  Maxillofacial trauma &/or burns

  Receding chin (micrognathia)

  Prominent incisors (buck teeth)

  Short plethoric &/or muscular neck

  Morbid obesity, acromegaly, scleroderma

  Prev Trac, head/neck surgx &/or radiation

  Pregnant, Illeus/SBO/full stomach

On Site Hospital TX/RX (con't)

- Tx Hypertension in the Neuro Pt with SAH, ICH, EDH, Trauma, & some strokes, ie, Pt's having intracranial mass effect/inc ICP:
  1) Control ICP
  2) Intubate/Sedate
  3) Control any SZ
  4) Nipride gtt: 1-10 mic/kg/min (SE's: cardiopulm shunt, CN-thio tox ?? Inc ICP)
  5) Esmolol gtt: 25-200mcg/kg/min (SE's: bradycardia, heart block, bronchospasm, unopposed alpha)
  6) Labatolol: 2.5-20 mg q 1 hr PRN (SE's: bradycardia, heart block, unopposed alpha)
  7) Hydralazine: 2.5-20 mg IV q 1hr PRN (SE's: reflex tachy, > AAA
  8) Nicardapine gtt: 5-15 mg/hr

On Site Hospital TX/RX (con't)

- Hypotension in the Neuro Pt:

  Causes: Cardiogenic = Hypovolemic > Acidosis >Neurogenic > Vasogenic

  Dx:

  IBP monitoring, 12 lead EKG, Trop-I, Blood gas, CXR, CVP or PAP monitoring, Blood Cultures, +/- BAT R/O

  Tx:

  1) Fluid Challenge in face of inc ICP W/ 500 cc 5% Albumen, or blood (repleats intravasc vol and inc oncotic pressure)

  2) Dopamine gtt : 5-20mic/kg min titrate SIBP 100-120

  3) Neosyephrine gtt: 0.5-5mic/kg/min

  4) Vasopressin gtt: 0.01-0.1 u/min

On Site Hospital TX/RX (con't)

- Control of Presumed Elevated ICP:
- (Trauma, SAH, ICH, SDH, EDH, Large stroke, Tumor)

1) Head of bed ~ 30 deg (inc JV outflow)

2) Intubate (PCO2 30-36, PEEP ~ 5), ET fastened w/o IJ occlusion, keep head forward & neck straight after intubation

3) Light- heavy sedation inversely proportional to GCS

4) Avoid IJ Location for central venous catheter (Subclavian)

5) Mannitol 1.5 G/kg IV, check Na++/serum osmo afterwards if time permits,

6) Hypertonic Saline: 23%, 7%, 3%

7) Lasix 10-20 mg IV ½ hr after Mannitol, check K+

9) Minimal- Euvolemic total fluids (MIVF + Rx + TF) ~ 40-100cc/hr

10) Ventricular drainage &/or ICP monitor

11) Fever control, or active cooling

12) Early Crainectomy

On Site Hospital TX/RX (con't)

- Control of Seizure

1) A-B-C's

2) Ativan 2-10 mg IV push

3) Phosphenytoin 18-20mg/kg IV load < 50 mg/min (SE's bradycardia and hypotension)

4) Depakon 1000-1500 mg IV load < 20 mg/min

5) Phenobarbital 200-500mg IV load < 60 mg/min, spike Dopamine &/or Neo gtt (SE's cardiopulm, immune syst suppression) Deploy PA cath, titrate to burst – suppression on EEG

6) Propofol gtt, titrate to burst – suppression on EEG

7) Keppra 1500 mg IV load

On Site Hospital TX/RX Overview

- Kept position head up > 30 degrees (max V outflow, min A hydrostatic head) at all times
- CVP/ IBP / PA cath monitoring, (no IJ lines)
- Allowed Low normothermia – core T 35-36.5 or mild hypothermia
- Loaded Dilantin 18-20mg/kg slowly (< 50mg/min)
- Normalized coags (Novo-7, FFP, Cryo-PTT, Vit K)
- Normalized Platelet count/function (# > 100K, DDAVP)
- (+/-) Steroids (exceptions = tumor, abscess)
- (+/-) Nimodapine in extensive and/or traumatic SAH
- Instituted Spinal Precautions, Spinal radiographs
- Cerebral vascular studies (angio, CTA, CTV, MRA, MRV)
- Serial CT, (+/-) MRI scans

On Site Hospital TX/RX Overview

- Intubated and sedated, (Narcs, Benzos, Propofol, Presidex) +/- paralytic gtt (1-0/4 train of 4) or Barbs /24 hr EEG
- Maintained MAP 80 -100, Pressors (dopa, neo, vaso) or Anti-HTN Rx, with CVP or PA catheter monitoring in many Pt's
- Given Mannitol 1.5g/kg load, can be followed by Lasix (synergy), albumen & blood, HCT 30-33, Euvolemia-Hypovolemia in acute phase, if tolerated
- Targeted PcO2 34-40, minimum PEEP / PS if possible, PaO2> 80-90
- Placed ICP monitor, goal ICP < 20, with CSF drainage via EVD if necessary and CPP > 60-70 in pt's with ICP sustained > 20
- PbTO2, and Brain Temp monitoring (Licox) target PbTO2 > 20
- (+/-) Lumbar drainage, for some CSF leaks
- Started Abx prophylaxis esp: pneumocephaly, CSF leaks, EVD
- (+/-) Emergent surgical evacuation and possible crainectomy

Timing of Craniotomy

- "Four hour rule" Seelig et al N Engl J Med: 82 patients with acute subdural, operation in < 4 hours = 30% mortality, if > 4 hours 90% mortality

- "Six hour rule" Citow

  Operation in < 6 hours = 30% mortality, if > 6 hours, 95% mortality

Timing of Craniotomy (con't)

- Wilberger et al, found no statistical significance to earlier evacuation, rather statistical outcome variables were: presenting neuro exam, and post op ICP
- Hatashita et al, found no statistical advantage in decompressing before ten hours post injury

Conclusion

- Severe brain injuries are associated with high mortality and morbidity
- GCS, Hunt & Hess, Fisher Grades, and age are strong predictors of outcome
- Timing of surgical repair and repair likely does have prognostic significance
- Periop care of the TBI Pt impacts outcome via: systemic control of airway, ICP, MAP,Volume status, coagulopathy, and possibly CBF

Future Directions

- Invasive brain tissue oxygenation monitoring
- Invasive CBF monitoring
- Invasive brain T monitoring
- Invasive brain Dialysis Catheter monitoring
- Minimization of early apoptosis via control of excitatory AA (glutamate, aspartate), control of NMDA receptor agonists,….? control of presynaptic endogenous opioid peptides
- Conivaptan

Questions

Severe Spinal Injury Epidemiology

Severe Spinal Injury Epidemiology

- Cervical
- Thoracic
- Lumbar
- Sacral

SCI R/O

- All victims with significant mechanism of trauma
- Trauma Pt's with LOC
- Minor trauma Pt's with neck or back pain, or sensory motor, or vasomotor findings on PE
- SCI may mask other injuries

Instability

Segmental instability is a loss of spinal motion segment stiffness, such that force application to that motion segment produces greater displacement(s) than would be seen in the normal structure, resulting in a painful condition, the potential for progressive deformity and neurologic structures at risk.

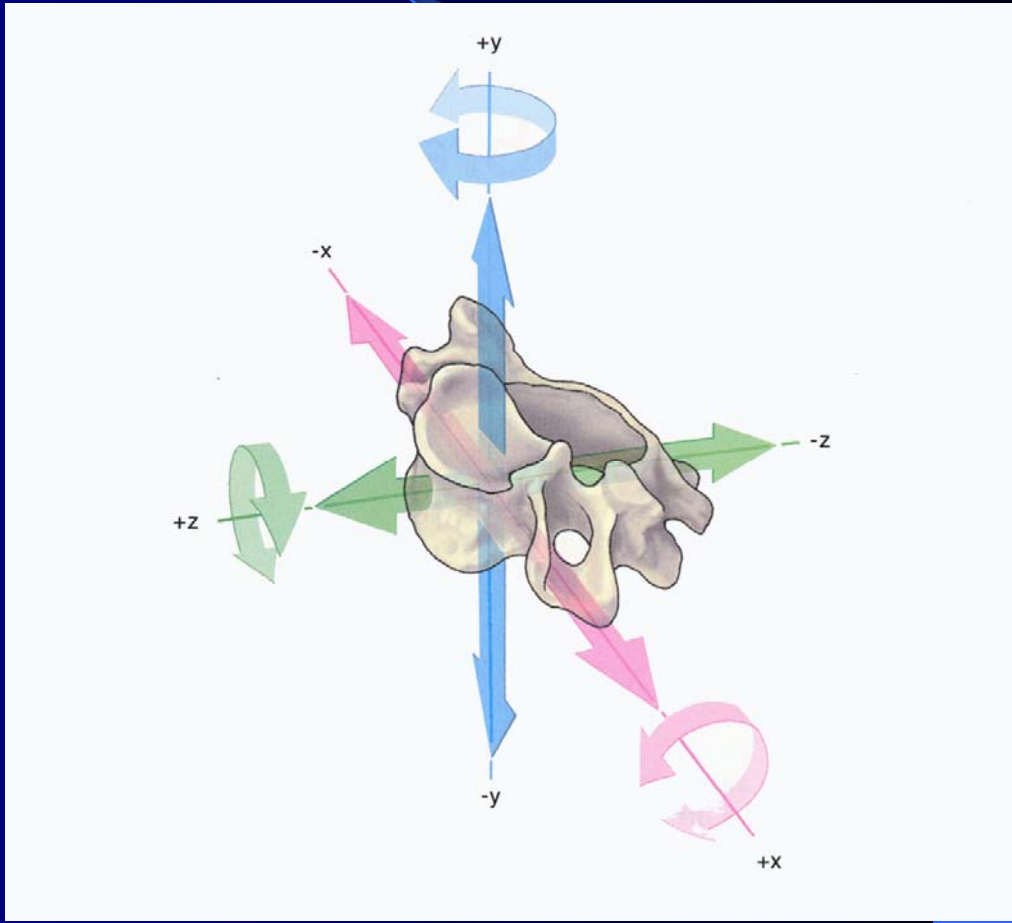
John W. Frymoyer

Instability and Treatment

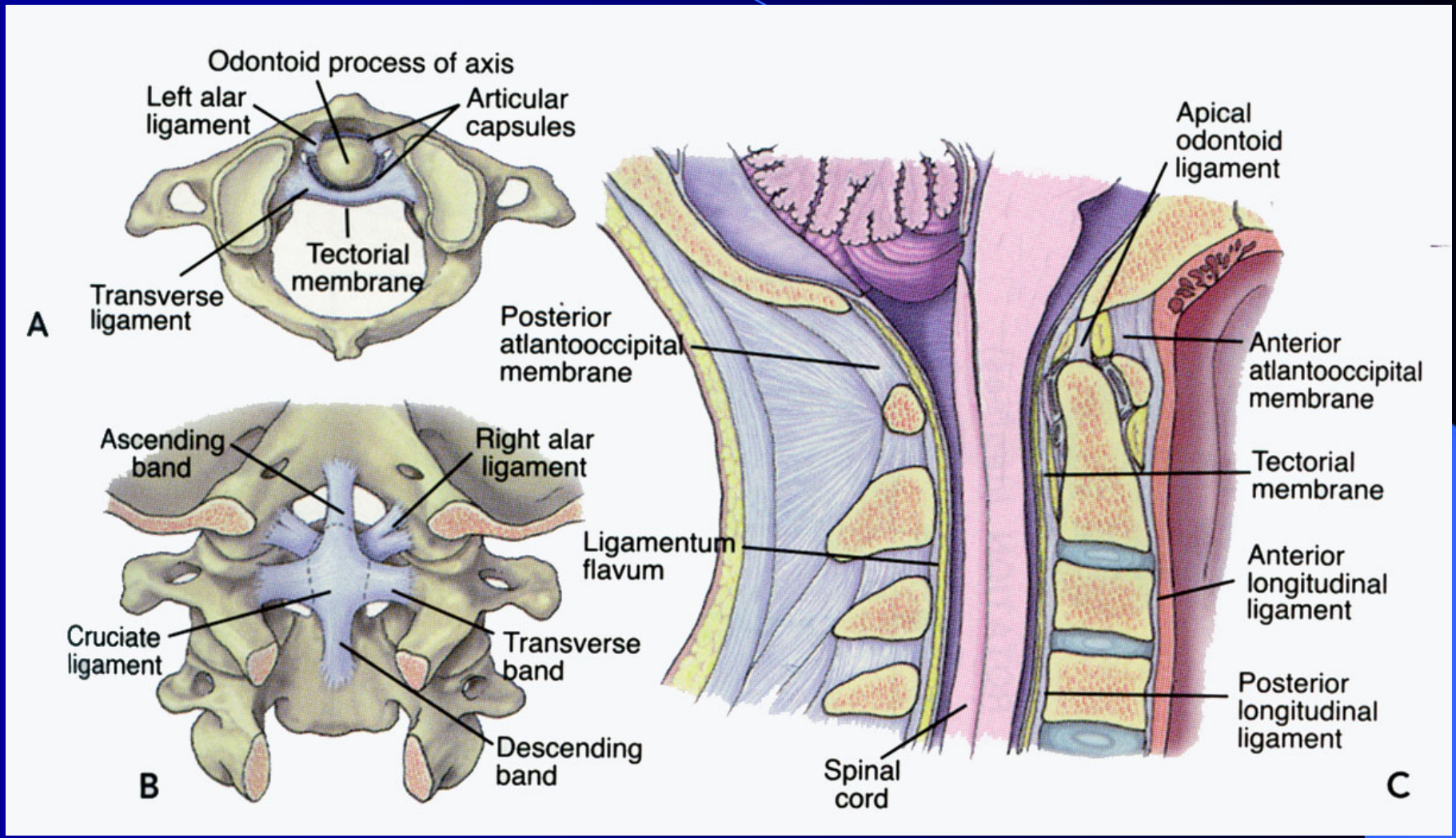
- Acute SCI with potential for healing to stability
- Acute SCI with low potential for healing to stability
- Chronic (glacial)
- Etiology
  - Osseous
  - Ligamentous
- Risk/benefit

Spinal Biomechanics

- Cartesian System
- Two motion types
  - Translations
  - Rotations
- Coupling
- Kinematics vs biomechanics



Upper Cervical Anatomy



Upper Cervical Instability

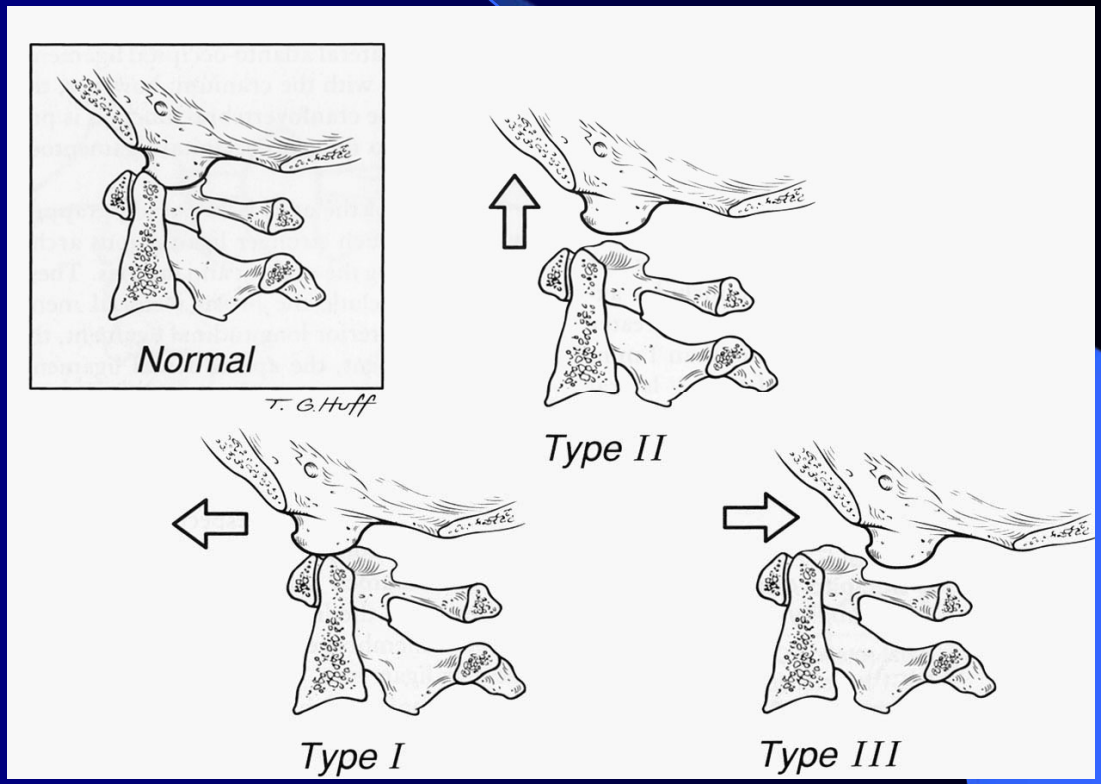
- Visible occipital condyles
- Widened C1 vs C2 on AP > 7mm
- **Rupture of transverse ligament**
- Type II odontoid fracture w/ > 6mm displacement
- Flex/ext range > 11 degrees (C1-3)
- > 50% loss of facet contact
- Interspinous widening
- C2-C3 z axis translation > 3mm

Upper Cervical Instability (con't)

- Occipito-atlantal dislocation
- C1 injuries
- C1-C2 dislocations
- C2 fractures
- C1-C2 combination injuries
- Odontoidectomy

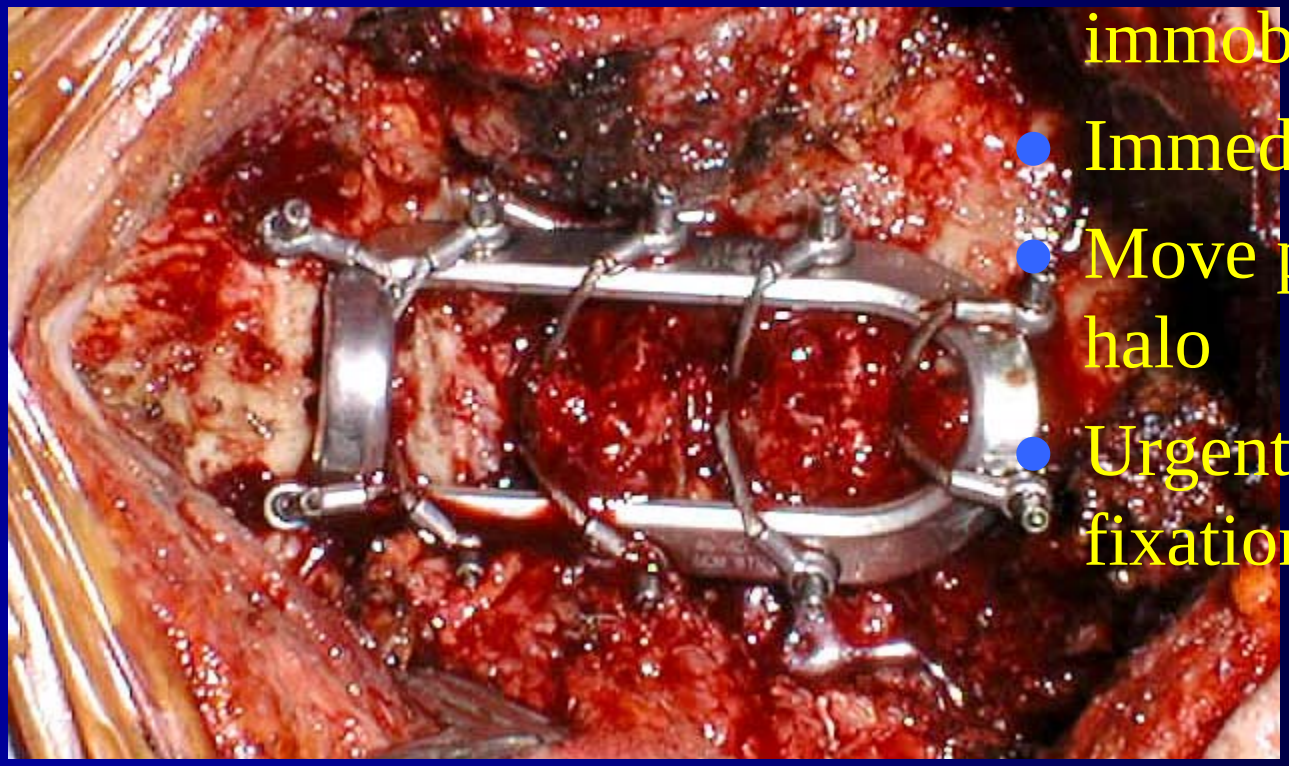
Occipito-atlantal Dislocation

- High mortality at scene
- Very unstable (immediate halo fixation)
- Floating condyles
- Power's ratio
- CT vs MRI

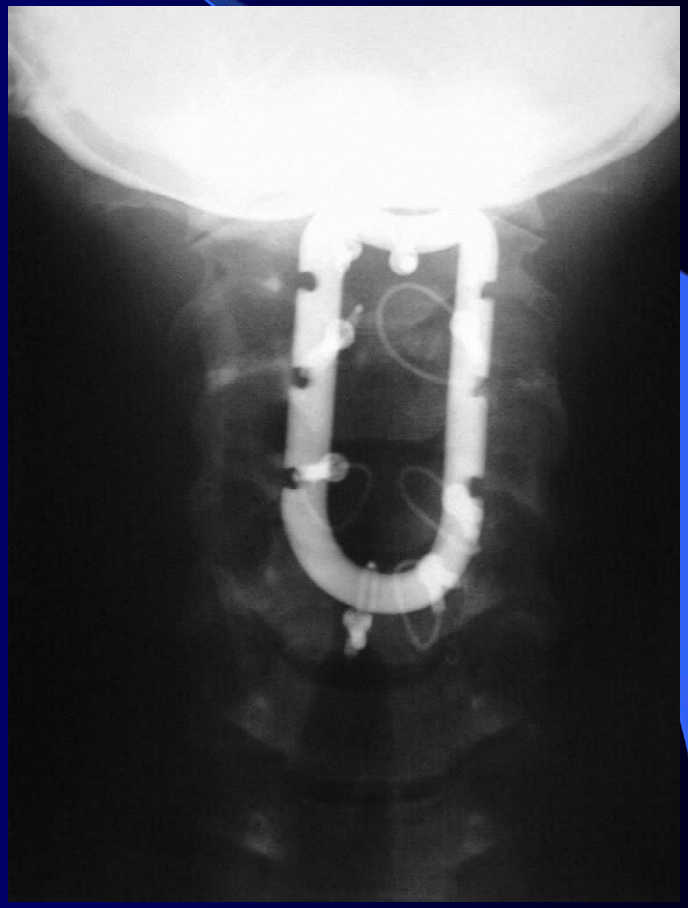


Occipito-atlantal Dislocation Treatment

- NO TRACTION!
- Backboard immobilization
- Immediate halo
- Move pt to OR with halo
- Urgent internal fixation



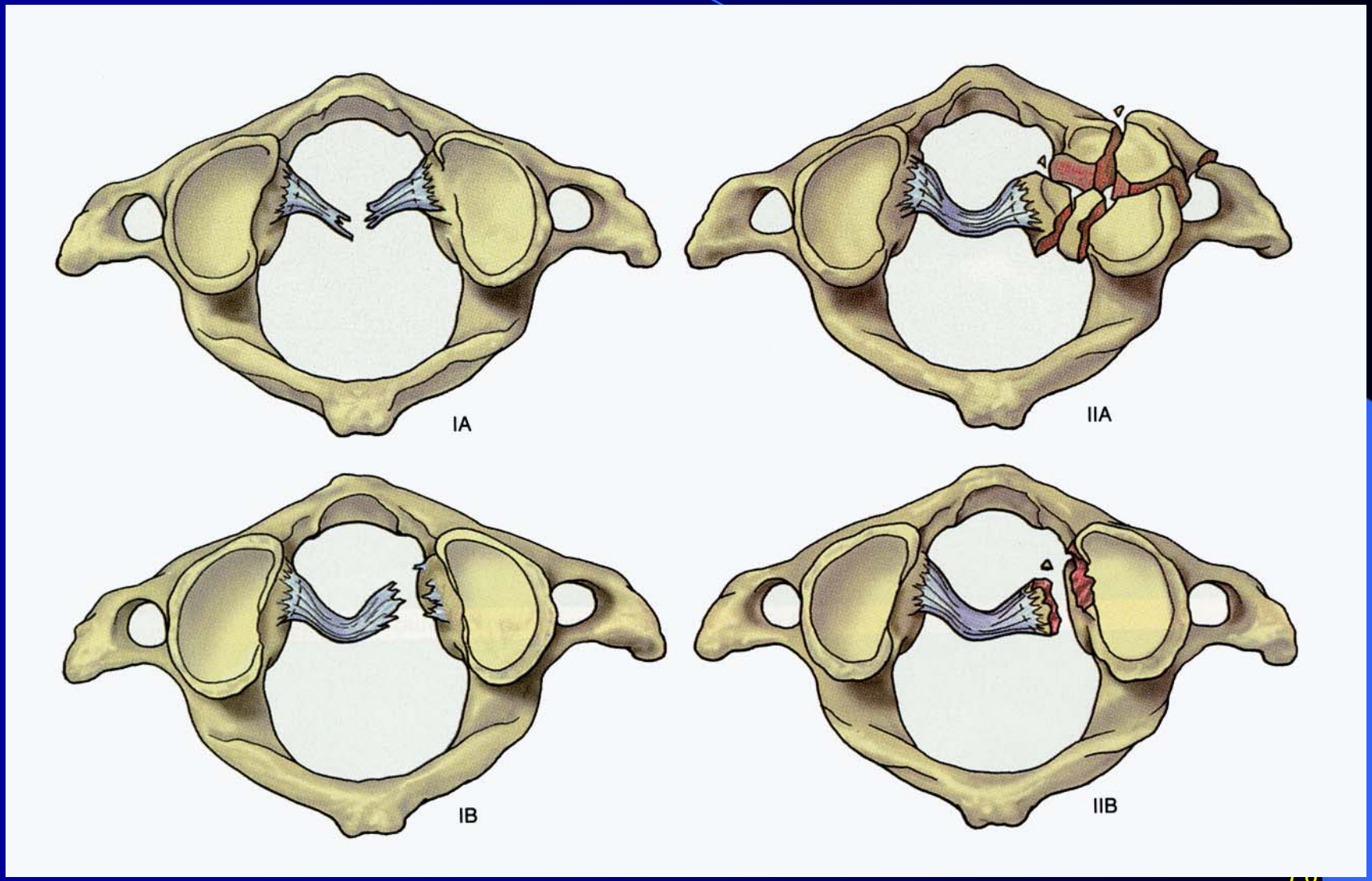
Occipito-atlantal Dislocation



C1 (atlas) Injuries

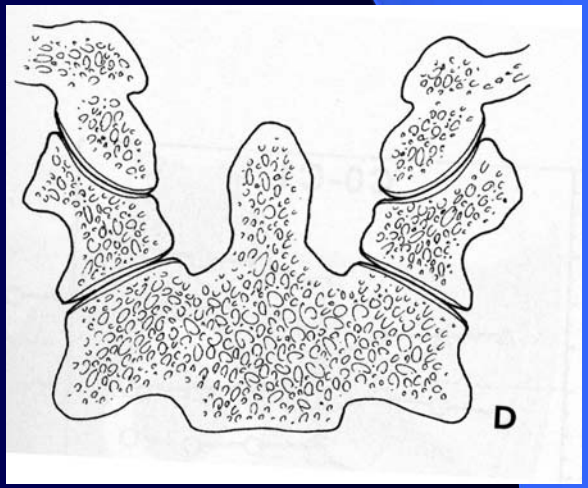
- Osseous
  - Ring fractures (Jefferson)
  - Lateral mass fractures
- Ligamentous
  - Transverse ligament
- 45% will have C2 injury

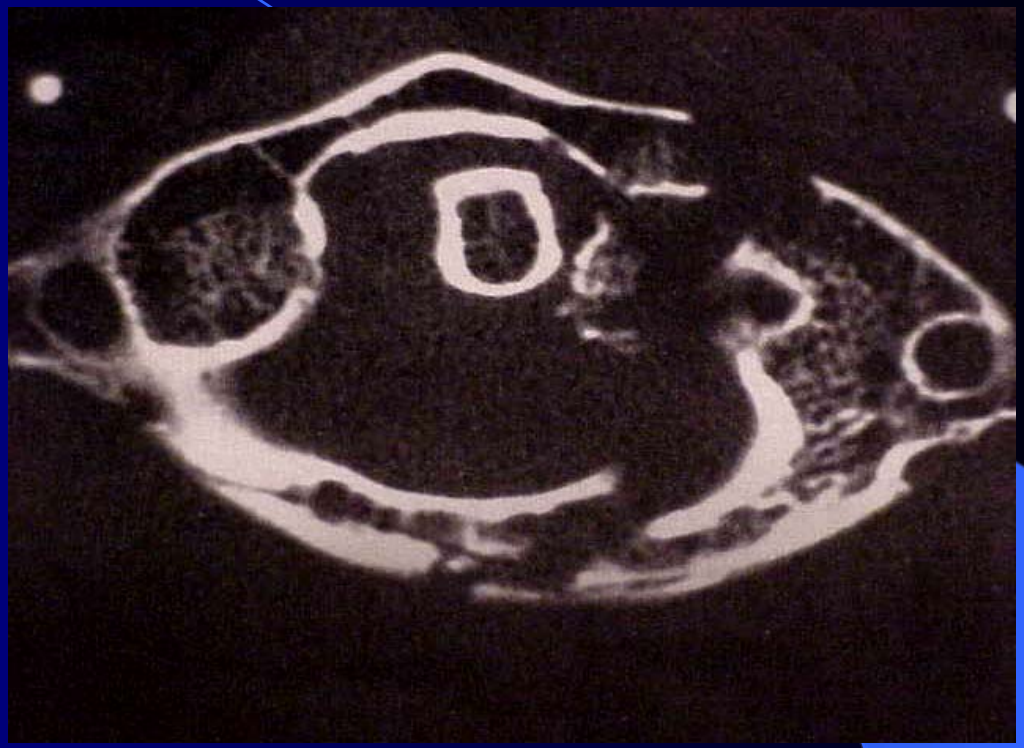
Atlas Injury



Atlas Injury
Diagnosis

- C spine plain film with odontoid view, showing overlap of C1 on C2 on AP > 7mm
- CT with 1 mm resolution and 3d reconstruction, showing predental space > 3mm
- MRI for transverse ligament



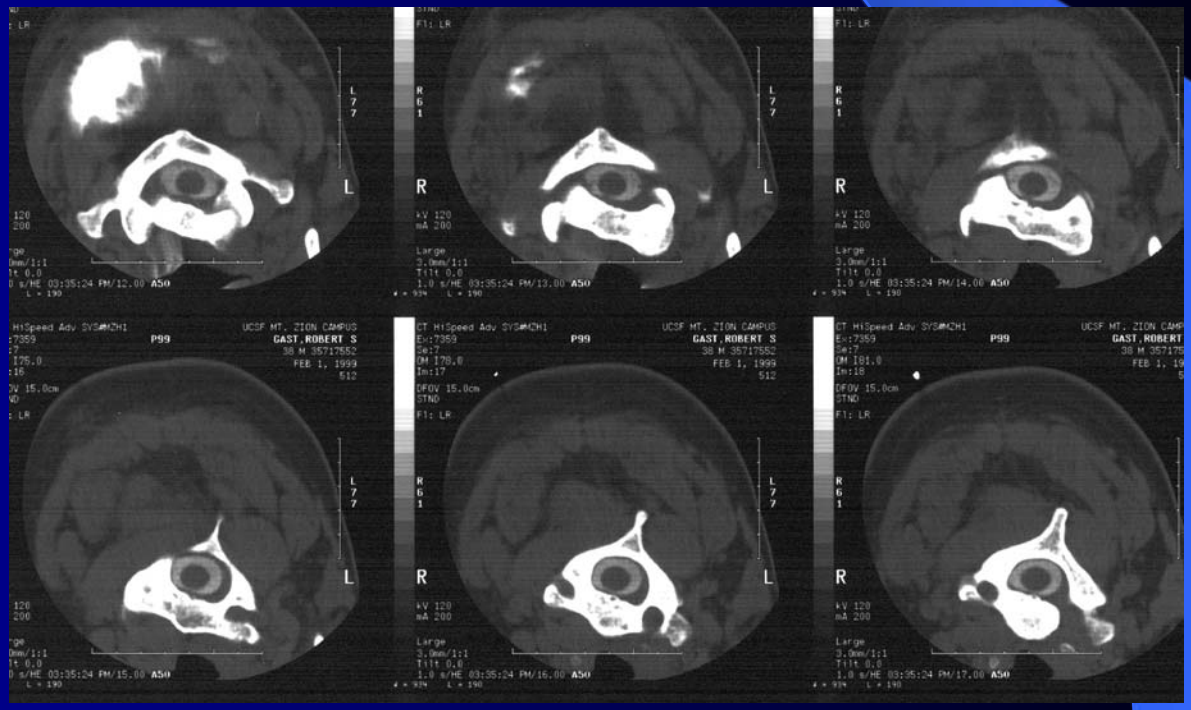


Atlas Injury
Treatment

- Dependent on transverse ligament and potential for healing to stability
- Ring fractures - external immobilization
- Transverse ligament incompetence
  - Osseous basis - possible nonsurgical management
  - Pure ligamentous injury - surgery

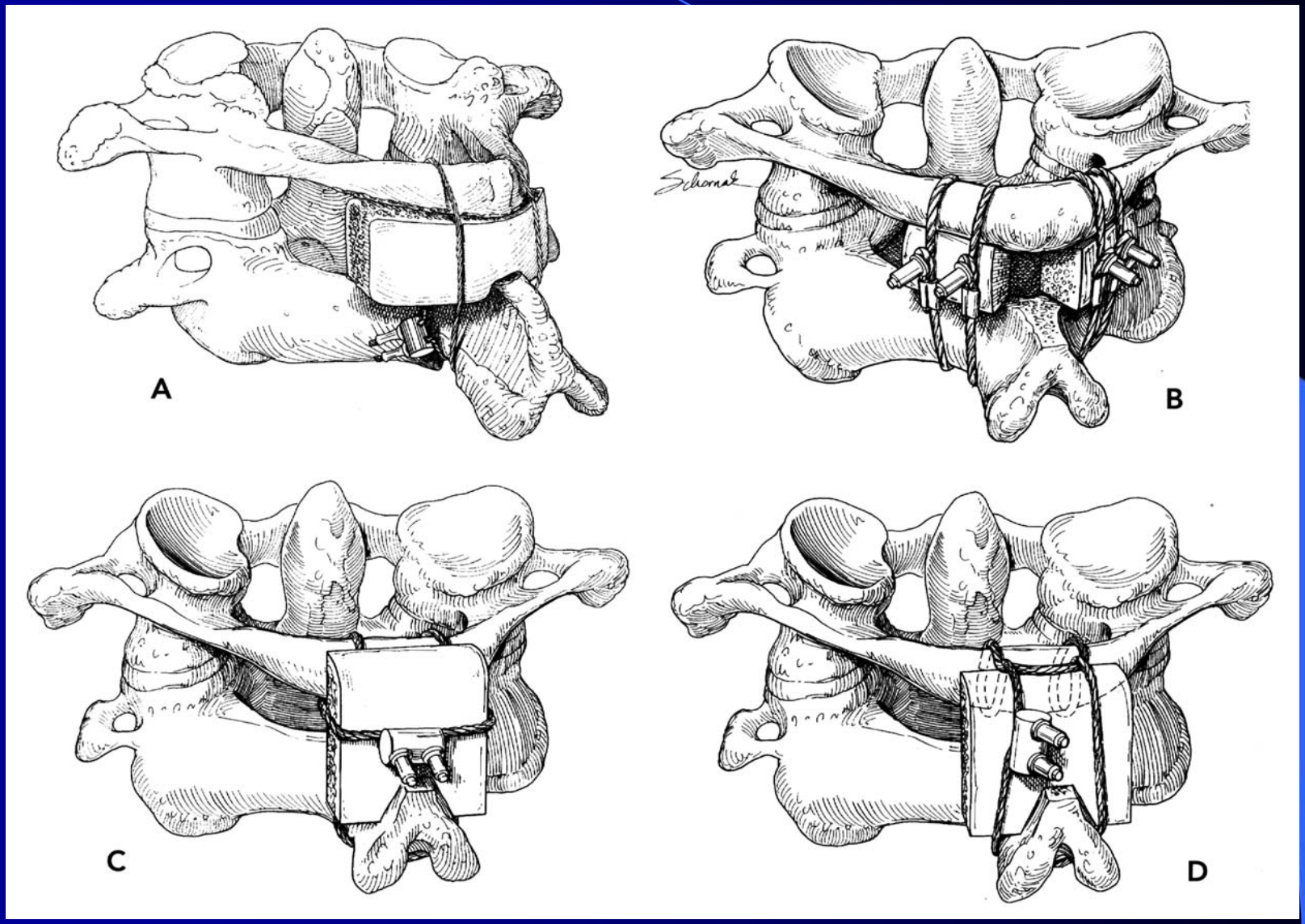
C1-C2 Dislocations

- Transverse ligament injury
- Rotatory subluxation

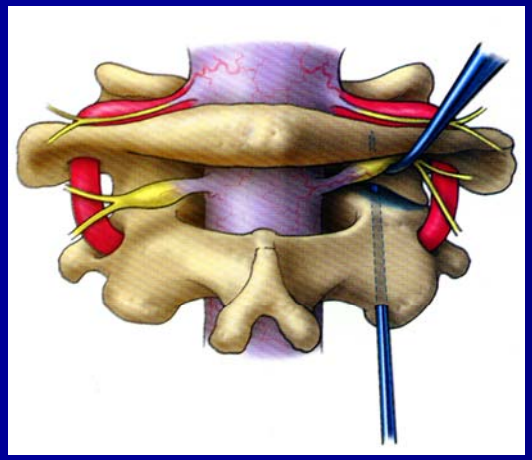


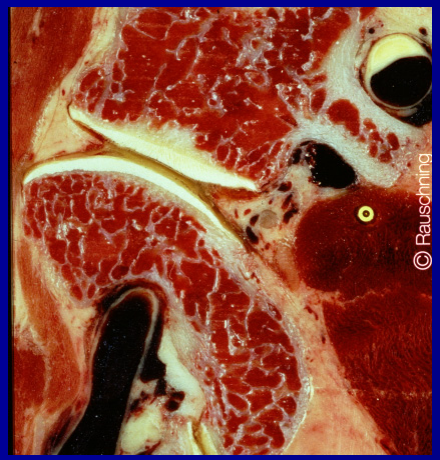
Transverse Ligament Disruption

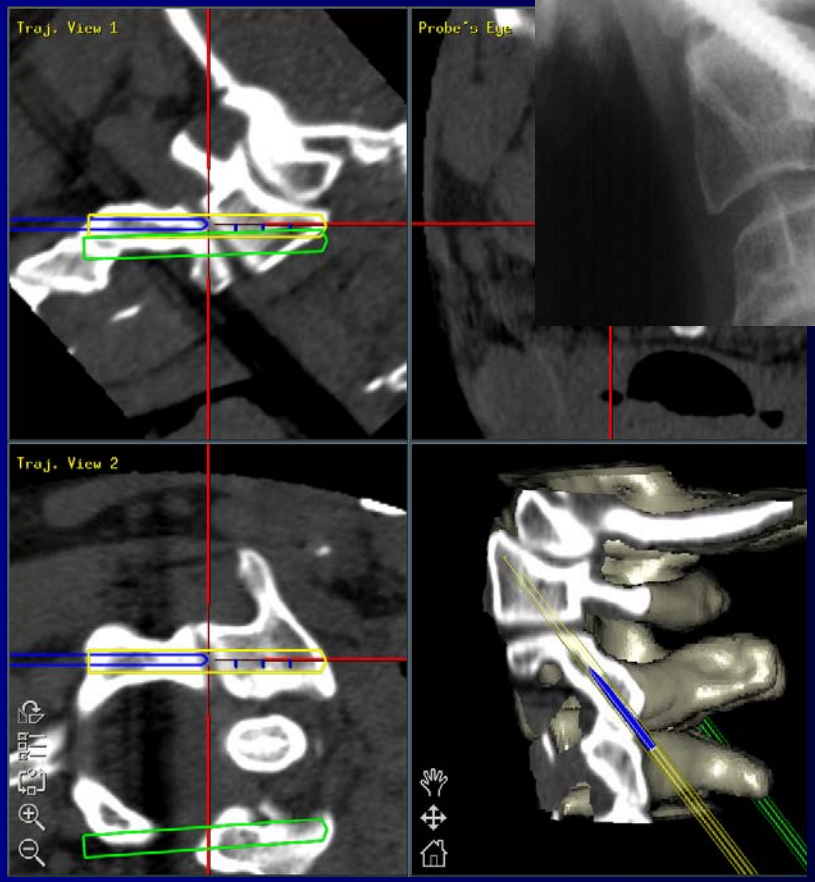
C1/2 Fusions



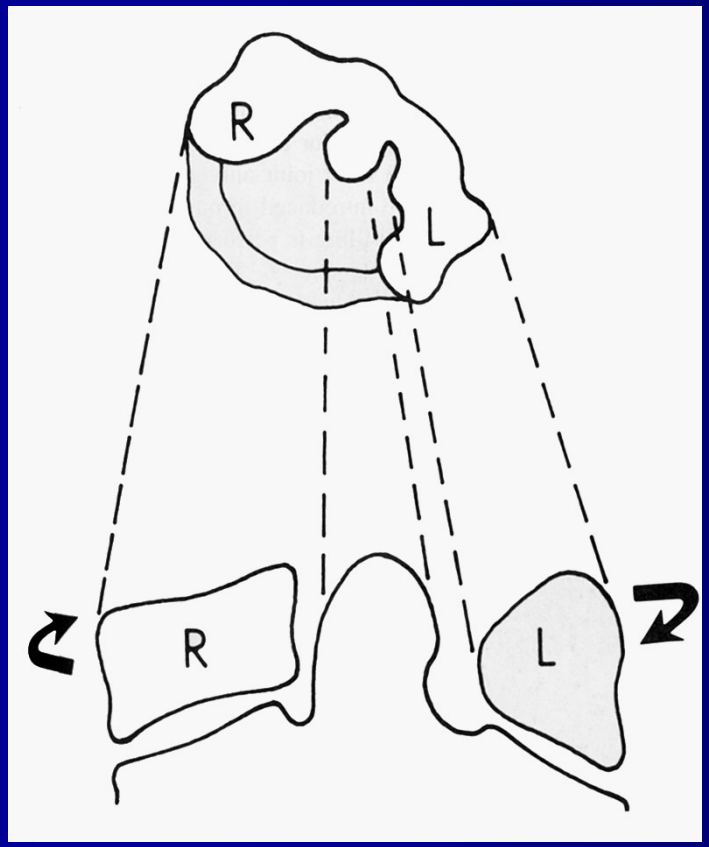
C1/2 Transarticular Fixation

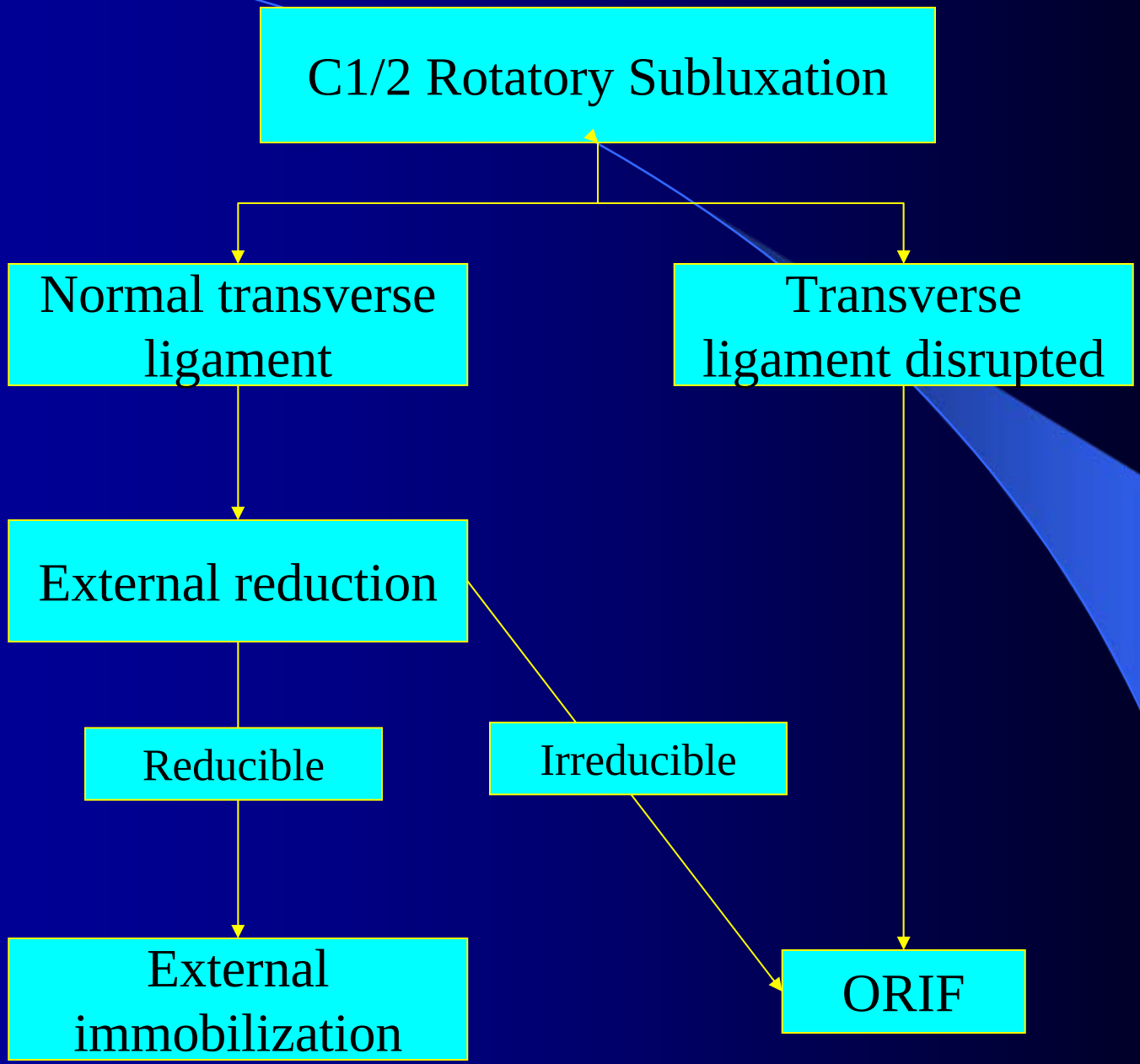




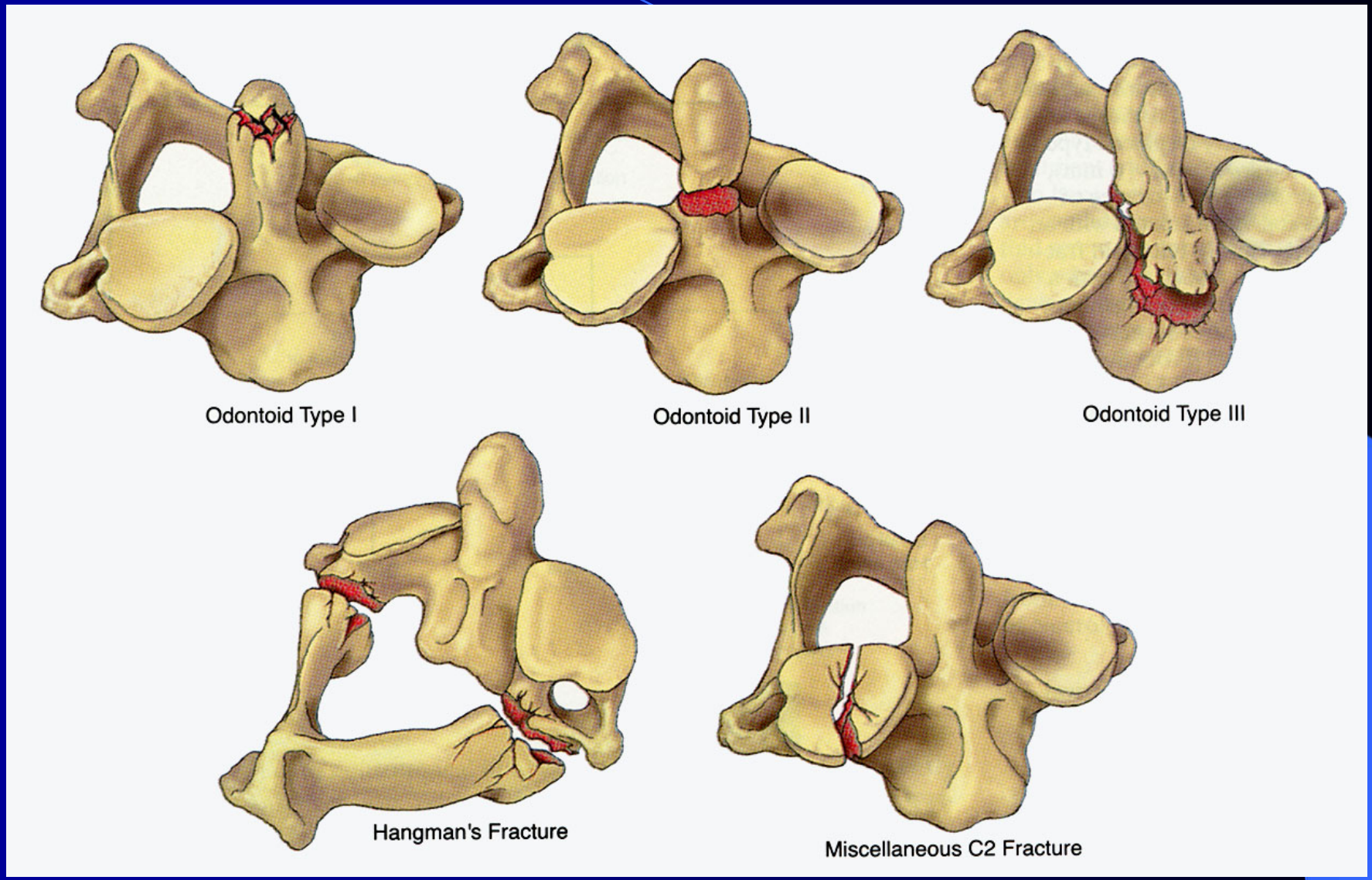


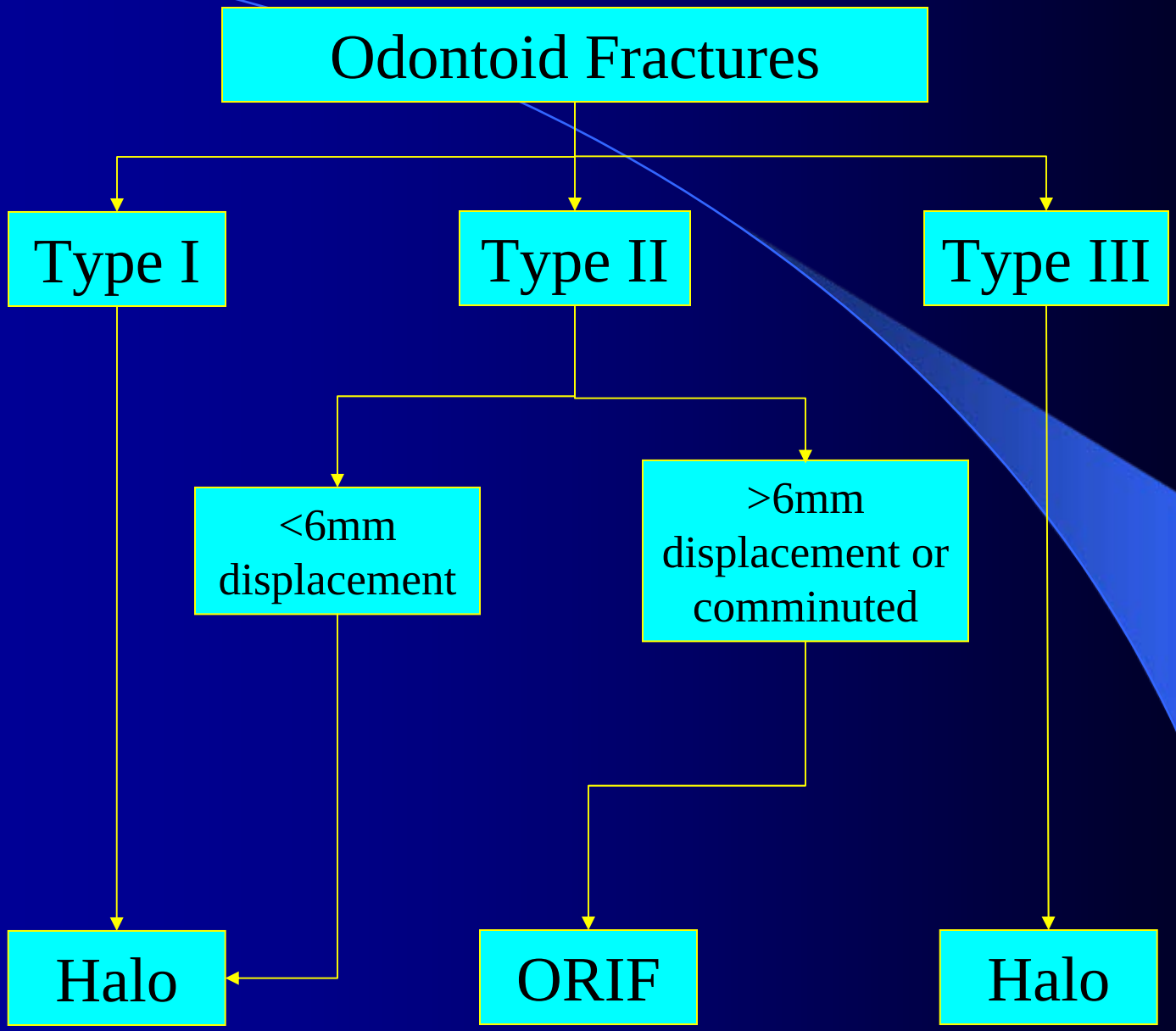
C1/2 Rotatory Subluxation



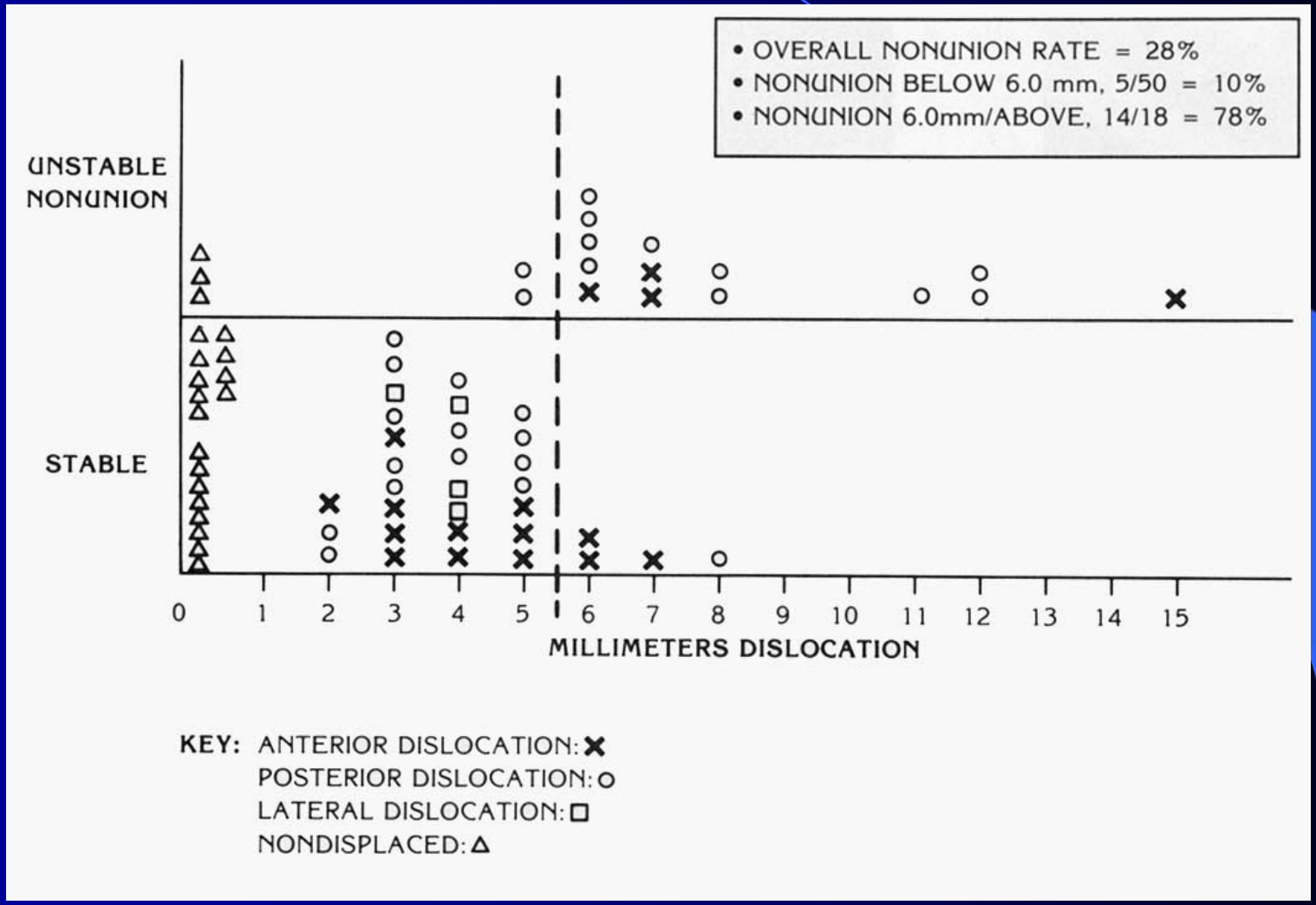

C1/2 Rotatory Subluxation
Normal transverse ligament
Transverse ligament disrupted
External reduction
Reducible
Irreducible
External immobilization
ORIF

C2 Fractures

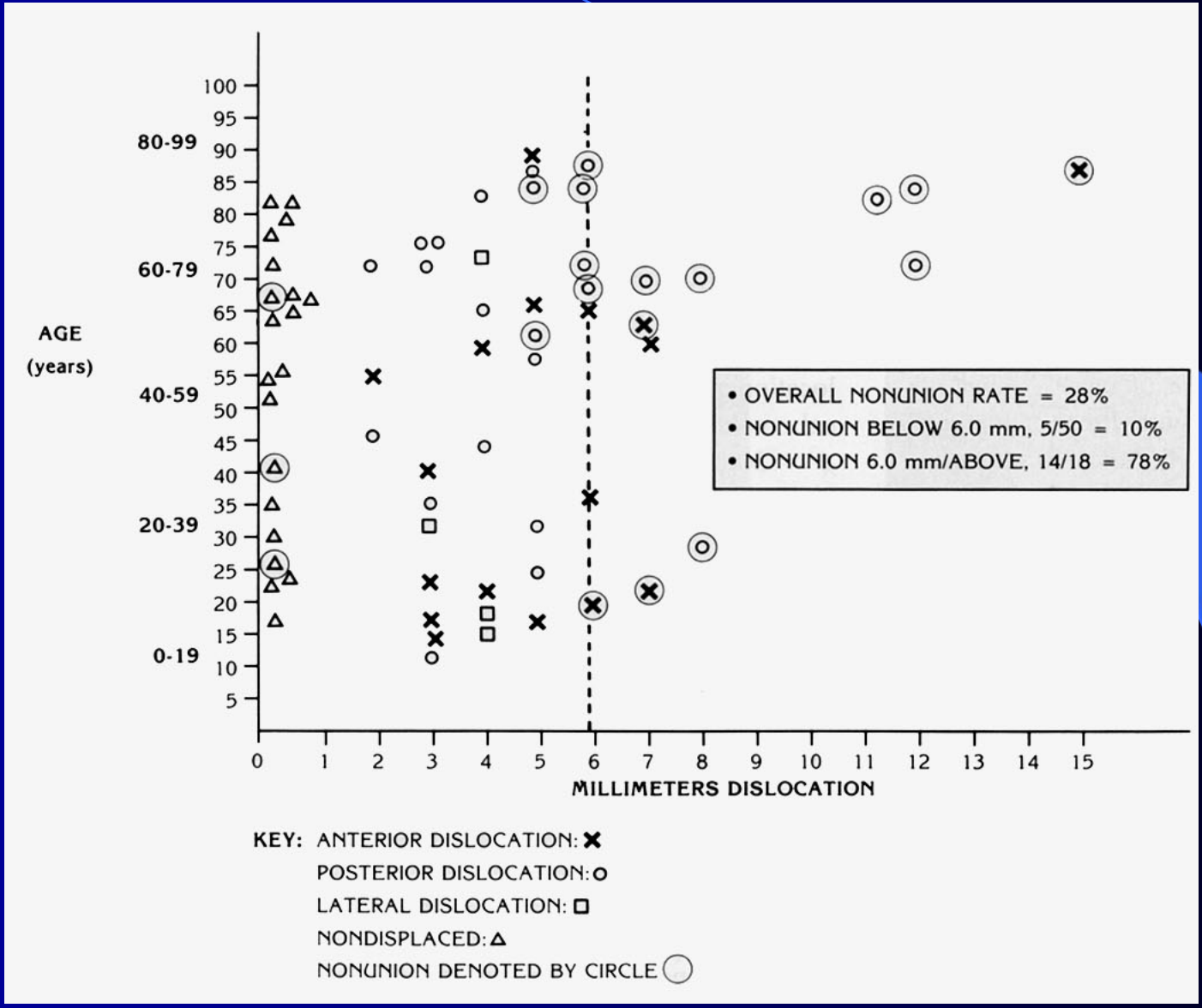



Odontoid Fractures
Type I
Type II
Type III
<6mm displacement
>6mm displacement or comminuted
Halo
ORIF
Halo

Odontoid Fracture by Displacement

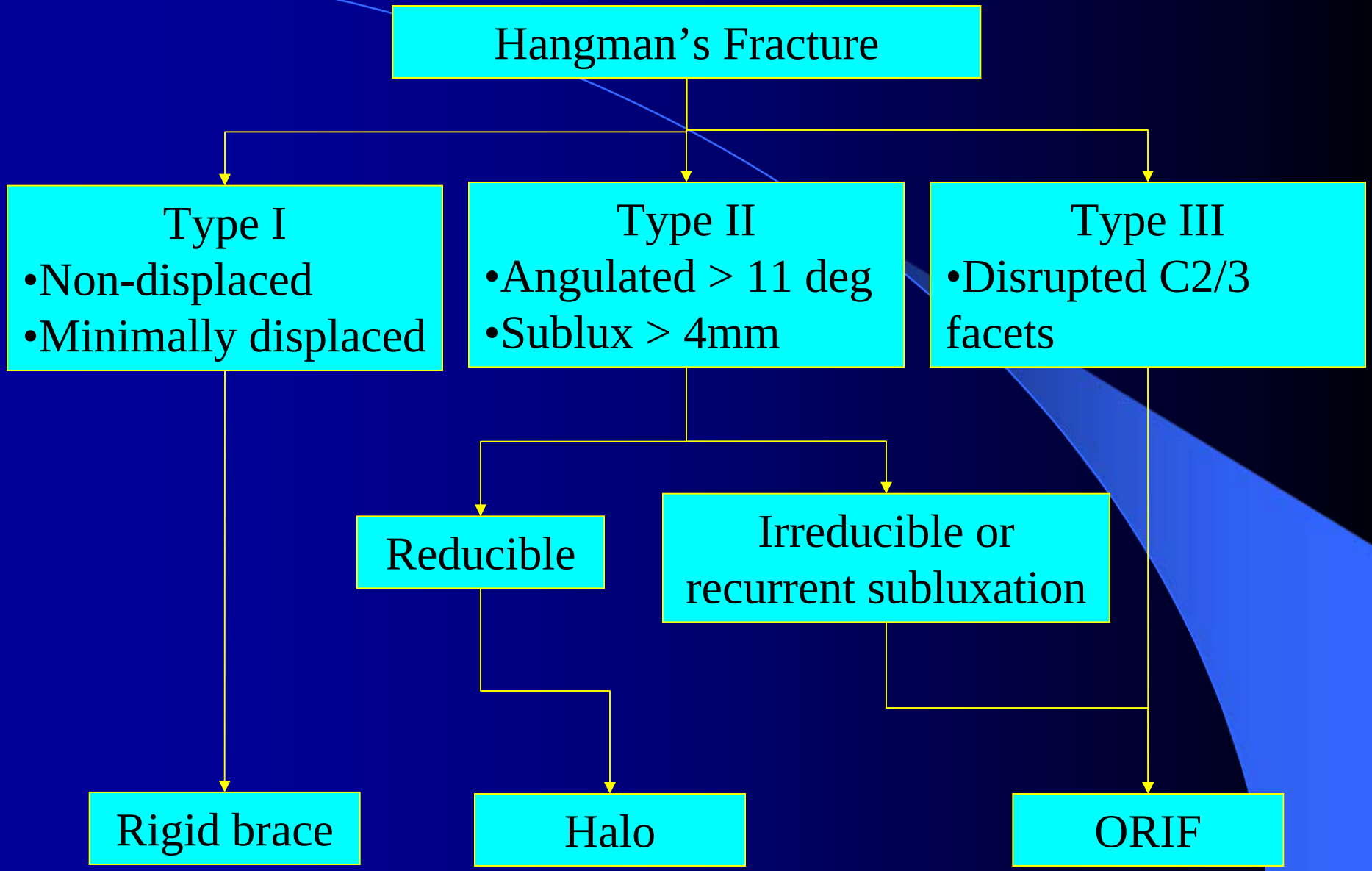


Odontoid Fracture by Age

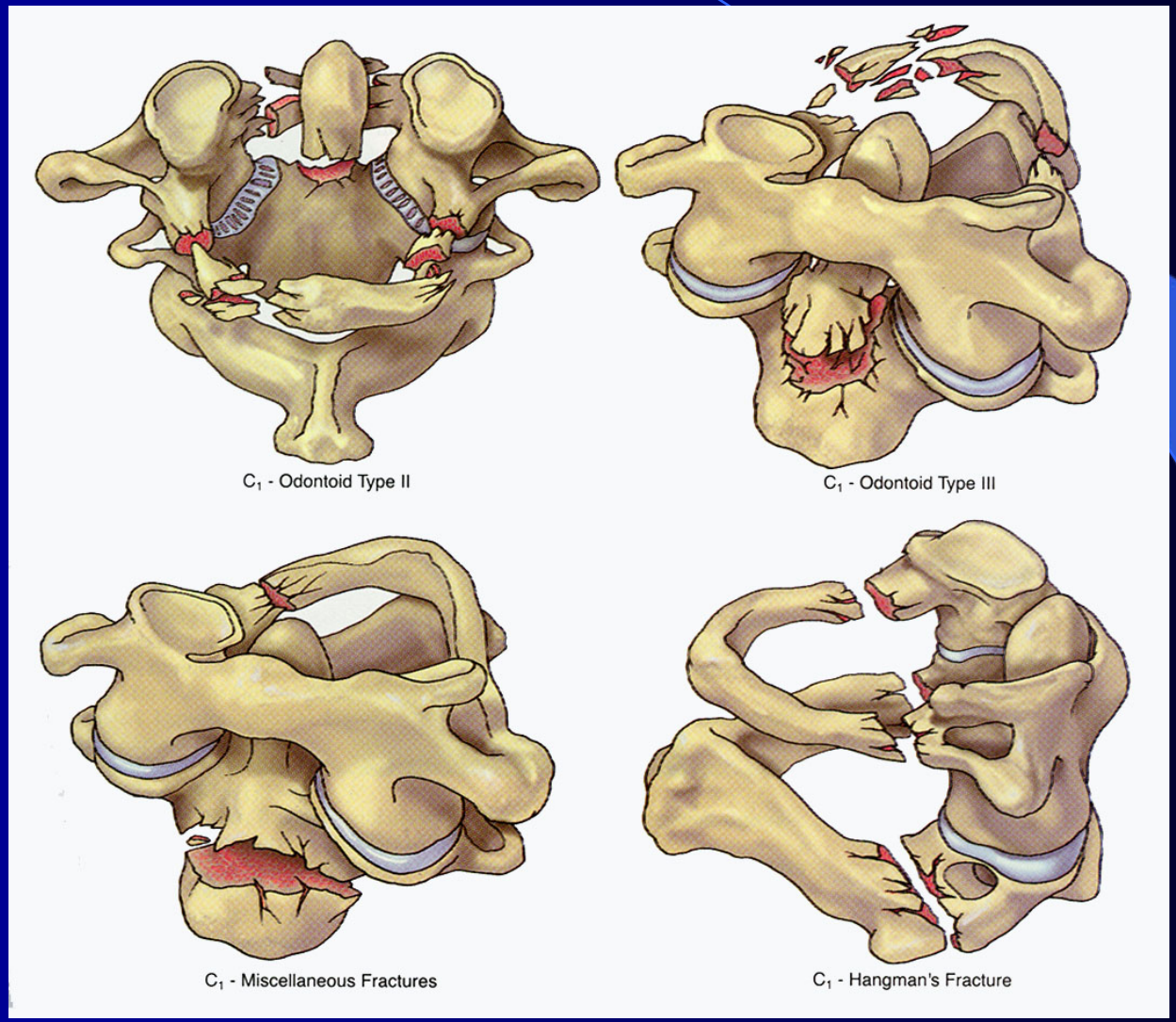


Odontoid Fracture


12-NOV-1999
IMAGE 13
SER 1-2
A


Hangman's Fracture
Type I
•Non-displaced
•Minimally displaced
Type II
•Angulated > 11 deg
•Sublux > 4mm
Type III
•Disrupted C2/3 facets
Reducible
Irreducible or recurrent subluxation
Rigid brace
Halo
ORIF

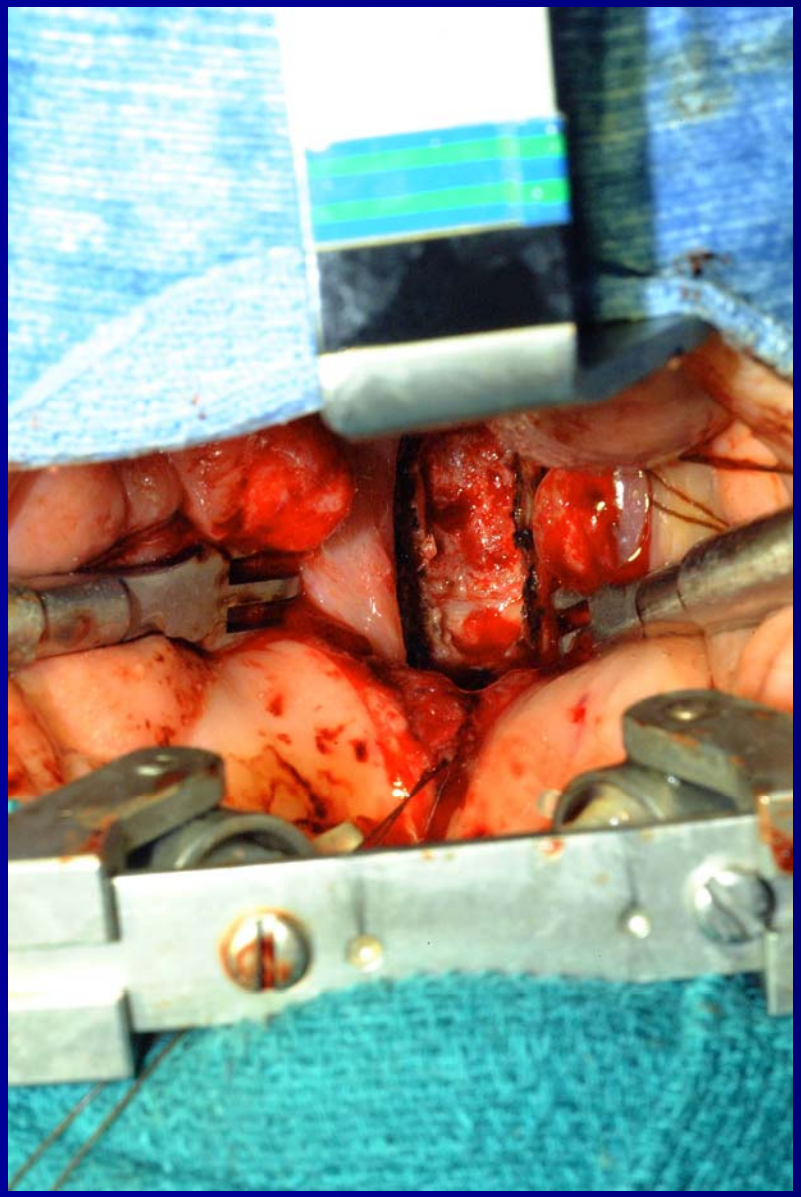
Complex Upper Cervical Fractures



Operative Intervention

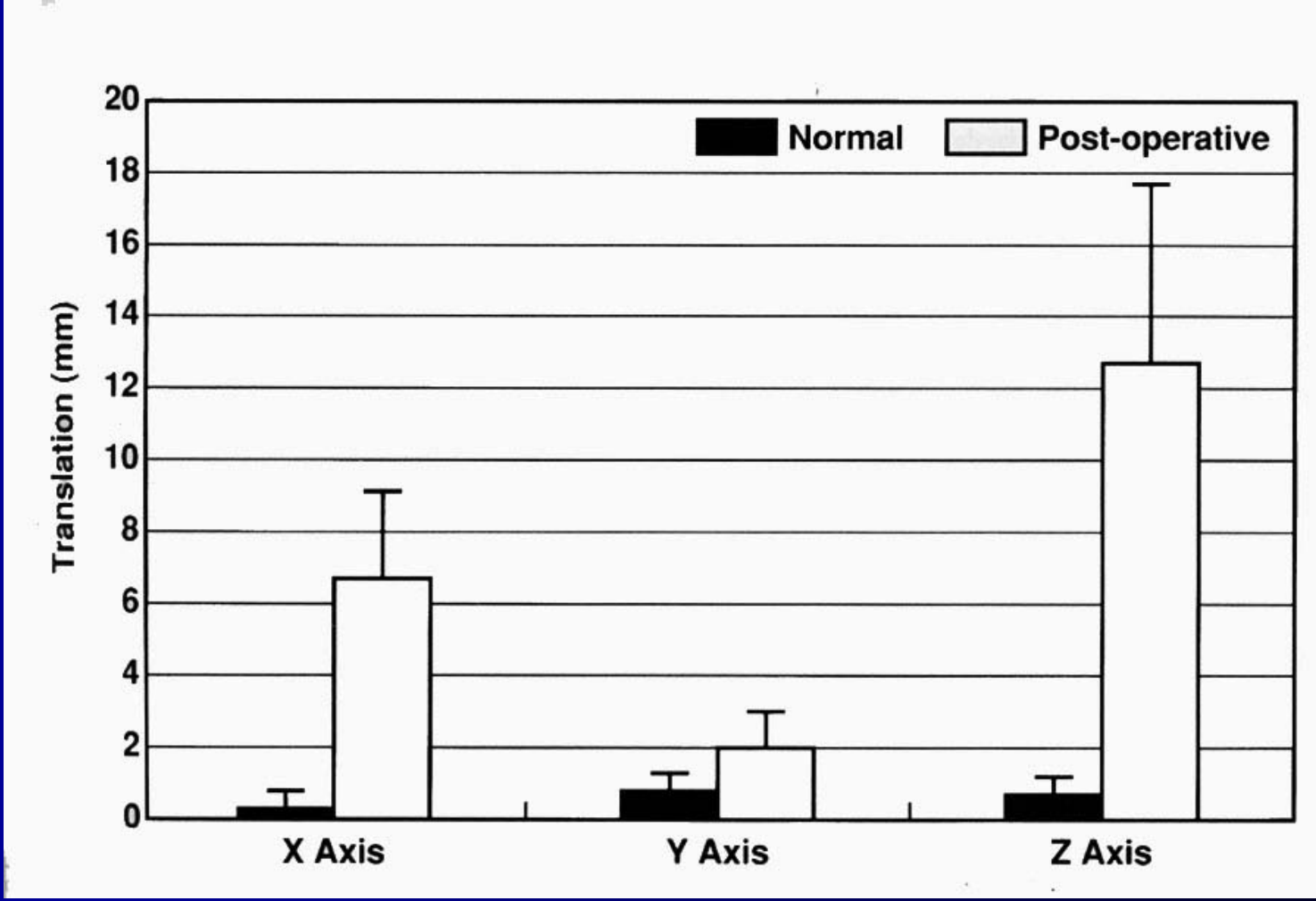
- Poor immobilization or recurrent deformity/malalignment
- Nonunion after nonsurgical treatment
- Ligamentous injury
- Above criteria for odontoid and Hangman's fractures

Transoral Odontoidectomy



Transoral Odontoidectomy

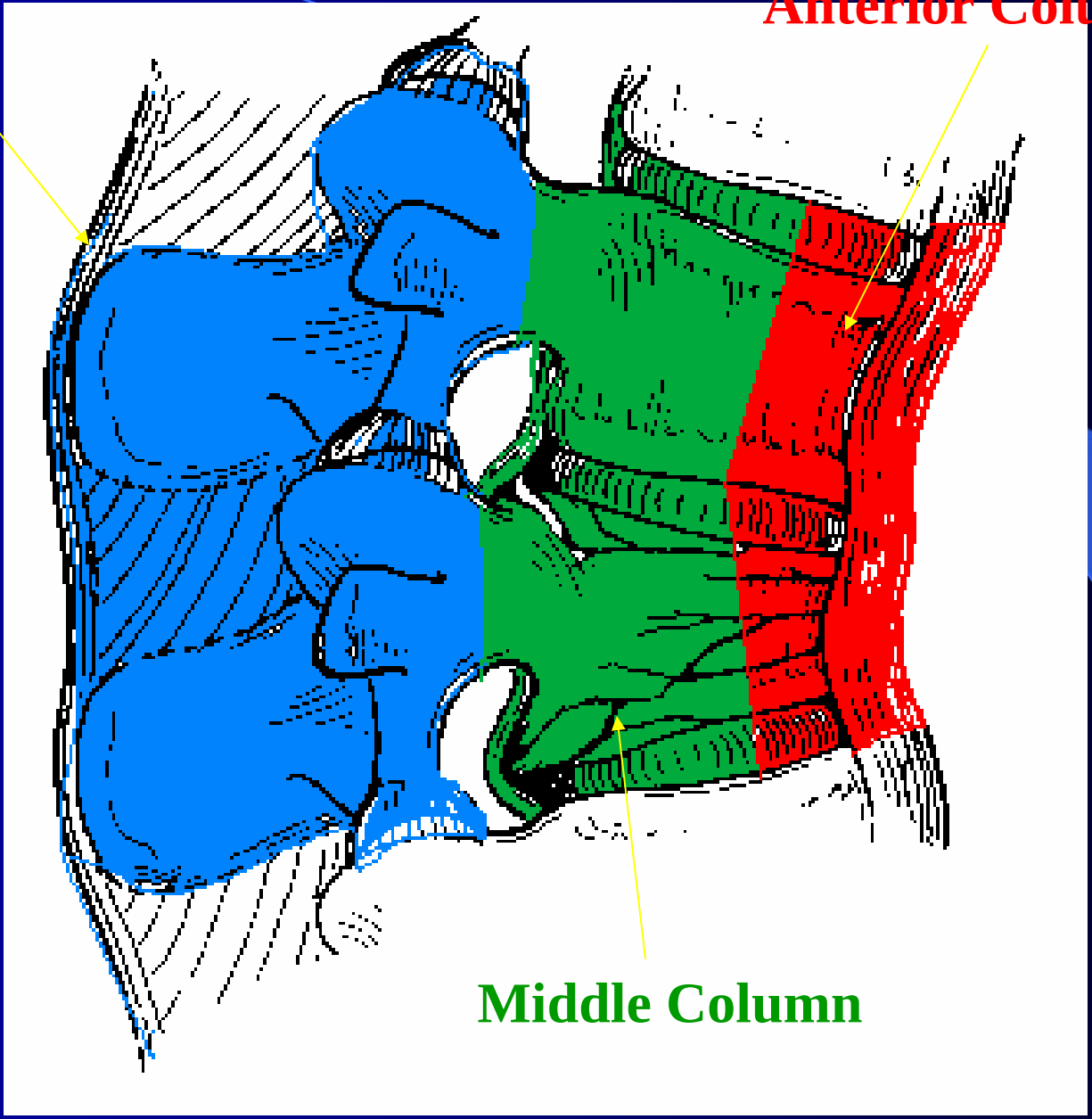
Stability



Three Column Model of Thoracolumbar Spine

- Anterior: anterior vertebral body + disc + anterior longitudinal ligament
- Middle: posterior vertebral body + disc + and posterior longitudinal ligament
- Posterior: facet joints/capsules + supraspinous/intraspinous ligaments + ligamentum flavum

Posterior Column



Hospital Care of Acute Non Traumatic Ischemic Stroke

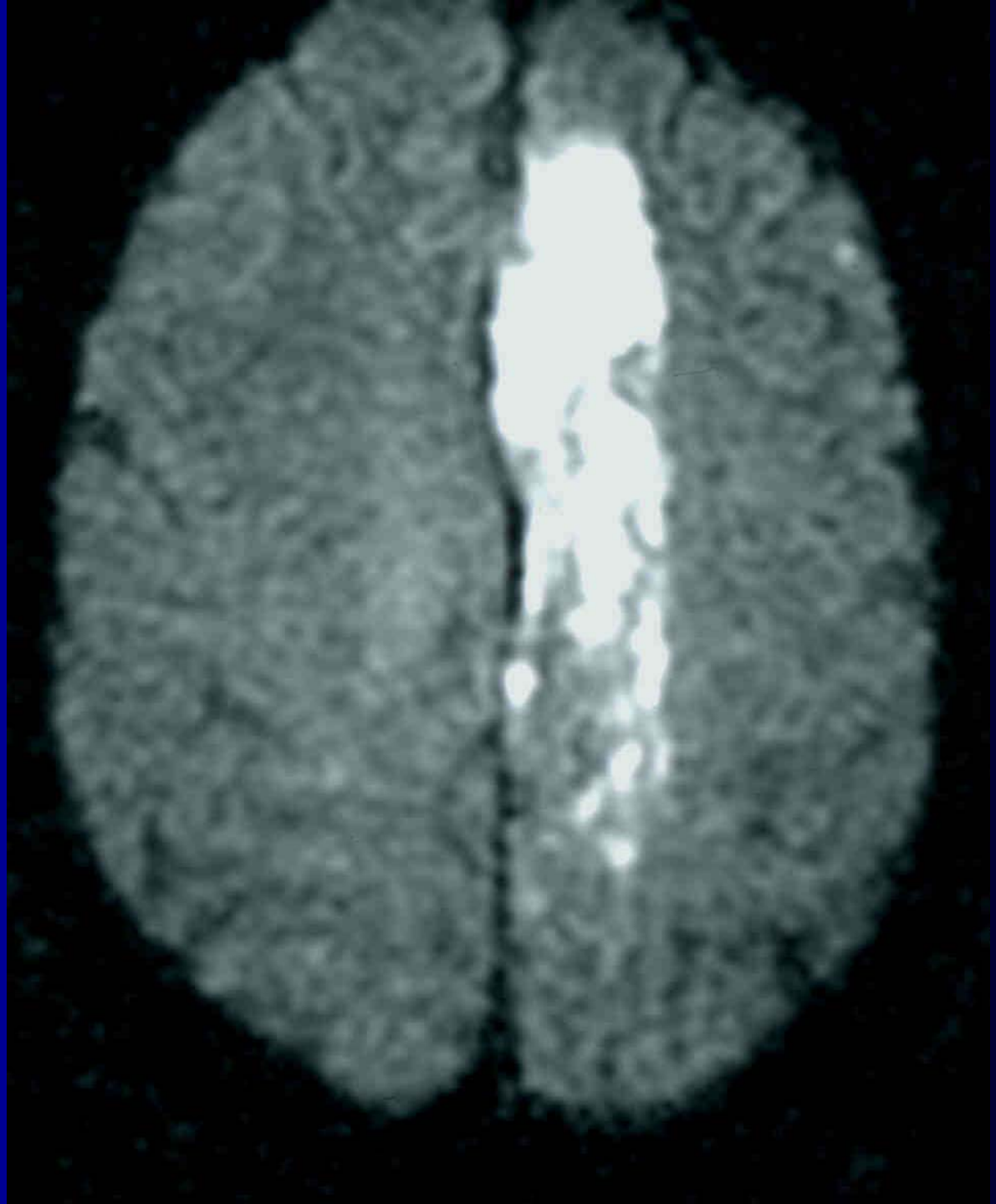
Definitions

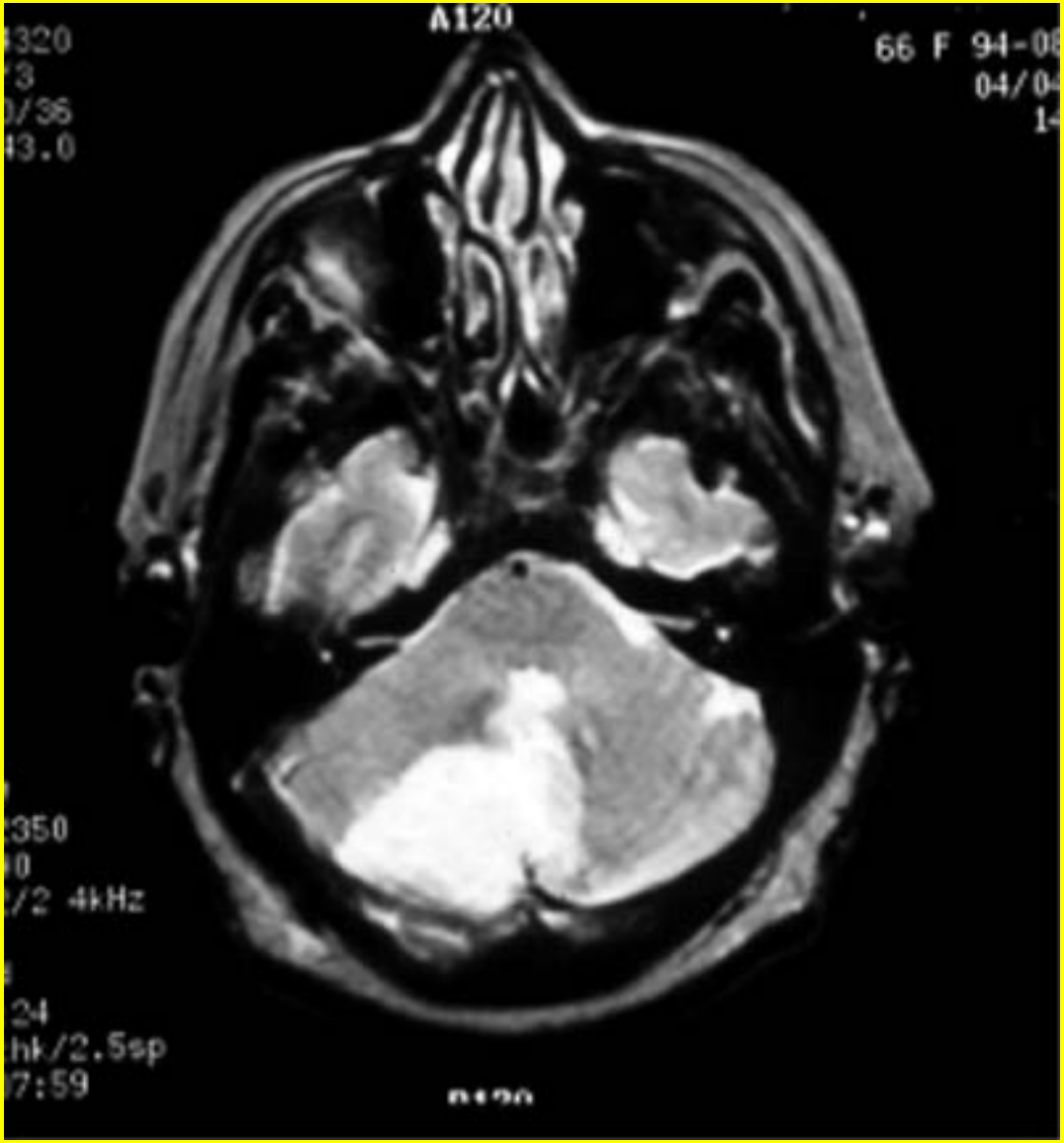
- **Stroke: Any vascular injury to the brain**
- ***Ischemic stroke* is a persistent clinical deficit at 24 hours.**
- **A TIA lasts less than 24 hours *and clears completely*.**
- **This distinction is a continuum with damage proportional to the severity and duration of ischemia.**

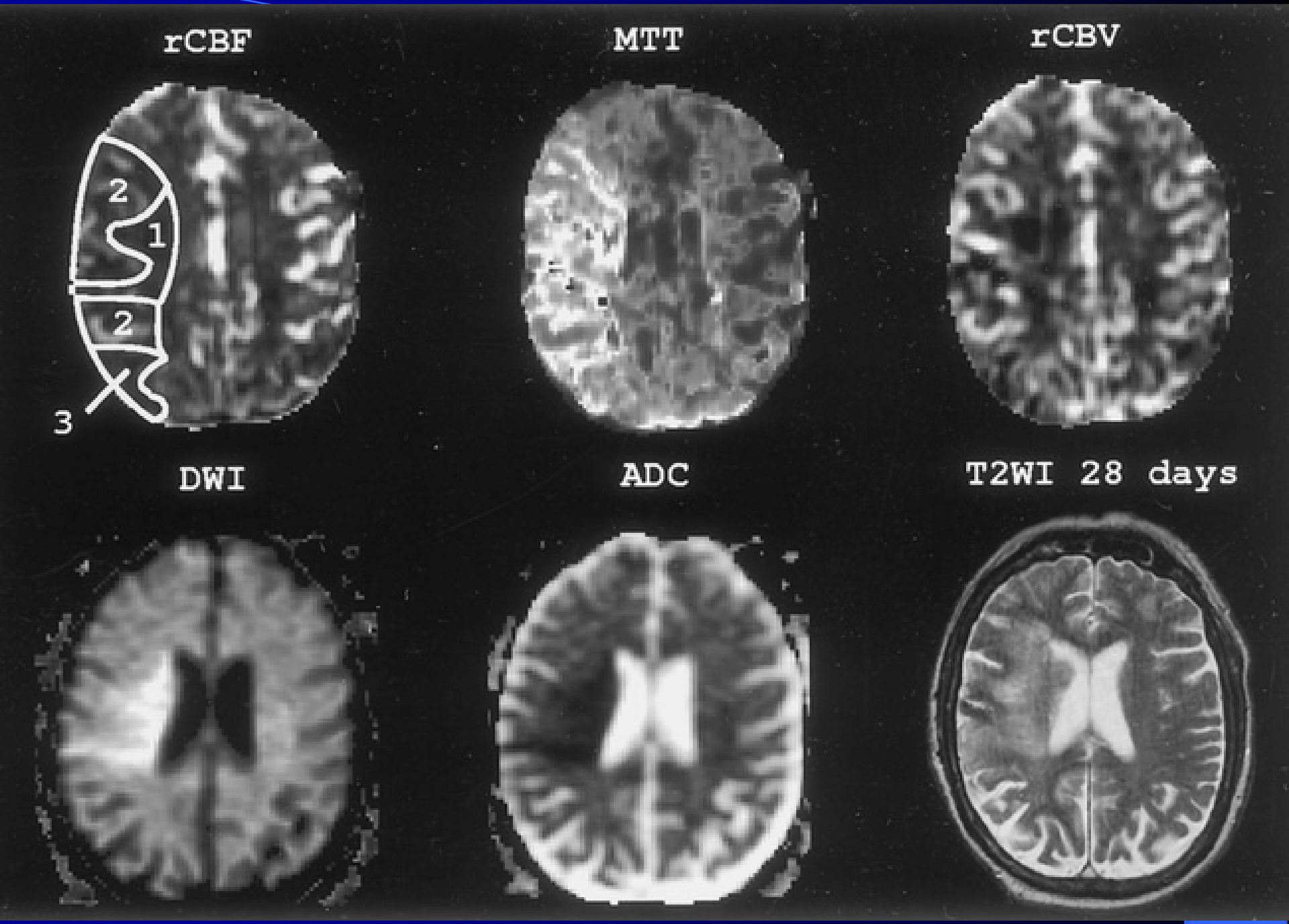
Definitions (con't)

- 80% are ischemic
- 20% are hemorrhagic (SAH, IPH, IVH)


64YR MALE NO IV CONTRAST




A120
66 F 94-0
04/0
1
320
3
0/36
43.0
350
0
/2 4kHz
24
hk/2.5sp
7:59


rCBF
MTT
rCBV
2
1
2
3
DWI
ADC
T2WI 28 days

Stroke in the United States

- 750,000 new strokes a year
- 4 million stroke survivors
- #1 cause of major neurologic disability
- #3 cause of death

Stroke risk factors

- HTN 6X
- Diabetes 3X
- Asymptomatic bruit 3X
- Rheumatic Atrial fib 17X
- Paroxsysmal Atrial fib 6X
- Lipids 2X
- Smoking 2X
- Prior CVA/TIA 10X
- Obesity 1.5X
- Age increases 10X/ 20 years of age

Ischemic stroke S/Sx

Unilateral paralysis—Weakness, clumsiness, or heaviness, usually involving 1 side of the body

Unilateral numbness—Sensory loss, tingling, or abnormal sensation, usually involving 1 side of the body

Language disturbance—Trouble understanding or speaking (*aphasia*) or slurred speech (*dysarthria*)

Monocular blindness—Painless visual loss in one eye, often described as a curtain dropping

Vertigo—Sense of spinning or whirling that persists at rest. Isolated vertigo is also a common symptom of many nonvascular diseases; therefore, at least one other symptom of TIA or stroke should also be present.

Ataxia—Poor balance, stumbling gait, staggering, incoordination of one side of the body

Stroke Mimics

- Systemic infection
- Brain tumor
- Toxic-metabolic
- Positional vertigo
- Syncope/ MI
- Trauma (post stroke)
- Seizure
- Dehydration / hyperosmolality

Brief exam for stroke

- Grimace (CN 7)
- Repeat a sentence (aphasia)
- Hold arms up with eyes closed (pronator drift)

ED / in Hospital evaluation

- Blood work
  - Complete blood count (CBC)
  - Serum electrolytes
  - PT (INR) / PTT
  - Blood glucose
  - Cultures
- Electrocardiogram / R/O MI
- Pulse oximetry / blood gas
- Chest x-ray
- Stat CT of head (non-contrast)

Emergency treatment of ischemic stroke

1. Intravenous fluids	Avoid D_5W and excessive fluid loading
2. Blood sugar	Determine immediately. Bolus of 50% dextrose if hypoglycemic; insulin if >300 mg%
3. Thiamine	100 mg if malnourished, alcoholic
4. Oxygen	Pulse oximetry. Supplement if So_2 <90%
5. Acetaminophen	If febrile
6. NPO	If at risk for aspiration
7. Cardiac monitor	

D_5W indicates 5% dextrose in water; So_2, oxygen saturation.

Blood pressure and acute ischemic stroke

- Transient and volatile elevation in blood pressure is common
- Usually lasts several days after the stroke
- Patients blood pressure may be very sensitive to medications

Blood pressure and acute ischemic stroke (con't)

- No benefit to aggressively reducing blood pressure in acute *ischemic* stroke, in other words, allow the pt to be HTN
- AHA: treat only if MAP > 130 or SBP > 220, DBP > 140

Algorithm for Emergency Antihypertensive Therapy for Acute Stroke

1. If Diastolic BP is >140 mm Hg on two readings 5 minutes apart, start infusion of sodium nitroprusside (0.5-10 mg/km/min).
2. If systolic BP is >220 mm HG and/or diastolic BP is 121-140 mm Hg on two readings 20 minutes apart, give 20 mg labetalol IV for 1-2 minutes. The labetalol dose may be repeated or doubled every 10-20 minutes until a satisfactory BP reduction is achieved or until a cumulative dose of 300 mg has been administered. (Labetalol is avoided for patients with asthma, cardiac failure, or severe cardiac conduction abnormalities.)

Medications used to treat stroke

- Heparin
- Warfarin
- TPA
- Aspirin
- Ticlopidine (Ticlid)
- Clopidogrel (Plavix)
- Dipyridamole (Persantine/Aggrenox)

Acute use of heparin and Stroke

- Given IV without bolus
- Controversial
- Little evidence for benefit in most patients with completed stroke outside of pt's with known A-fib/transmurial thrombus/ sig carodit and post circ stenosis
- Not recommended in new AHA guidelines

Warfarin therapy and stroke

- Valvular disease and valve replacement
- Atrial fibrillation / ventricular thrombus / high grade carodit and post circ stenosis
- Unclear benefit vs aspirin in other settings (WARSS trial *favors aspirin*)
- Risk, cost, complications

Systemic thrombolytic treatment

- **Intravenous tissue plasminogen activator (TPA)**
  - ***3 hour* window to treat from onset of symptoms**
  - **Many contraindications**
  - **Risk of hemorrhage**

TPA contraindications (ACLS)

Evidence of intracranial hemorrhage on pretreatment evaluation
Suspicion of subarachnoid hemorrhage on pretreatment evaluation
Recent (within 3 months) intracranial or intraspinal surgery, serious head trauma, or previous stroke
History of intracranial hemorrhage
Uncontrolled hypertension at time of treatment (see "Management of High Blood Pressure")
Seizure at stroke onset
Active internal bleeding
Intracranial neoplasm, arteriovenous malformation, or aneurysm
Known bleeding diathesis, including but not limited to
—Current use of oral anticoagulants (eg, warfarin sodium), an international normalized ratio >1.7, or a prothrombin time >15 seconds
—Administration of heparin within 48 hours preceding the onset of stroke and an elevated activated partial thromboplastin time at presentation
—Platelet count <100 000/mm^3

tPA indicates tissue plasminogen activator.

TPA complications

- No difference in mortality at 3 months between the r-TPA and placebo
  - 17% TPA
  - 21% placebo
- Higher incidence of symptomatic hemorrhage in the r-TPA group
  - 10X hemorrhage rate (6% with TPA)
  - 3% of TPA patients died from hemorrhage

TPA Results

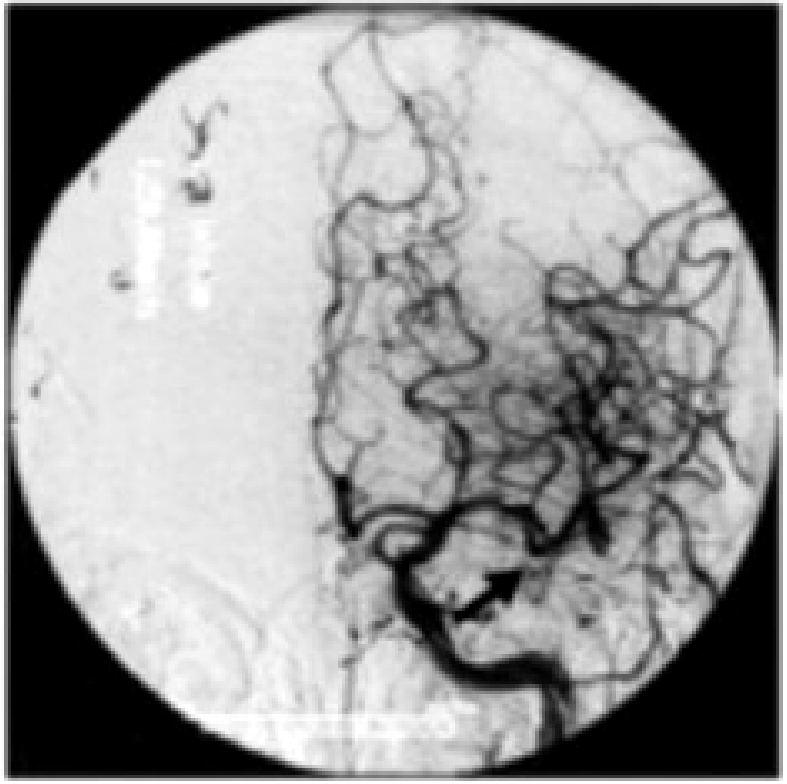
- 12% absolute increase in patients with good outcome at three months with r-TPA
- No difference for age, race, sex, stroke location, or stroke mechanism

Intraarterial thrombolytics

- Dx benefit of a diagnostic angiography
- Mechanical disruption of the clot + locally directed therapy
- Limited evidence
- Limited availability in some institutions
- Results at UCHSC excellent on NSS

2 Hours, 20 Minutes

4 Hours, 20 Minutes



Aspirin therapy and stroke

- Effective in secondary prevention of stroke and TIA
- Heart and peripheral vascular disease benefits
- Well understood (cyclo-oxegenase) / known safety profile
- Cheap
- Side effects directly related to dose
- No effective measure of aspirin effect – yet
- 325 mg/day American Heart Assoc.

Clopidogrel &Ticlopidine

- Inhibit the platelet ADP pathway
- Clopidogrel better tolerated than ticlopidine
- Marginally more effective than aspirin
- $

Common complications of stroke

- Seizures
- Aspiration
- DVT/ pulmonary embolism
- Appendage dislocation

Summary

- New approach to stroke
- Time is critical
- Simple interventions – glucose control, moderate IVF, temperature, blood pressure
- R/O stroke mimics prior to use of thrombolytics