

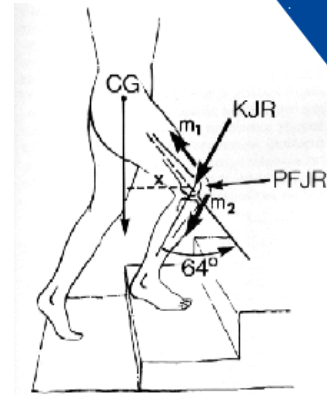


Investigation: Mechanism of Injury

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UNIVERSITY
Dept. of Kinesiology
Athletic Training Education



January 21, 2021

Why me?

- › I am an Athletic Trainer
- › Athletic trainers are health care professionals who collaborate with physicians to optimize activity and participation of patients and clients.
- › Athletic training encompasses the prevention, diagnosis, and intervention of emergency, acute, and chronic medical conditions involving impairment, functional limitations, and disabilities.





What we will cover...

› This lecture is designed to:

- analyze means of injuries
- assist in those questions that arise in claim handling.
- provide points of view on how an injury occurs, the signs and symptoms present and what these discoveries mean
- review the impact such claims have on the insurance industry.



Content Objectives

- › At the end of the presentation the participant will:
 - have knowledge of anatomy/body structure
 - understand types of bodily injury (BI)
 - have knowledge of types of medical procedures and rehabilitation
 - understand documentation standards for medical related BI claims.

Anatomy & Injury



Skin & Soft Tissue Injuries



Skin

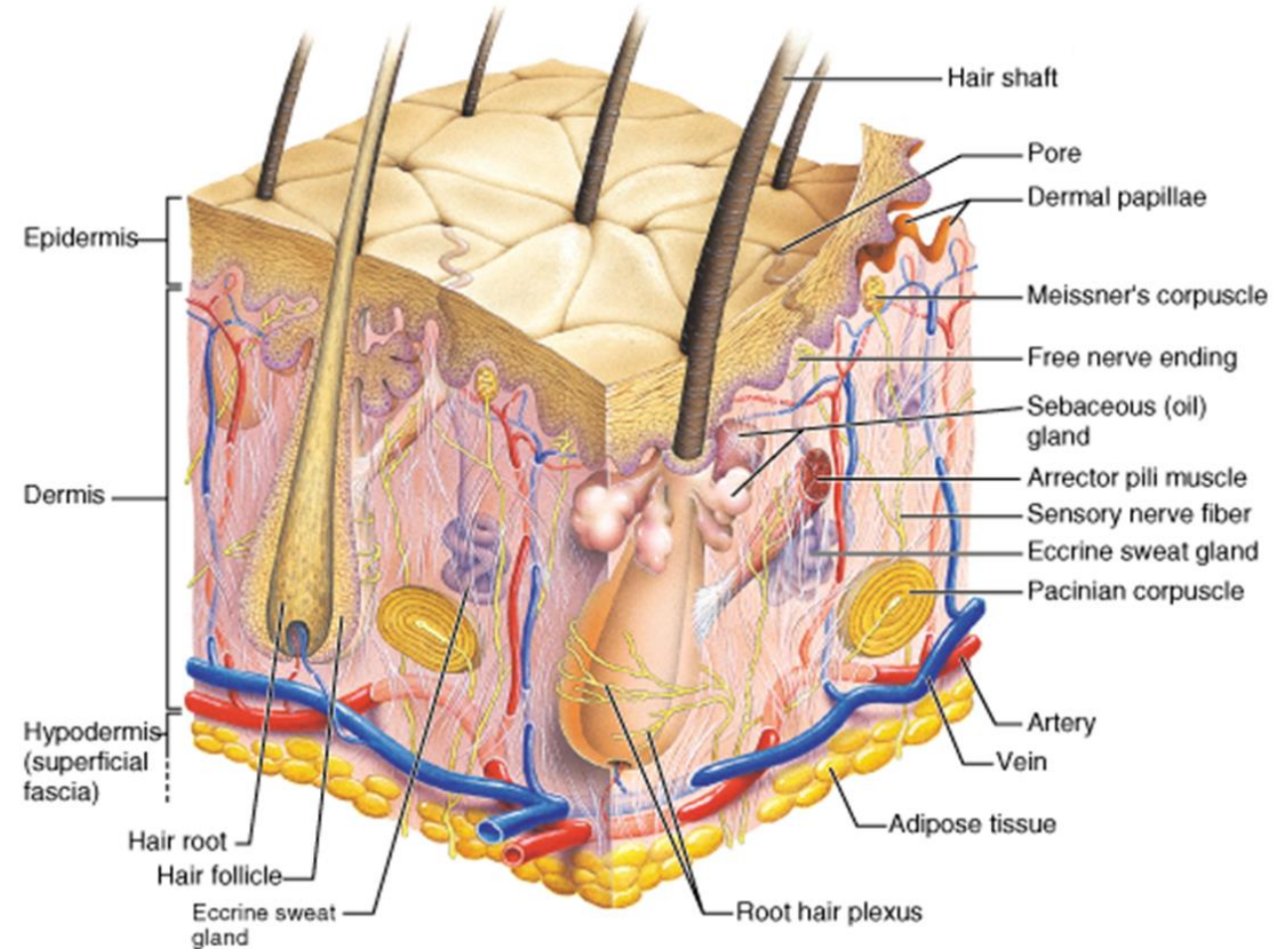
Anatomy (structure)

- › Epidermis (thinner outer layer of skin)
- › Dermis (thicker connective tissue layer)
- › Hypodermis (subcutaneous layer or Sub-Q)

› Muscle and bone

Physiology (function)

- › 1- Protection
- › 2- Regulation of body temperature
- › 3- Sensation
- › 4- Excretion
- › 5- Blood reservoir
- › 6- Synthesis of Vitamin D (cholecalciferol)



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Soft Tissue Injuries

- › Trauma that happens to the skin is visually exposed
- › Categorized as a skin wound
- › Defined as a break in the continuity of the soft parts of body structures caused by a trauma to these tissues
- › Mechanical forces include:
 - Friction, scraping, compression, tearing, cutting, penetrating

Abrasion

- › Skin scraped against a rough surface
- › Several layers of skin are torn loose or totally removed
- › Usually more painful than a deeper cut b/c scraping of skin exposes millions of nerve endings



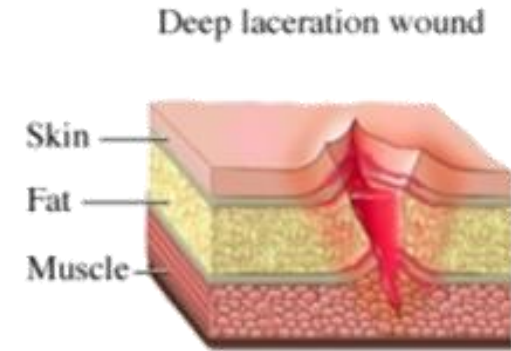
Incision

- › Skin has been sharply cut
- › Surgical cut made in skin or flesh



Laceration

- › Flesh irregularly torn; cut or tear in the skin
- › Minimal bleeding, minimal pain, & no numbness or tingling
- › Cuts ≤ 0.25 " (6mm) deep and 0.5" (1.3cm) long & have smooth edges → can be treated at home
- › Deeper lacerations should be treated by physician (stitches)



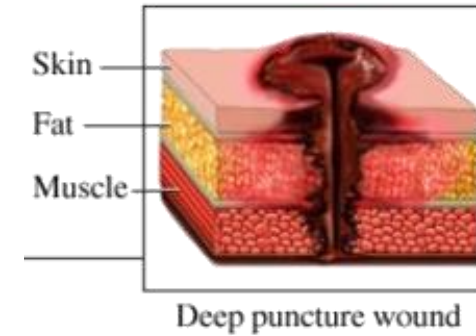
Avulsion

- › Layers of skin torn off completely or only flap of skin remains
- › Same mechanism as laceration, but to extent that tissue is completely ripped from it's source
- › May be considerable bleeding



Puncture Wound

- Penetration of skin by sharp object
 - Nails, tacks, ice picks, knives, teeth, needles
- May be small in diameter and not seem serious
- Do require treatment by physician
- Can become infected easily b/c dirt and germs carried deep in the tissue



Contusion

- › A blow compresses or crushes the skin surface and produces bleeding under the skin
- › Does not break skin
- › Bruising due to injury to blood vessels
- › Most mild and respond well to RICE



Blister

- Continuous rubbing over the surface of the skin causes a collection of fluid below or within the epidermal layer



A collection of fluid below or within the epidermal layer that develops from friction.

- A) Contusion
- B) Laceration
- C) Blister
- D) Hematoma

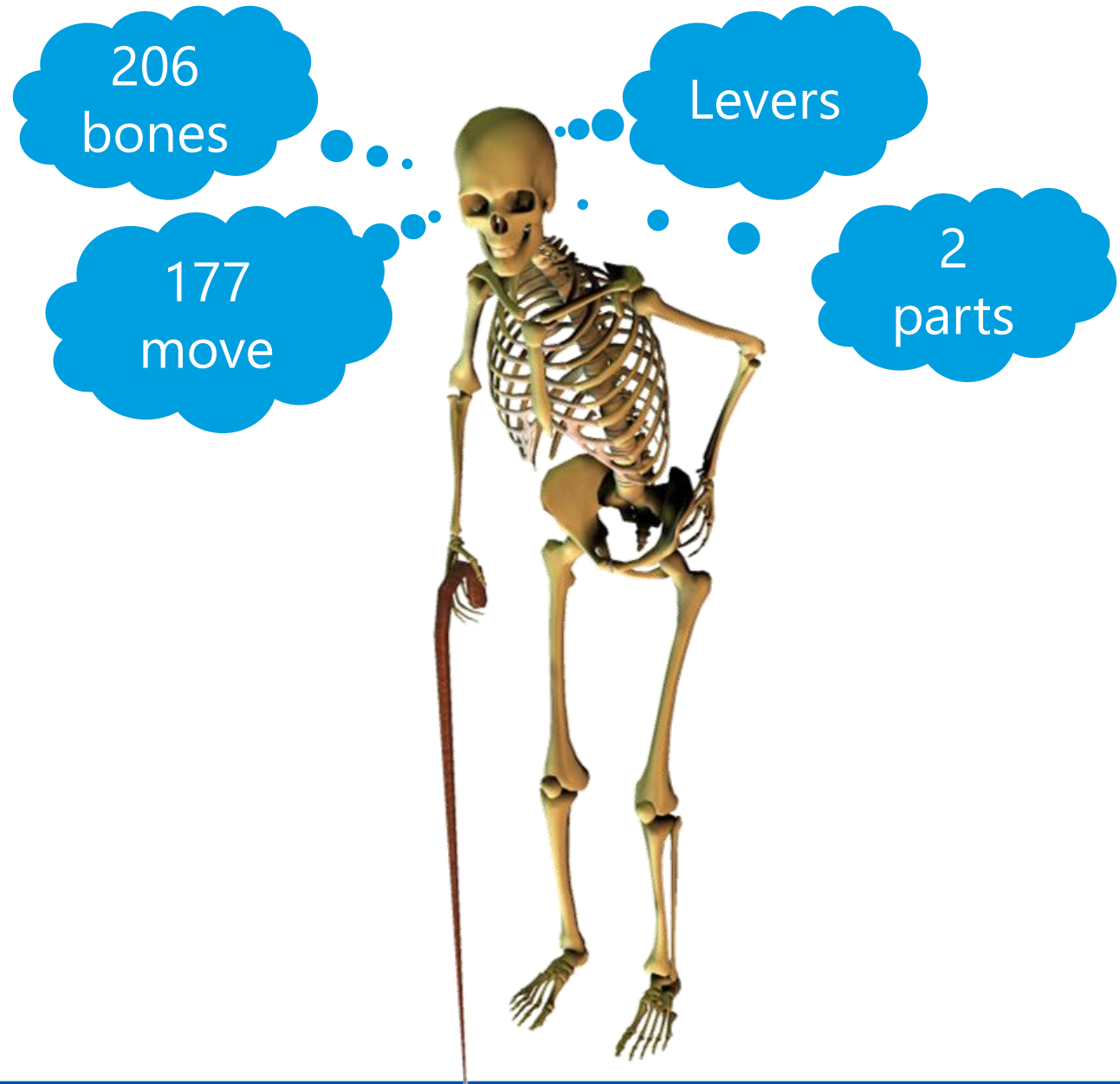
REVIEW QUESTION

A collection of fluid below or within the epidermal layer that develops from friction.

- A) Contusion
- B) Laceration
- C) Blister**
- D) Hematoma

REVIEW
QUESTION
ANSWER

Skeletal System



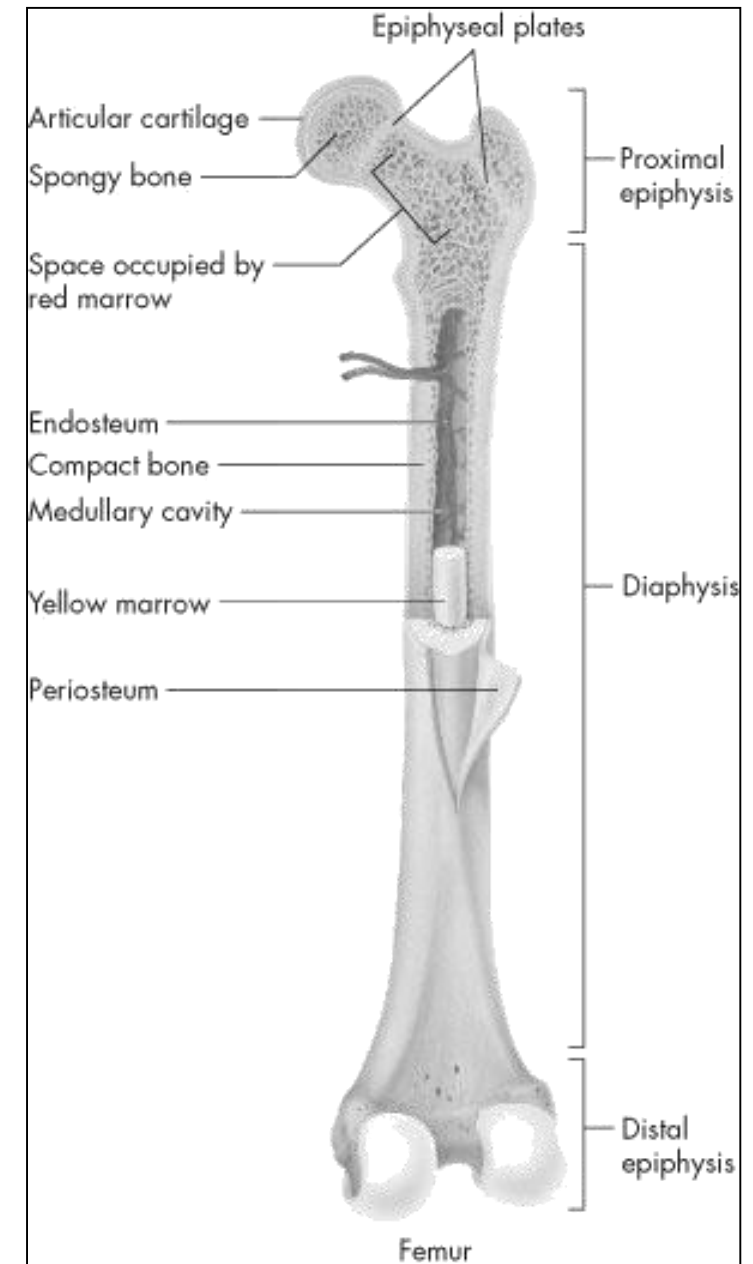


Functions of the Skeletal System

- › Protect vital organs
- › Support soft tissue
- › Makes red blood cells (RBCs)
- › Reservoir for minerals
- › Provide attachments for muscles
- › Acts as a system of machines to produce movement

Typical Bony Features

- › Diaphysis
 - long cylindrical shaft
- › Cortex
 - hard, dense compact bone forming walls of diaphysis
- › Periosteum
 - dense, fibrous membrane covering outer surface of diaphysis
- › Endosteum
 - fibrous membrane that lines the inside of the cortex



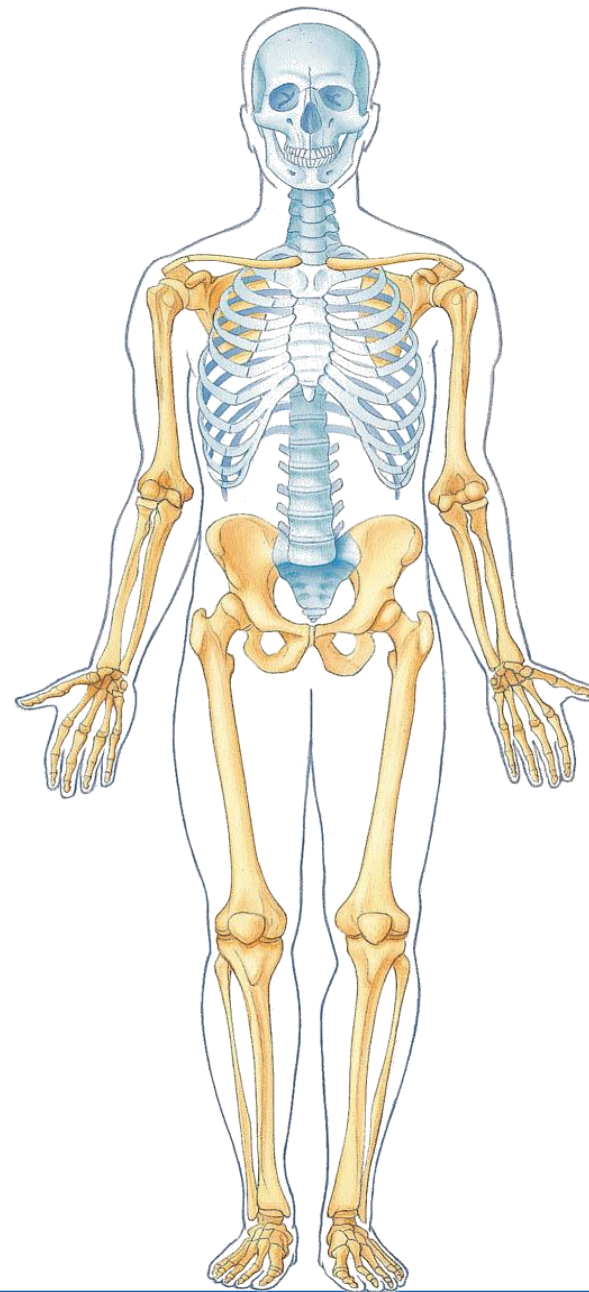
Divisions of the Skeleton

› Axial Skeleton

- skull
- thorax
- vertebral column

› Appendicular Skeleton

- shoulder girdle
- upper extremities
- pelvis
- lower extremities

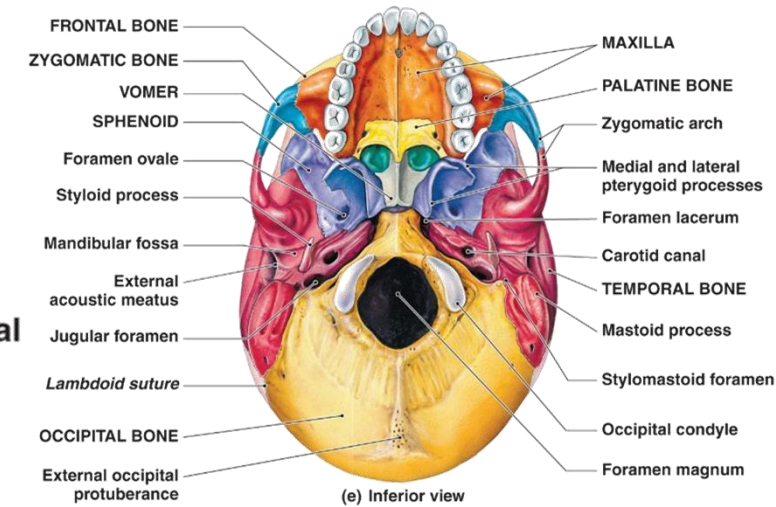
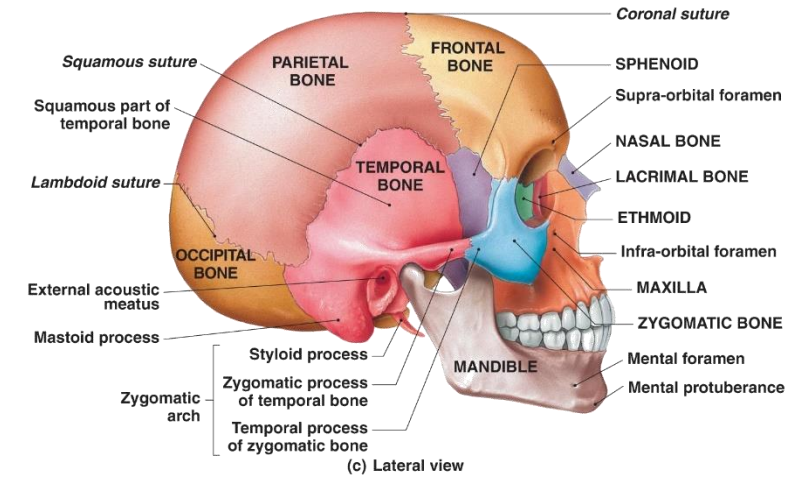
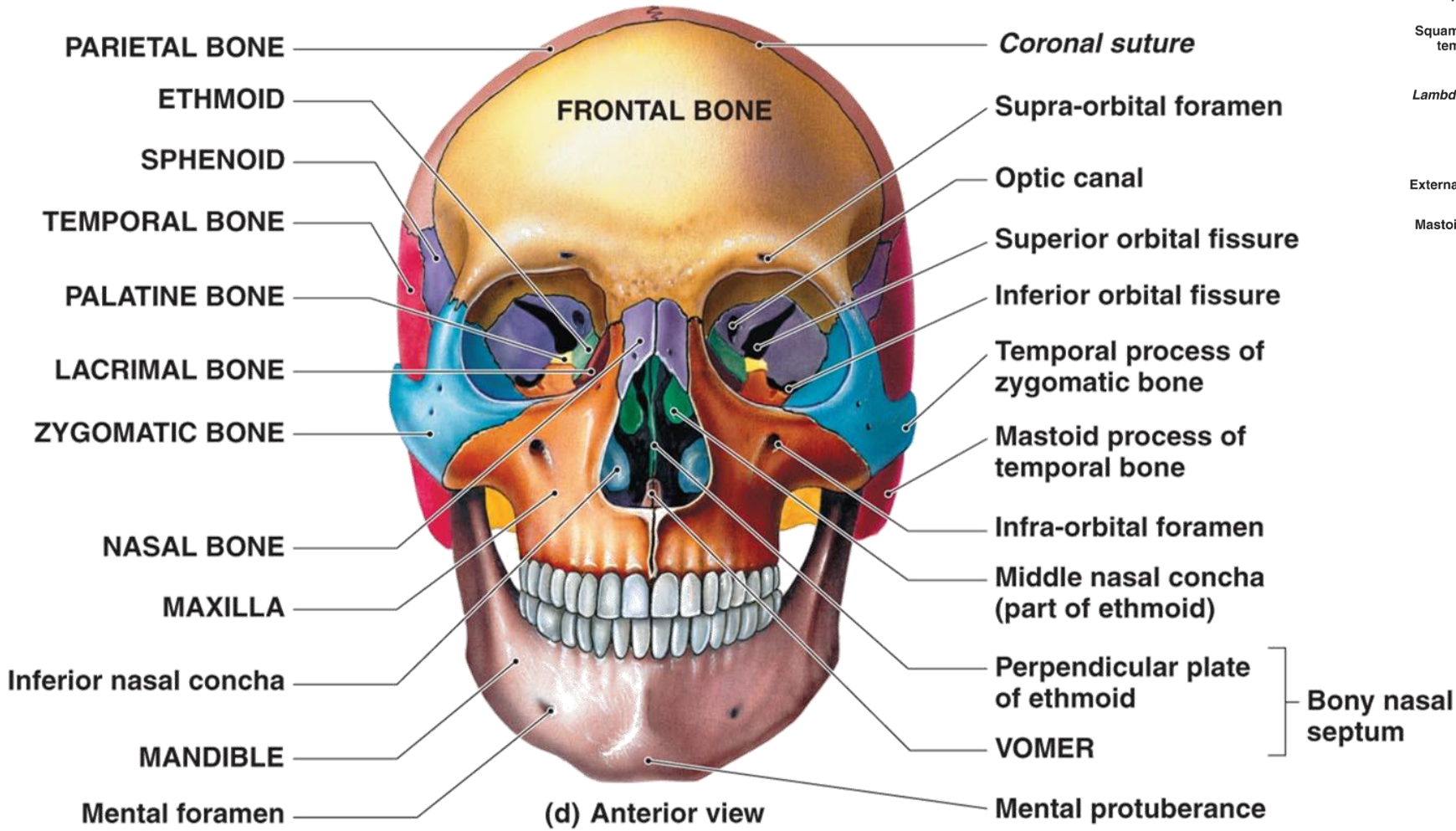


Head & Spine Injuries

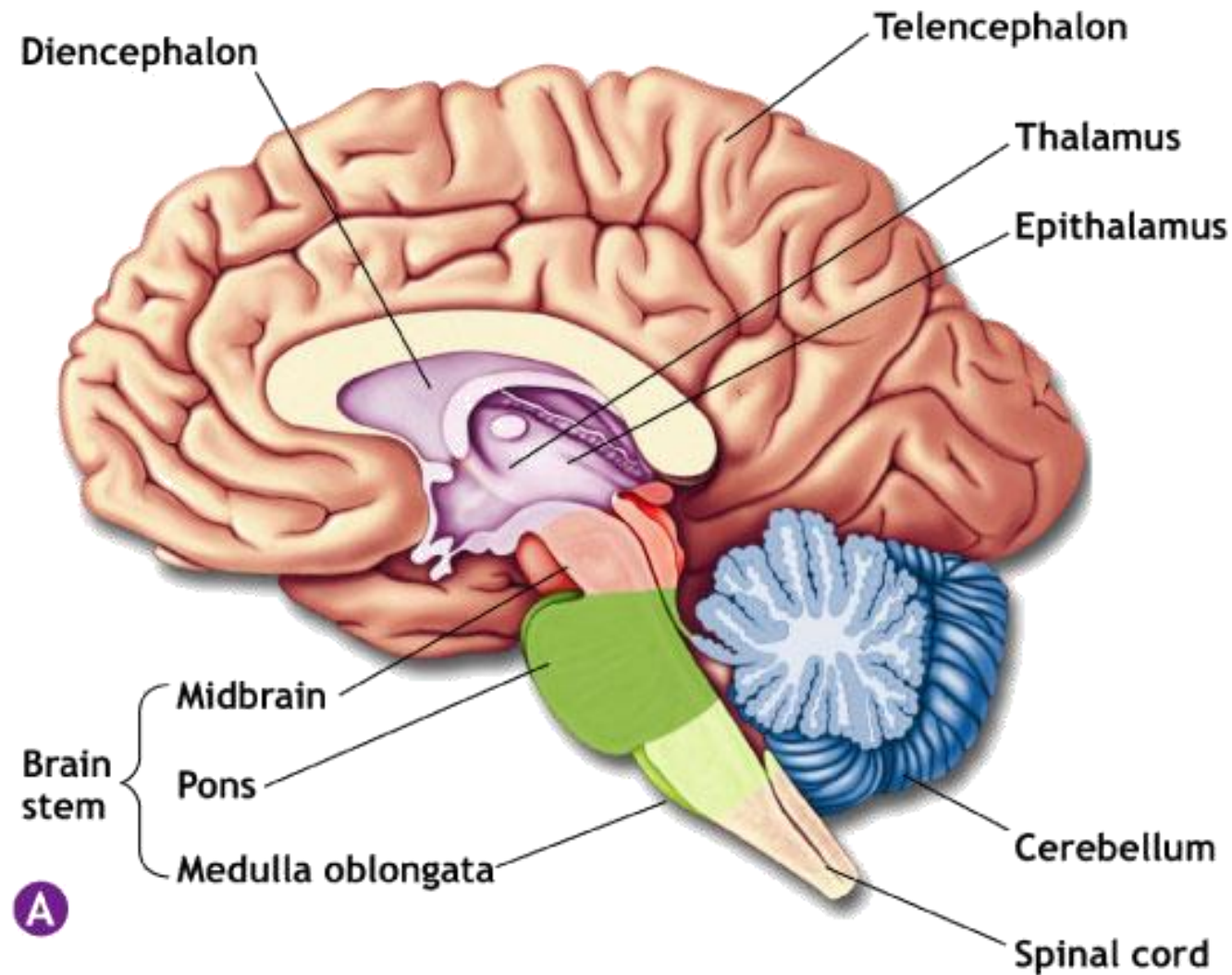


Dr. Peabody took on the most challenging research projects.

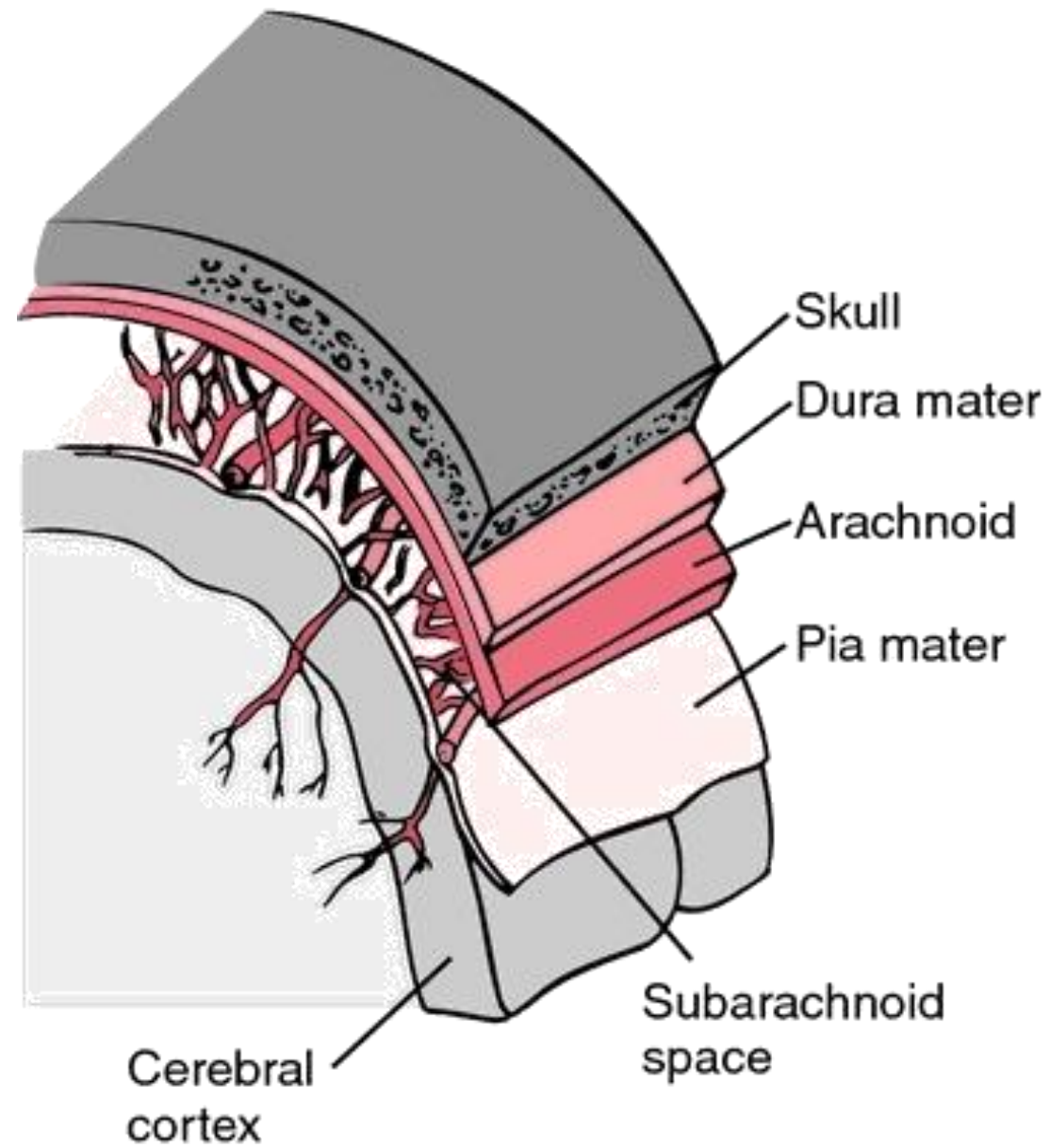
The Adult Skull



Brain (Mid-sagittal View)



Meninges



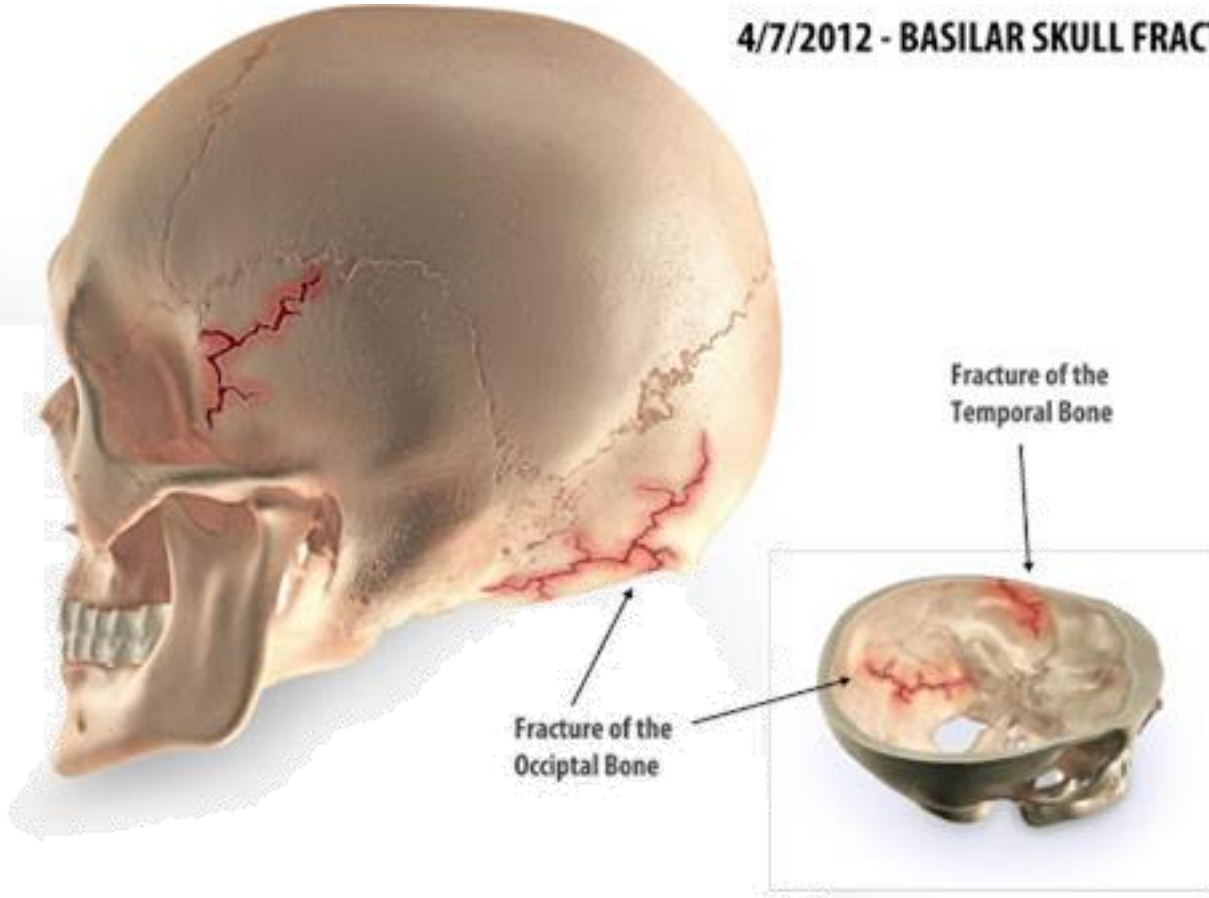


Types of Head Injuries

- › Scalp lacerations
- › Skull fractures
- › Basal Skull fractures
- › Concussion
- › Post-concussion syndrome
- › Cerebral contusions and lacerations

Battle's Sign & Raccoon Eyes

4/7/2012 - BASILAR SKULL FRACTURE



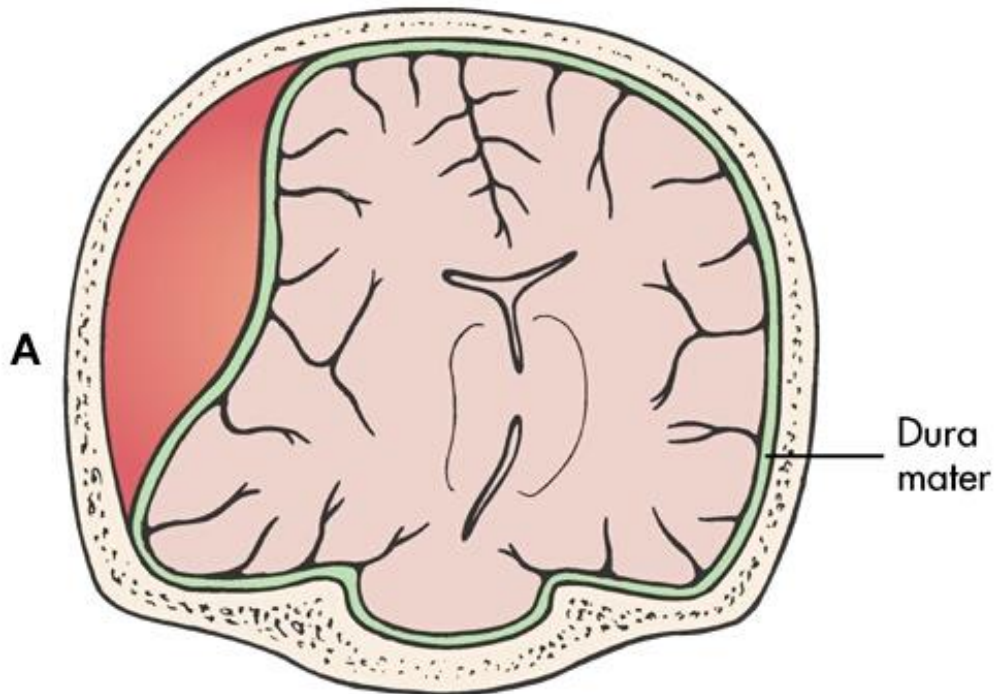
Battle's Sign



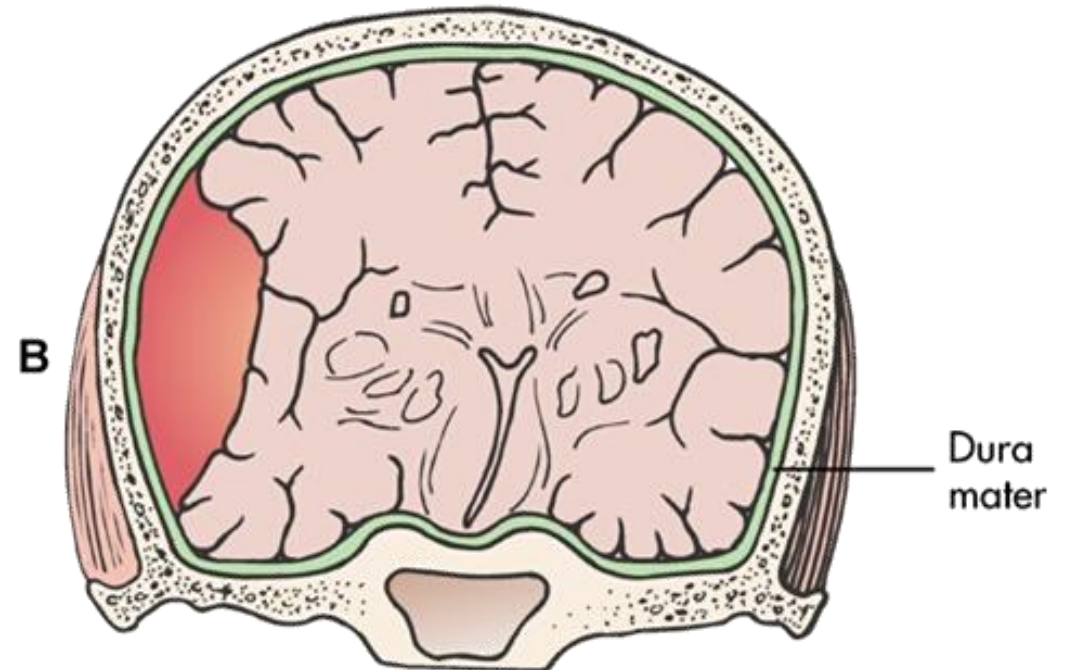
Raccoon Eyes

Epidural vs. Subdural Hematomas

Epidural Hematoma



Subdural Hematoma



From Price SA, Wilson LM: *Pathophysiology: clinical concepts of disease processes*, ed 6, St. Louis, 2003, Mosby.

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Definition of TBI / Concussion

- › May result in neuropathological changes
- › Acute clinical symptoms largely reflect a functional disturbance rather than a structural injury.
- › Results in a graded set of clinical symptoms that may or may not involve LOC
- › Resolution of the clinical and cognitive symptoms typically follows a sequential course;
- › However, post-concussive symptoms may be prolonged.

Overview of TBI

› What is a traumatic brain injury (TBI)?

- traumatic biomechanical forces applied to the head, face, neck, or body that affects brain functioning

› Common causes:

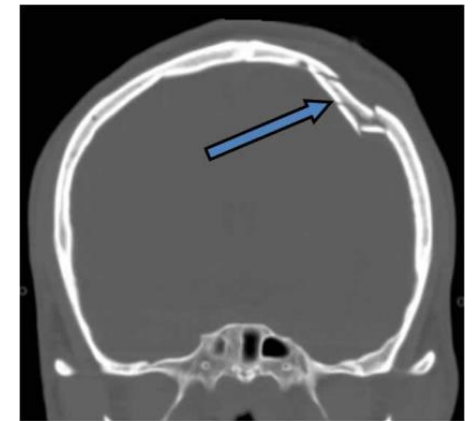
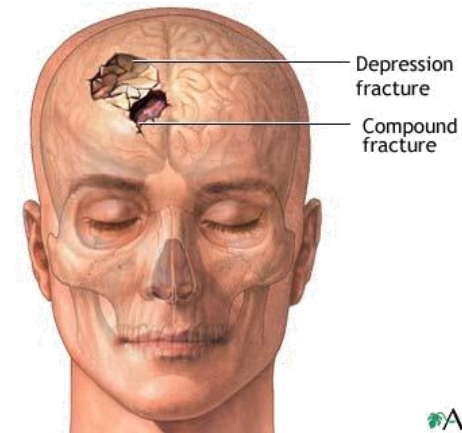
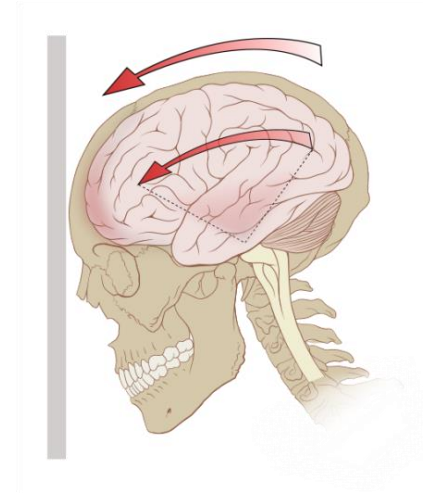
- Falls
- Motor vehicle accidents
- Struck by/against an object
- Assaults / GSW
- Recreational sports



Overview of TBI

> Types of TBI:

- Closed TBI: brain is injured without penetration of the skull
 - Acceleration-deceleration in a single plane
 - Linear
 - Coup / contre-coup injuries
- Open TBI: brain is injured with penetration of the skull (skull Fx)



ADAM.

http://surgery.arizona.edu/sites/surgery.arizona.edu/files/images/fig1_skull-fracture.jpg

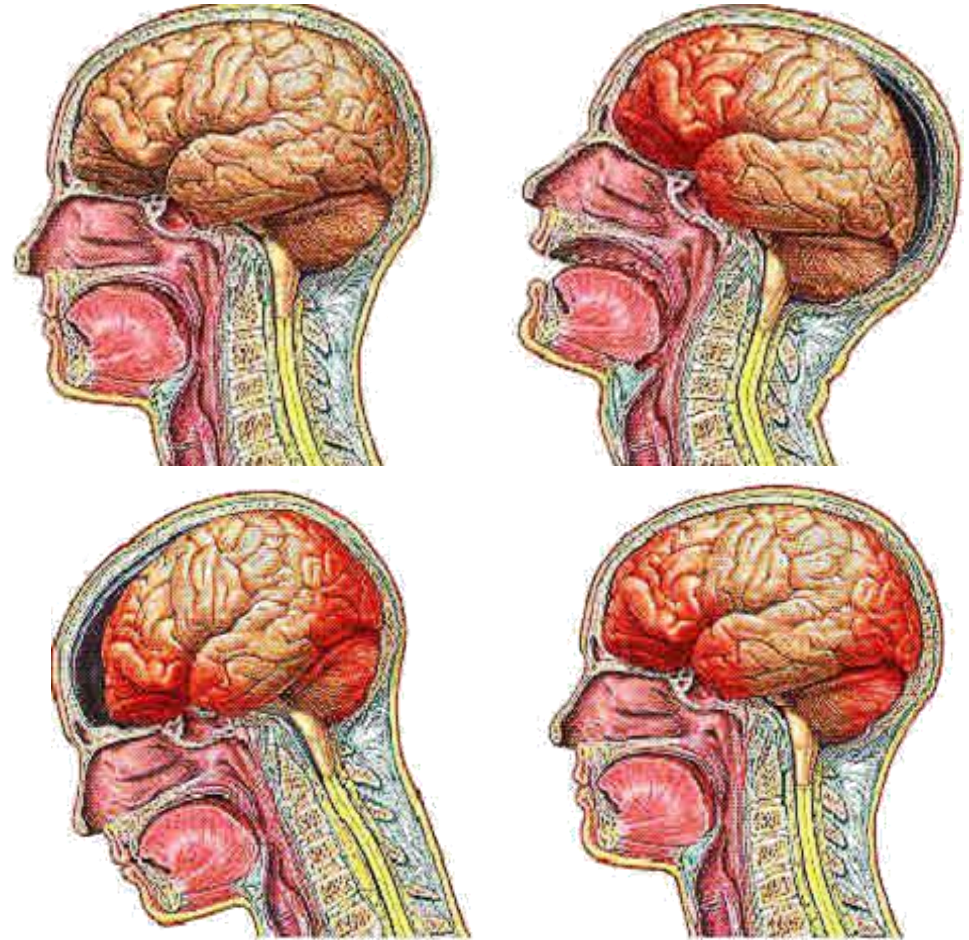
Coup / Contre-Coup Injury Mechanism

Unilateral Strike



<http://www.vh.org/adult/patient/neurosurgery/braininjury/03whattypesbraininjuries.html>

Forward / Backward Movement



http://www.carolinalegal.com/html/tbi_facts.html

Brain Tissue Deformation Under Lateral Loading

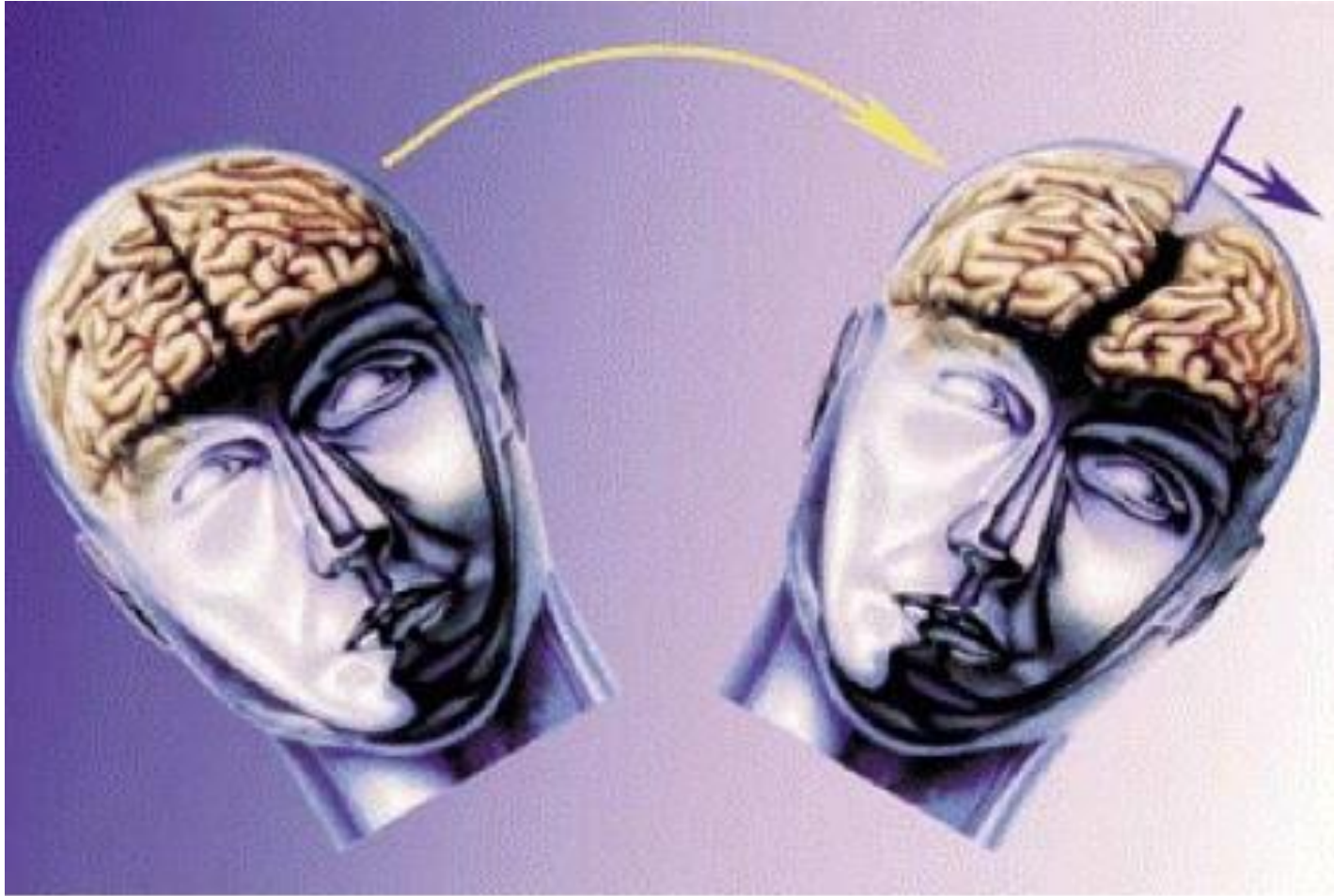


Image Source: The University of Utah: <http://sportsnscience.utah.edu/tag/brain/>

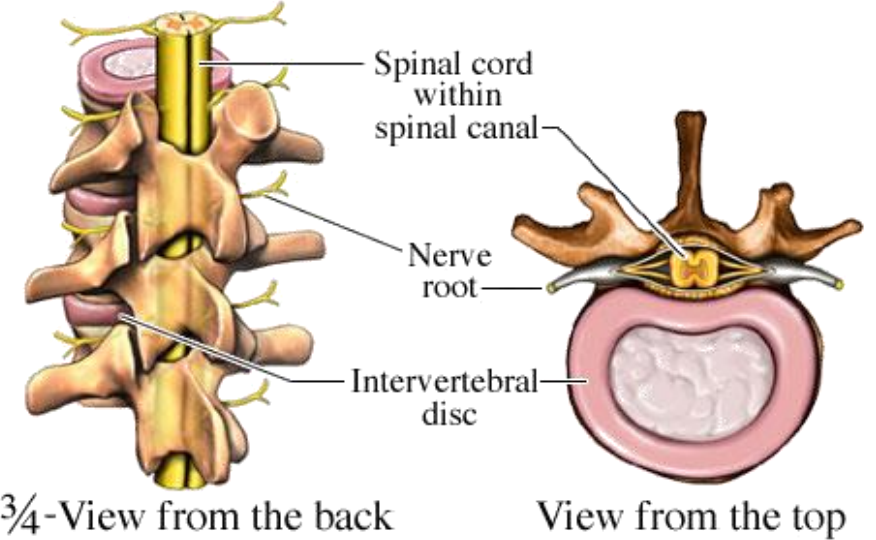
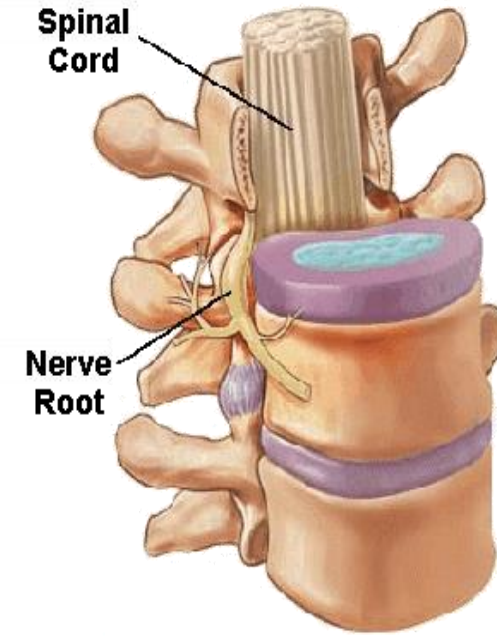
Spine & Spinal Cord

› Bones - vertebral column

- 7 Cervical
- 12 Thoracic
- 5- Lumbar
- 5- Sacral

› Discs

- between vertebra



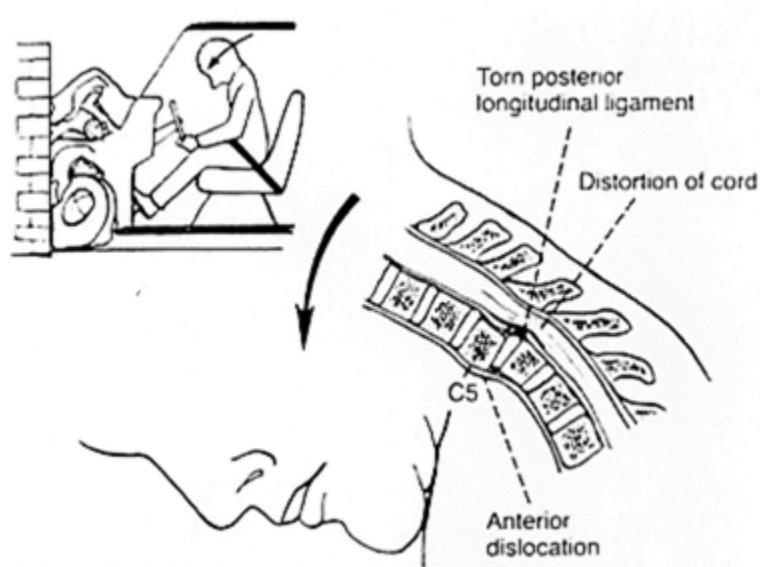


Etiology of Traumatic SCI

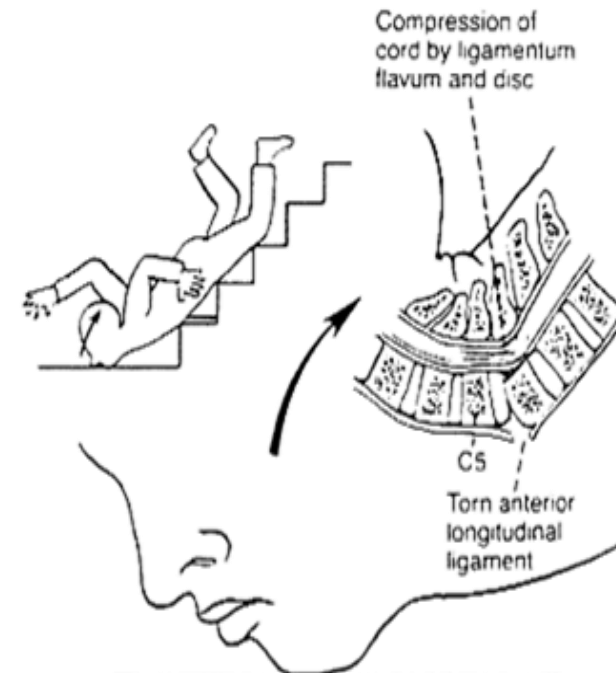
- › MVA- most common cause
- › Other: falls, violence, sport injuries
- › SCI typically occurs from indirect injury from vertebral bones compressing cord
- › SCI frequently occur with head injuries
- › Cord injury may be caused by direct trauma from knives, bullets, etc.

Classifications of SCI MOI

- › Flexion (hyperflexion)
- › Most common because of natural protection position.
- › Generally causes neck to be unstable because stretching of ligaments



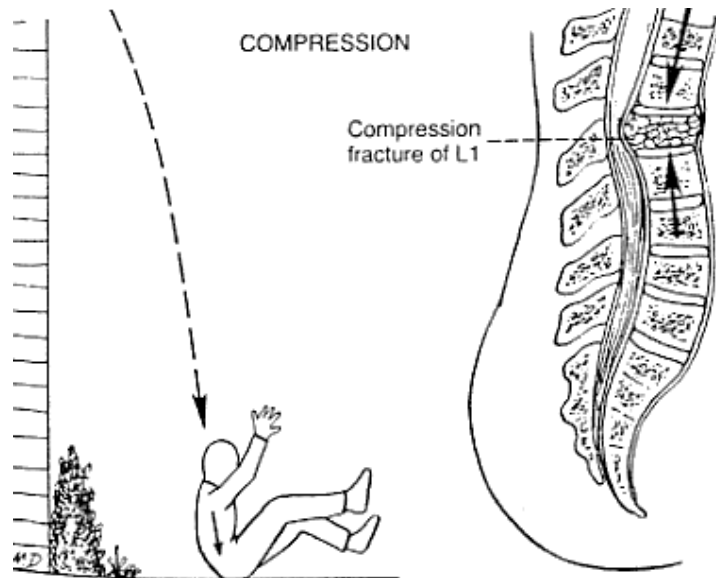
- › Hyperextension
- › Caused by chin hitting a surface area, such as dashboard or bathtub
- › Usually causes central cord syndrome symptoms



Classifications of SCI MOI

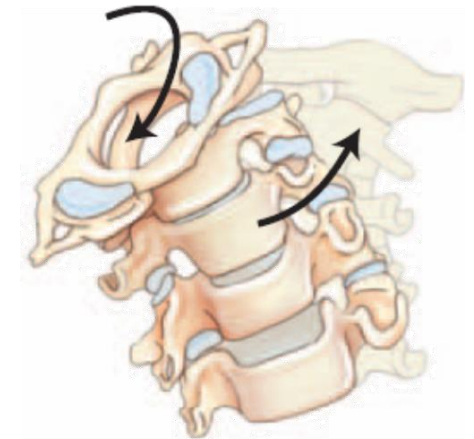
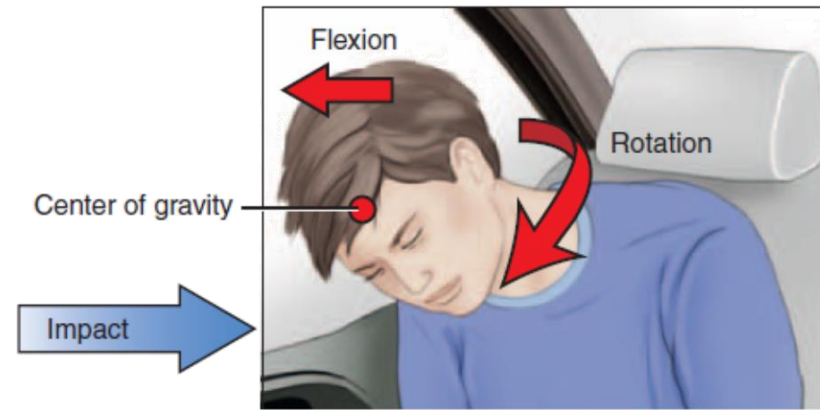
Compression

- › Caused by force from above, as hit on head
- › Or from below as landing on butt
- › Usually affects the lumbar region



Flexion/Rotation

- › Most unstable
- › Results in tearing of ligamentous structures that normally stabilize the spine
- › Usually results in serious neurologic deficits

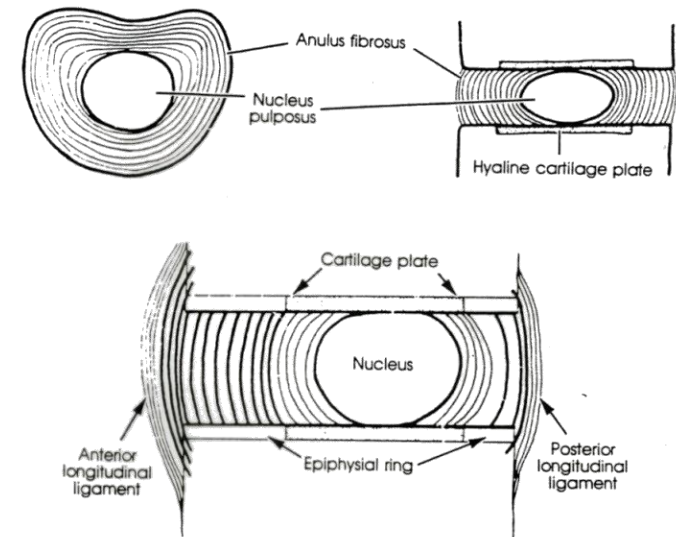
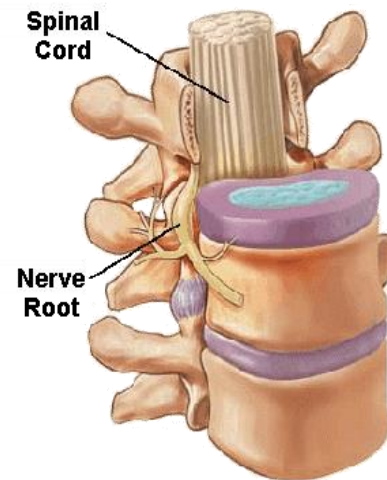
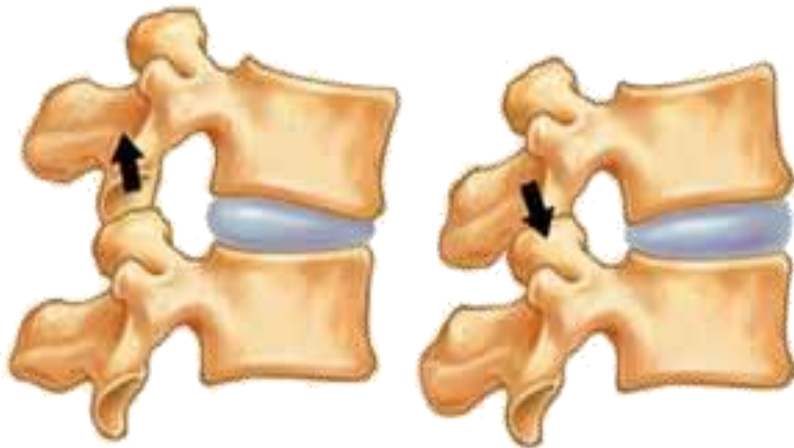


Intervertebral Disks

Function

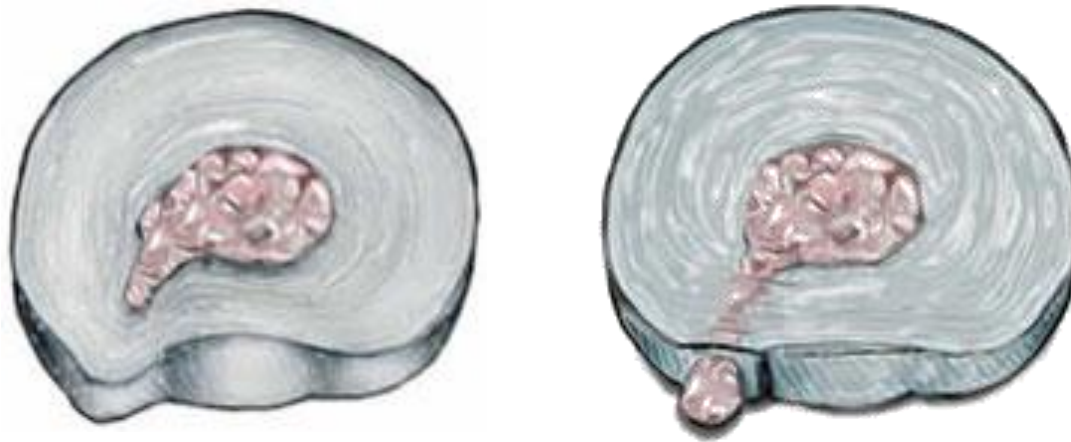
- › to allow for mobility of the spine and act as shock absorber
- › Located between vertebral bodies
- › Composed of nucleus pulposus a gelatinous material surrounded by annulus fibrosis- a fibrous coil

**Lateral (Side) View:
Working Facet Joints**



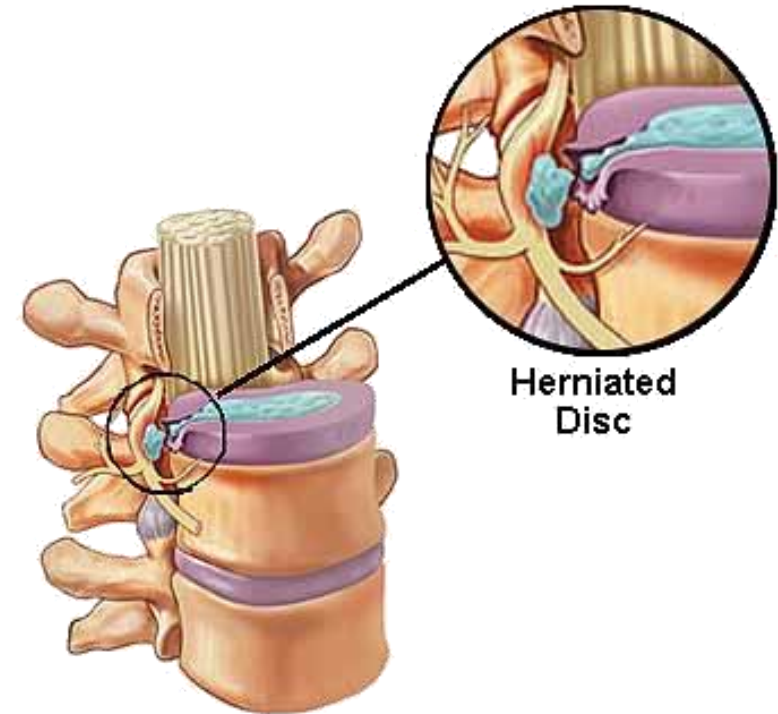
Herniated Disc

- › Herniated nucleus pulposus, (HNP) slipped disc, ruptured disc
- › HNP- annulus becomes weakened/torn and the nucleus pulposus herniates through it.
- › Risk Factors-
 - Standing erect
 - Aging changes
 - Poor body mechanics
 - Overweight
 - Trauma



Herniated Disc

- › HNP compresses
 - Spinal nerve (sensory or motor component) as it leaves the spinal cord
- › Sensory root or nerve usually affected
 - pain, parenthesis, or loss of sensation
- › Motor root or nerve may be affected
 - paresis or paralysis
- › Radiculopathy-
 - pathology of the nerve root
- › Most common site for HNP
 - L4-5 disc- the 5th lumbar nerve root
 - posterior sensory nerve or root compressed
- › Classic symptoms-
 - low back sciatica pain
 - pain increases with increase in intrathoracic pressure



Diagnostic Tests

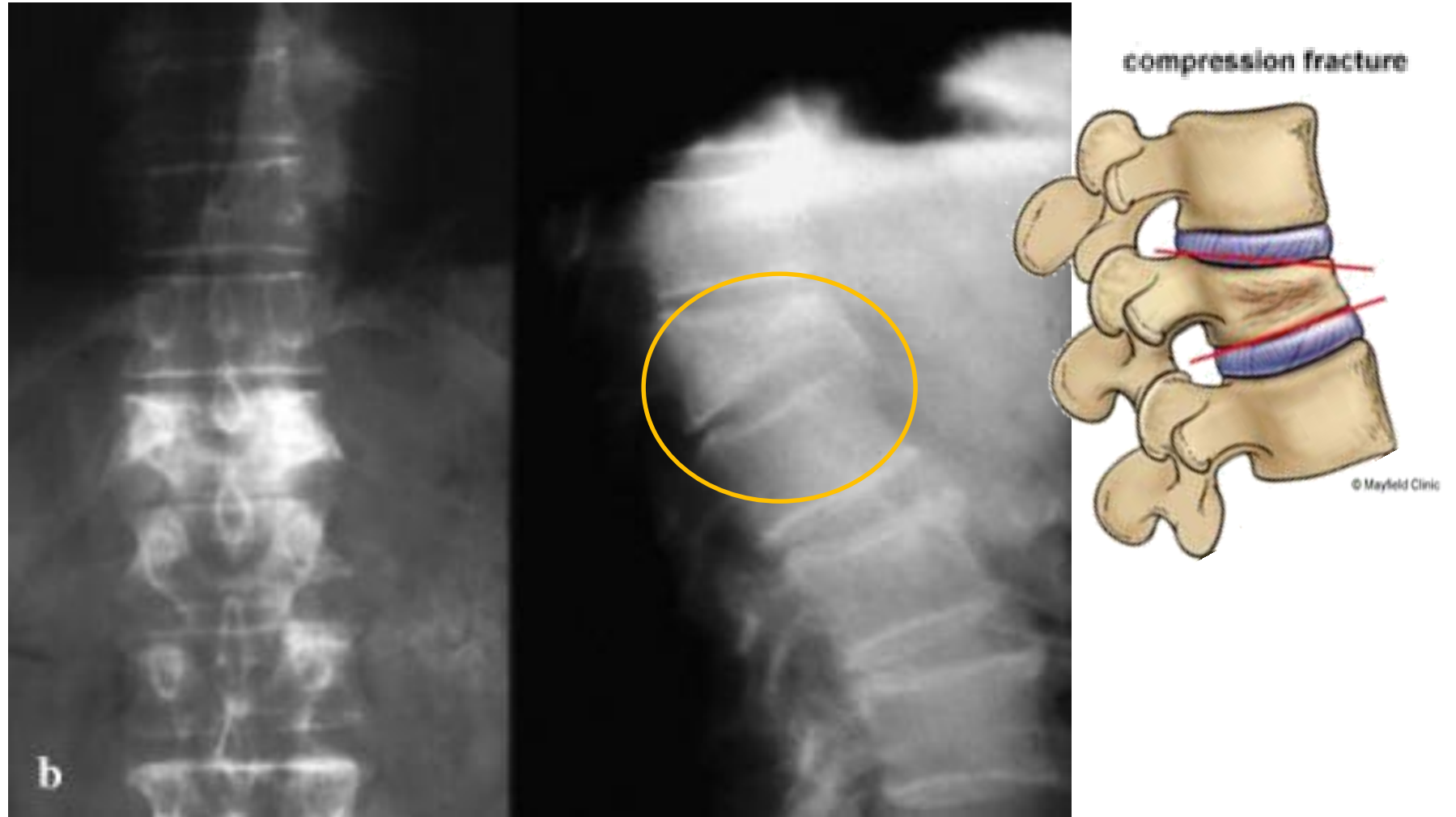
- › X-ray
 - identify deformities and narrowing of disk space
- › CT/MRI
- › Mylogram Nerve conduction studies (EMG)
 - detect electrical activity of skeletal muscles



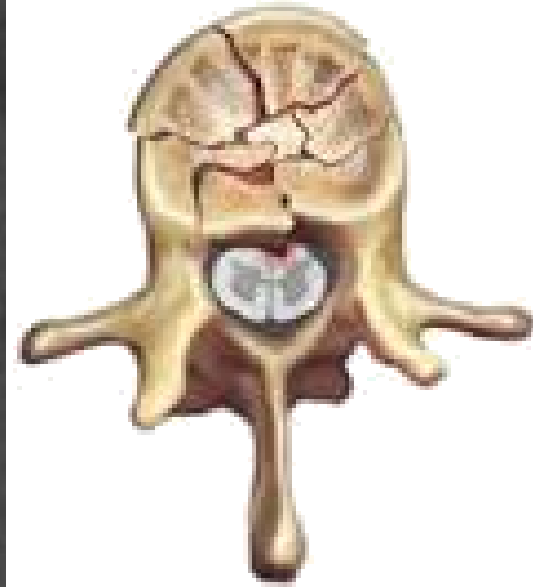
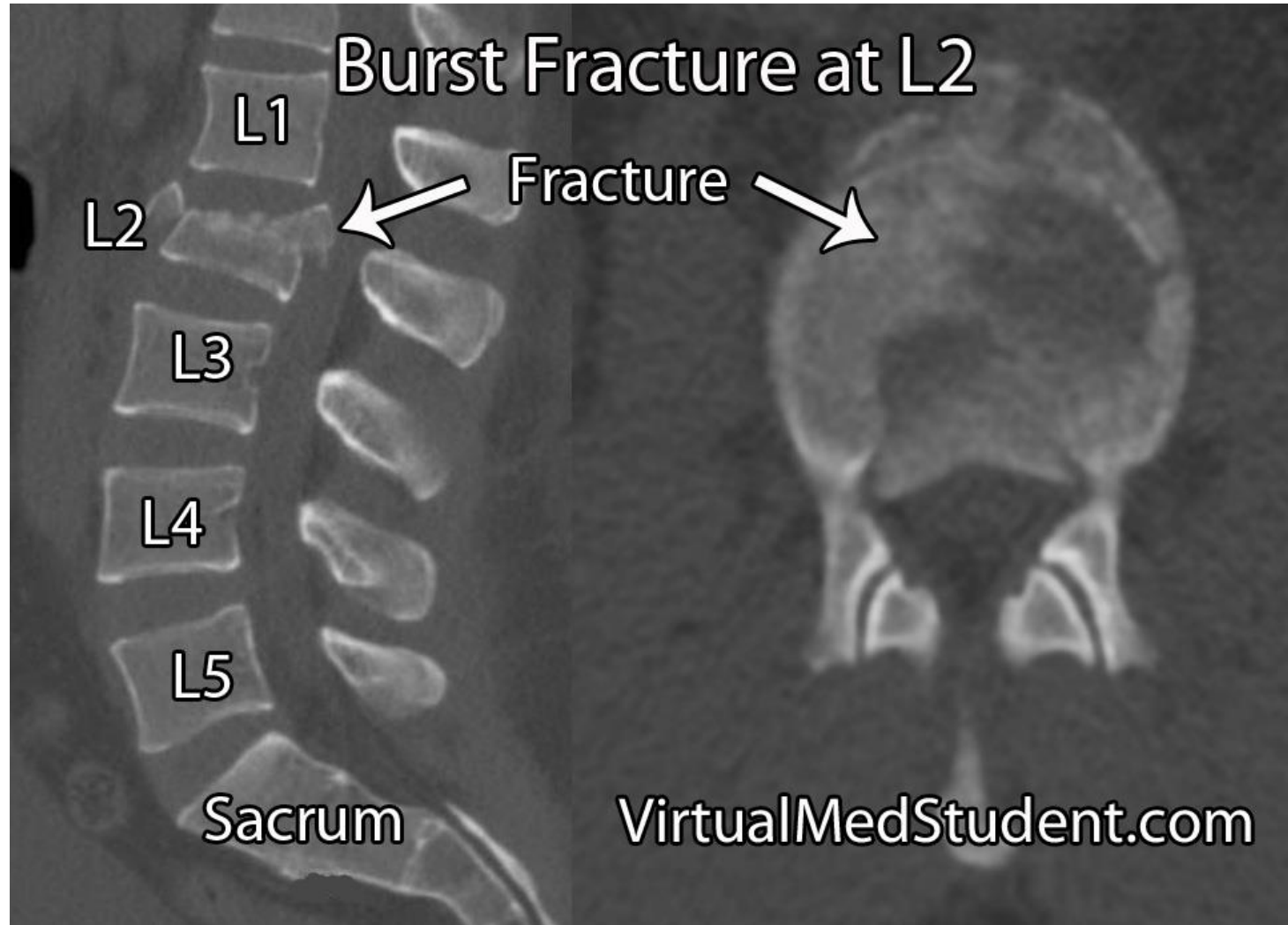
Types of Vertebral Fractures

Type of Fracture	Column Affected	Stable v. Unstable
Compression/Wedge Fracture	Anterior only	Stable
Burst Fracture	Anterior & Middle	Unstable
Fracture/Dislocation Injury	Anterior, Middle, Posterior	Unstable
Seat belt fracture	Anterior, Middle, Posterior	Unstable

Wedge Fx



Burst Fracture



An indication of a basil skull fracture characterized by bruising behind the ear is known as

- A) Battle's Sign
- B) Fluid Aspiration
- C) Rhabdomyolysis
- D) Wruh's node

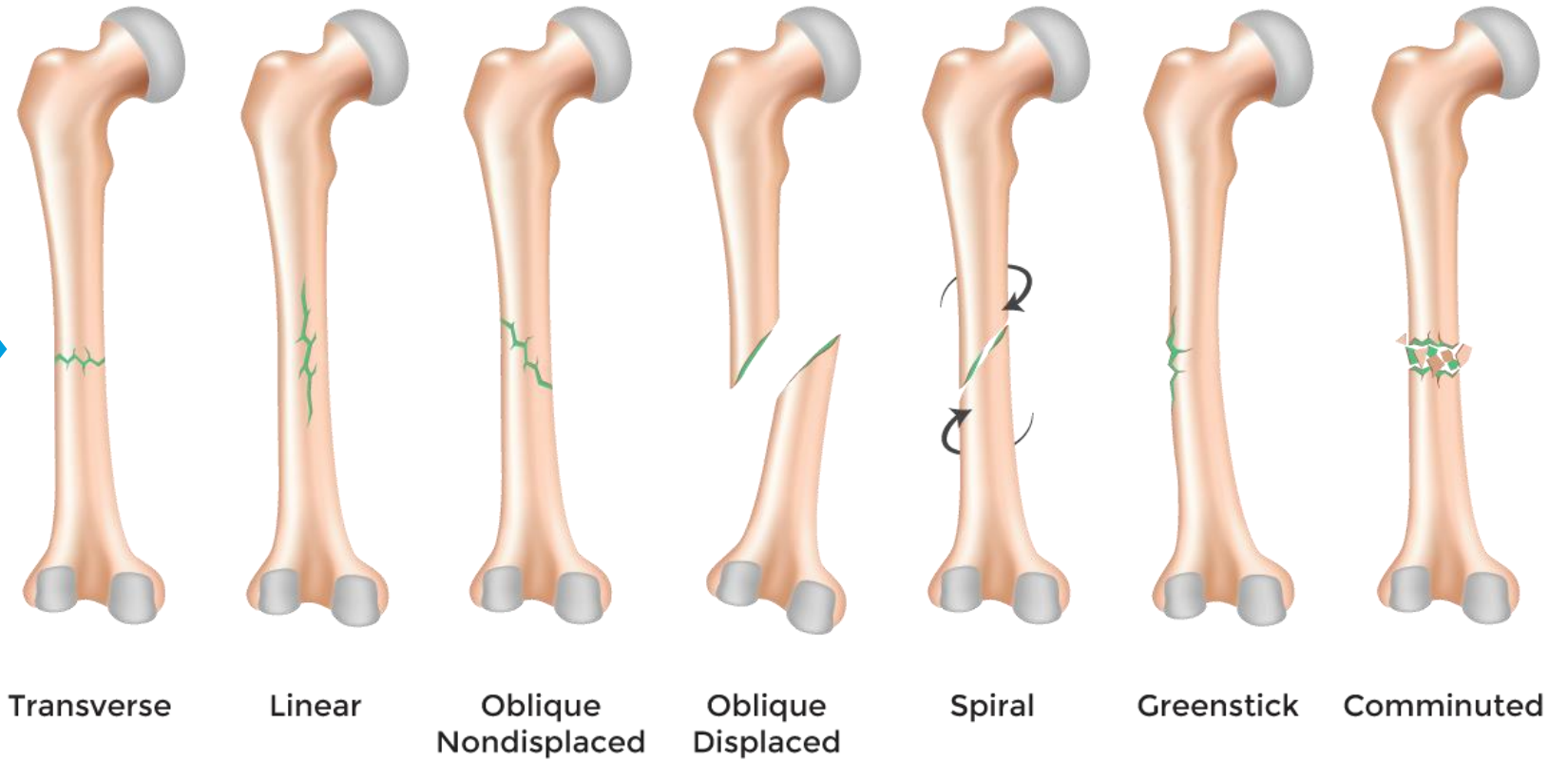
REVIEW QUESTION

An indication of a basil skull fracture characterized by bruising behind the ear is known as

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REVIEW
QUESTION
ANSWER

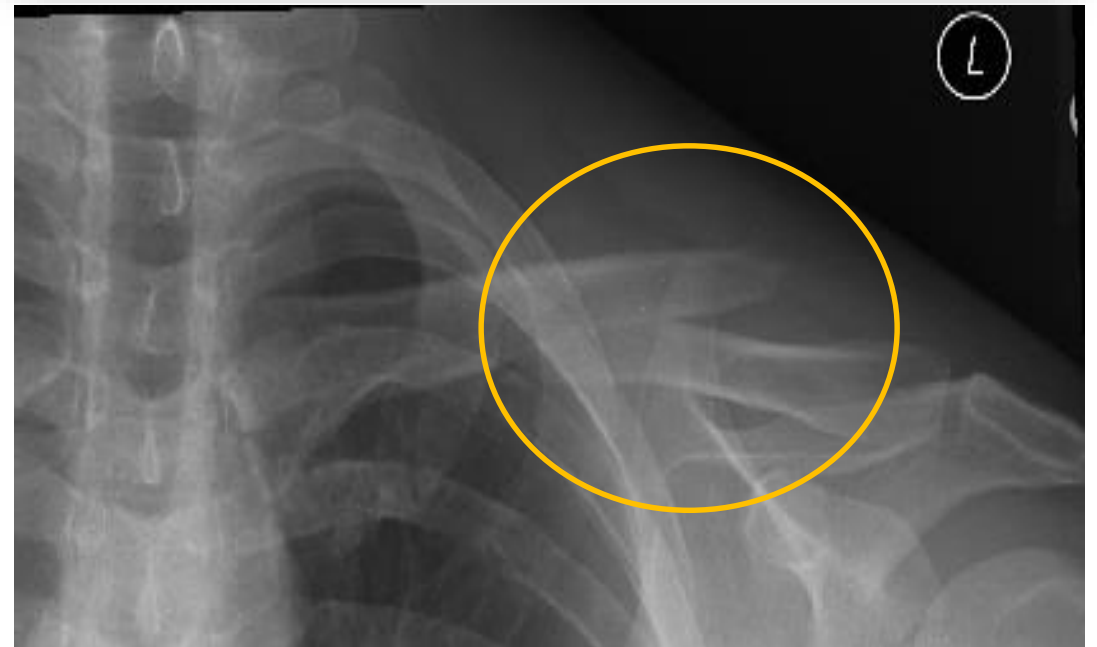
Appendicular Skeletal Fractures



Clavicle Fractures

> Mechanism

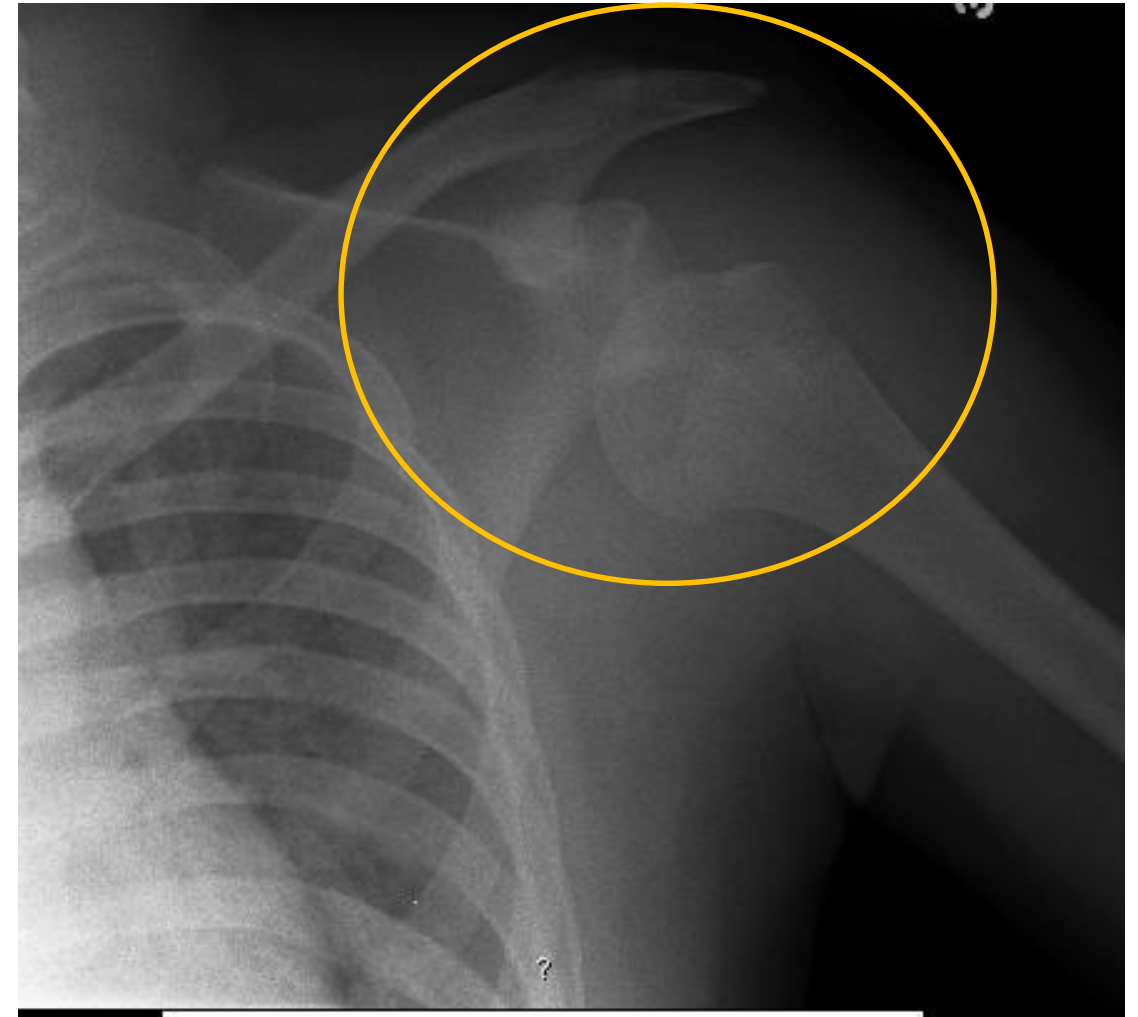
- Fall onto shoulder (87%)
- Direct blow (7%)
- Fall onto outstretched hand (6%)
- Location of Fx
 - Type I - Middle Third (80%)
 - Type II - Distal Third (15%)
 - Type III - Medial Third (5%)



Shoulder Dislocations

› Epidemiology

- Anterior: Most common
- Posterior: Uncommon, 10%, Think Electrocutions & Seizures
- Inferior: Rare, hyperabduction injury



Humeral Fx.

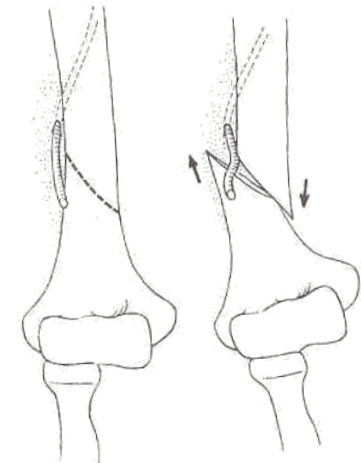
> Proximal

- Most common
- elderly, osteoporosis
- Females 2:1 over males
- FOOSH
- MVA



> Mid Shaft

- MVA
- FOOSH
- Fracture pattern depends on stress applied



> Holstein-Lewis Fractures

- Distal 1/3 fractures
- May entrap or lacerate radial nerve as the fracture passes through the intermuscular septum

Holstein-Lewis fracture.

Reproduced by permission from A Holstein and GB Lewis, *Journal of Bone and Joint Surgery* 45A:1382, 1963.

Elbow Dislocations

› Epidemiology

- 11-28% of injuries to the elbow
- Posterior dislocations most common
- Highest incidence - 10-20 years and usually sports injuries

› Mechanism of injury

- Most common - fall on outstretched hand or elbow resulting in force to unlock the olecranon from the trochlea
- Posterior dislocation - hyperextension, valgus stress, arm abduction, and forearm supination
- Anterior dislocation - direct force to the posterior forearm with elbow flexed



Forearm Fractures

› Epidemiology

- Highest ratio of open to closed than any other fracture except the tibia
- More common in males than females, most likely secondary MVA, contact sports, altercations, and falls

› Mechanism of Injury

- Commonly associated with MVA, direct trauma missile projectiles, and falls



Distal Radius Fractures

> Epidemiology

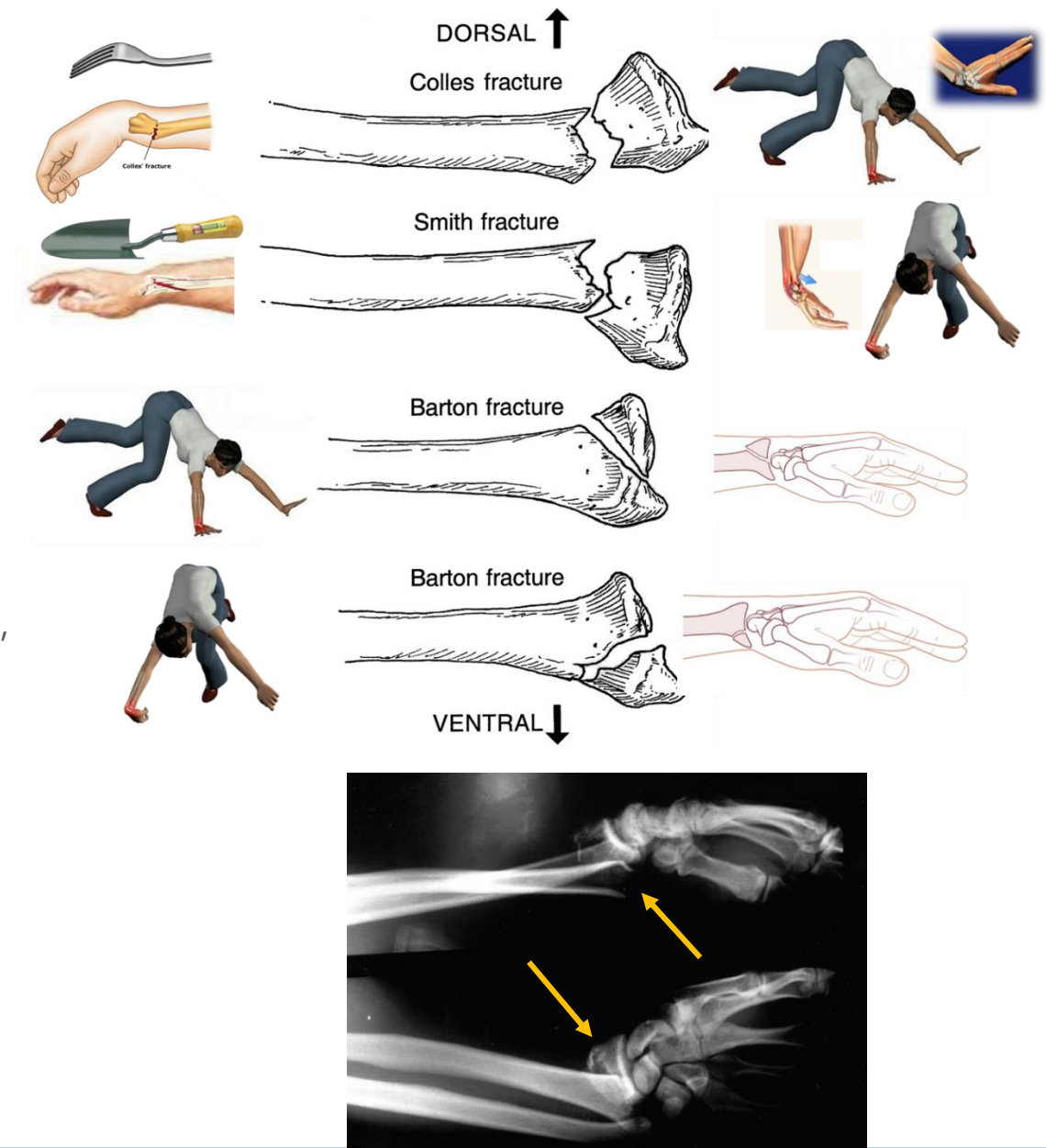
- Most common fx of UE
- FOOSH
- seen in younger and older pop

> Mechanism of Injury

- FOOSH - wrist in dorsiflexion
- High energy injuries (ie MVA) result in significantly displaced, highly unstable fractures

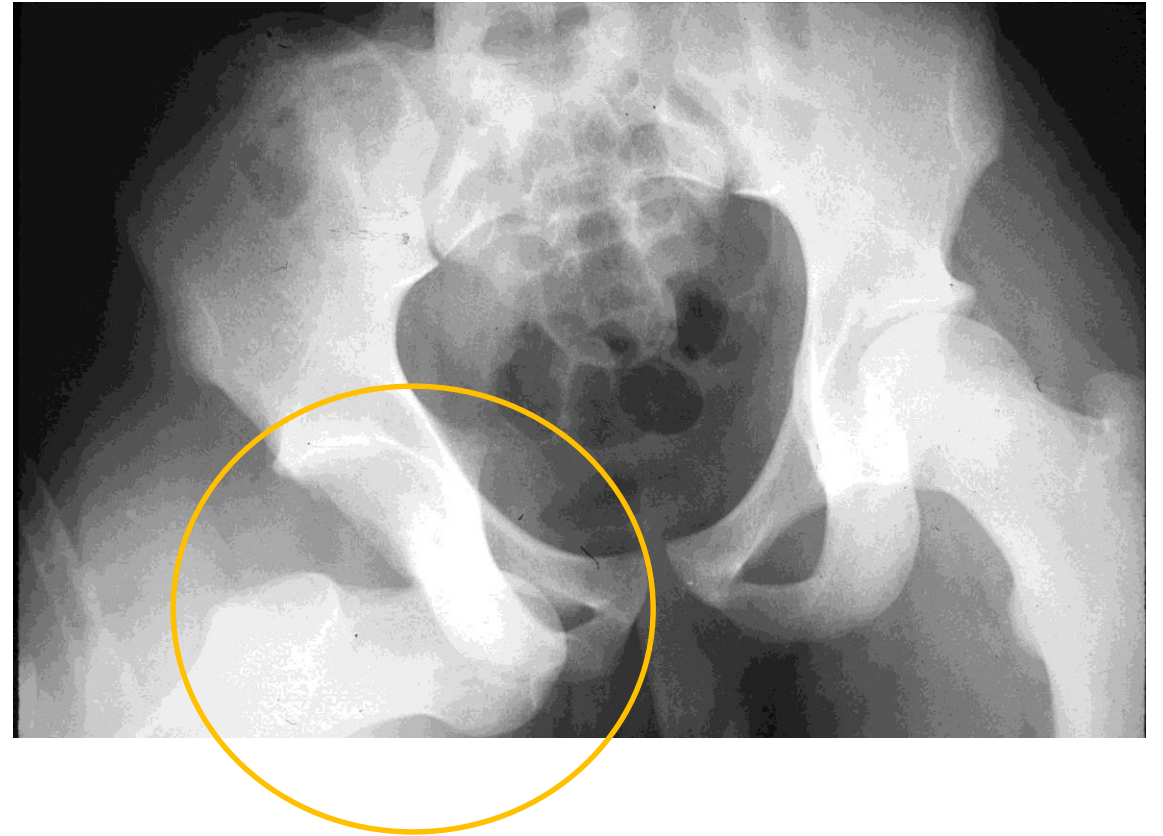
> Types

- Colles' Fracture
 - Smith Fracture (Reverse Colles)
 - Barton Fracture
 - Radial Styloid Fracture (Chauffeur Fracture)



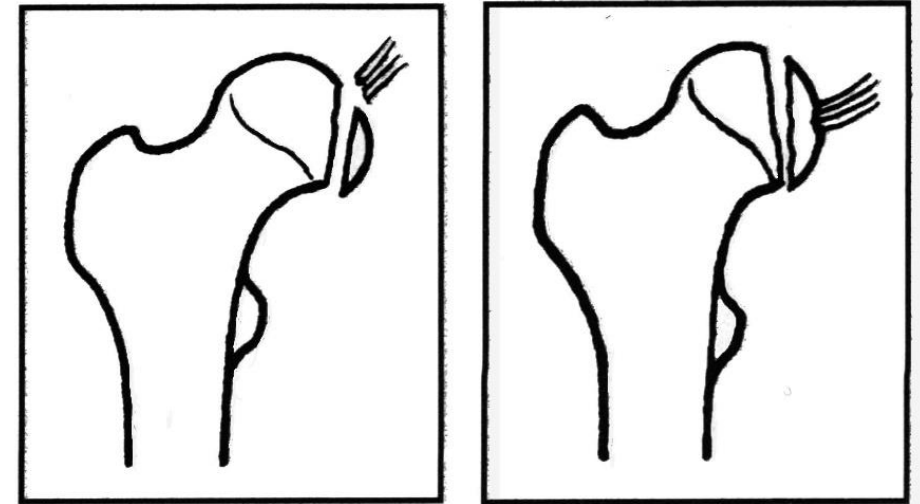
Hip Dislocations

- › Significant trauma, usually MVA
- › Posterior: Hip flexion, IR, Add
- › Anterior: Extreme ER, Abd/Flex



Femoral Head Fractures

- Concurrent with hip dislocation due to shear injury
- Pipkin Classification
 - I: Fracture inferior to fovea
 - II: Fracture superior to fovea
 - III: Femoral head + acetabulum fracture
 - IV: Femoral head + femoral neck fracture



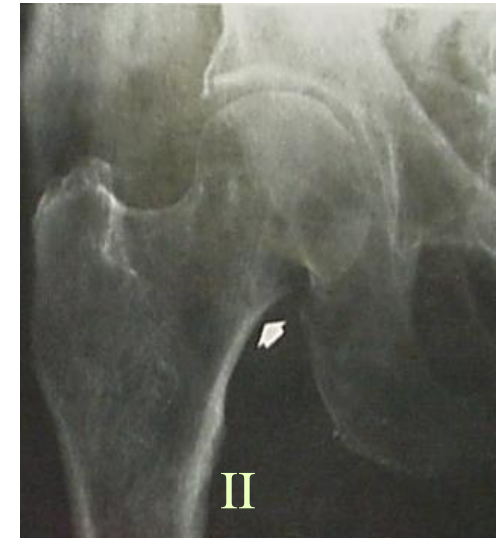
Femoral Neck Fractures

› Garden Classification

- I Valgus impacted
- II Non-displaced
- III Complete: Partially Displaced
- IV Complete: Fully Displaced

› Functional Classification

- Stable (I/II)
- Unstable (III/IV)



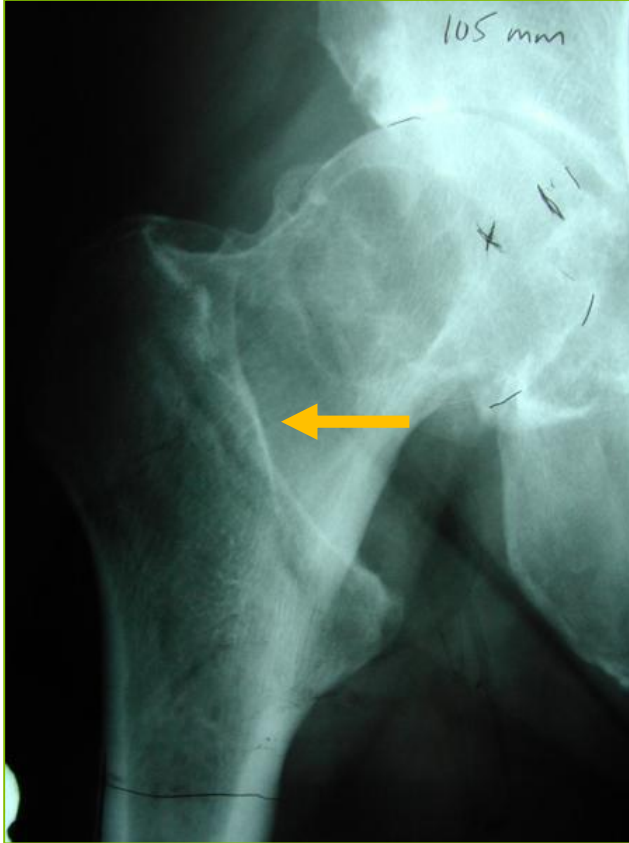
Intertrochanteric Hip Fx

› Classification

- # of parts: Head/Neck, GT, LT, Shaft
- Stable
 - Resists medial & compressive Loads after fixation
- Unstable
 - Collapses into varus or shaft medializes despite anatomic reduction with fixation
- Reverse Obliquity
 - major frx line extends from proximal-medial to distal-lateral through intertroch-subtrochanteric region



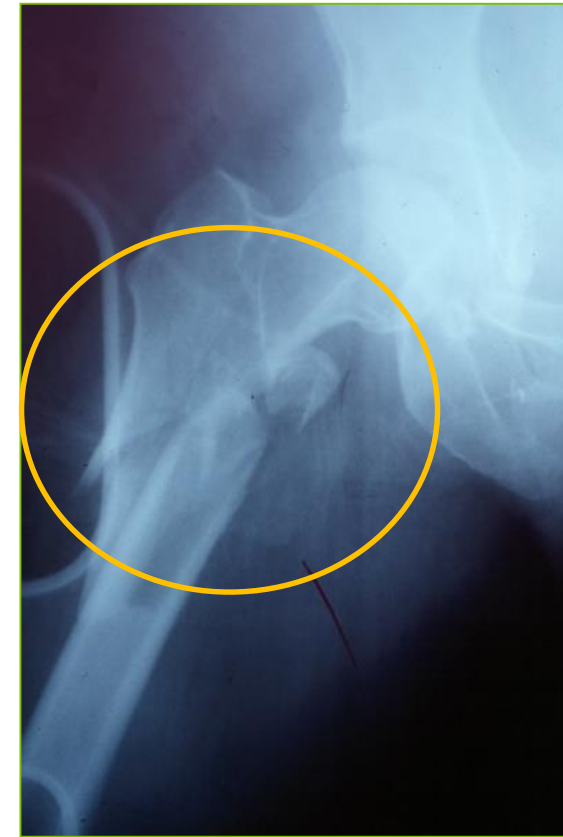
Intertrochanteric Hip Fx



Stable



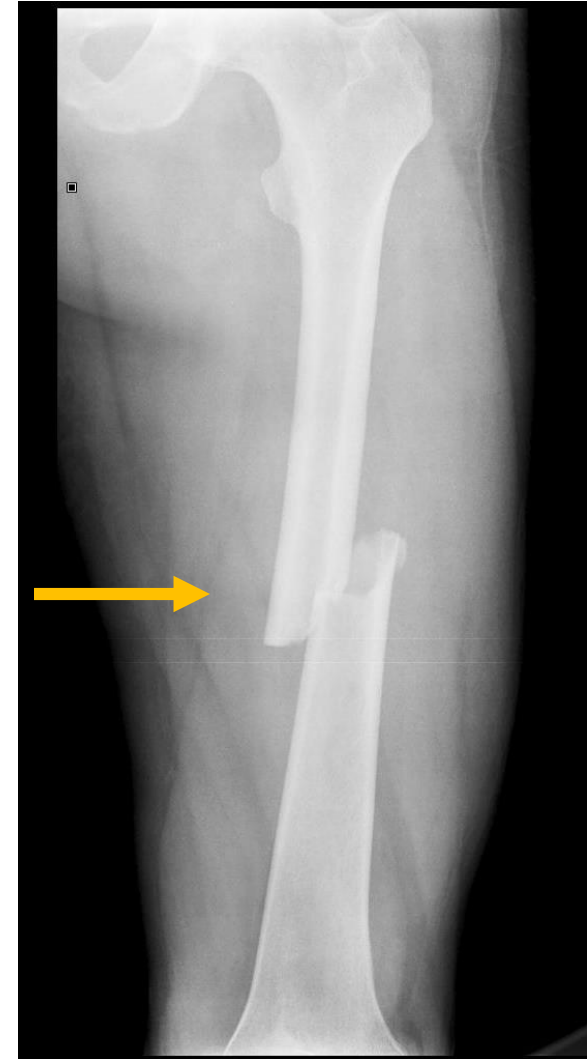
Unstable



Reverse
Obliquity

Femoral Shaft Fx

- › Type 0 - No comminution
- › Type 1 - Insignificant butterfly fragment with transverse or short oblique fracture
- › Type 2 - Large butterfly of less than 50% of the bony width, > 50% of cortex intact
- › Type 3 - Larger butterfly leaving less than 50% of the cortex in contact
- › Type 4 - Segmental comminution
 - Winquist and Hansen 66A, 1984



Knee Dislocations

> High association of injuries

- Ligamentous Injury
 - ACL, PCL, Posterolateral Corner
 - LCL, MCL
- Vascular Injury
 - Intimal tear vs. Disruption
 - Obtain ABI's → (+) → Arteriogram
 - Vascular surgery consult with repair within 8hrs
- Peroneal >> Tibial N. injury



Patella Fractures

> History

- MVA, fall onto knee, eccentric loading

> Physical Exam

- Ability to perform straight leg raise against gravity (ie, extensor mechanism still intact?)
- Pain, swelling, contusions, lacerations and/or abrasions at the site of injury
- Palpable defect

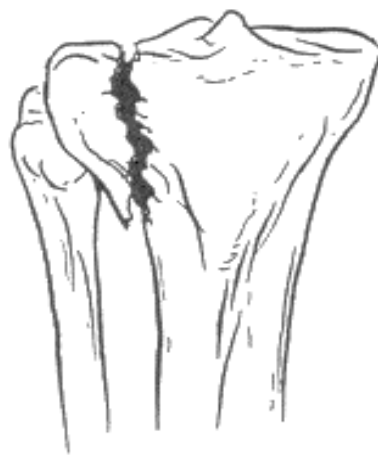


Tibial Plateau Fractures

- › MVA, fall from height, sporting injuries
- › Mechanism and energy of injury plays a major role in determining orthopedic care
- › Examine soft tissues, neurologic exam (peroneal N.), vascular exam (esp with medial plateau injuries)
- › Be aware for compartment syndrome
- › Check for knee ligamentous instability



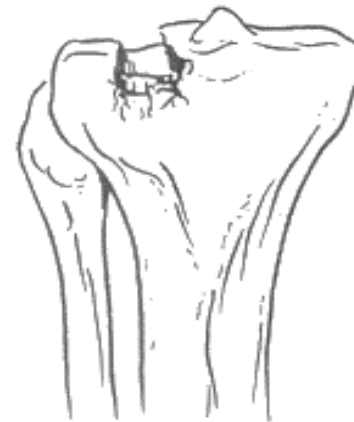
Schatzker Classification of Plateau Fxs



Type I



Type II



Type III

Lower Energy



Type IV



Type V



Type VI

Higher Energy

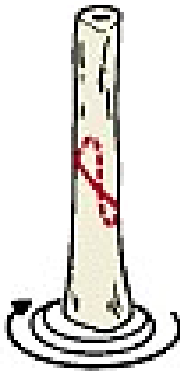
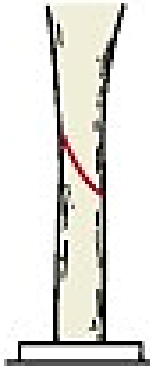

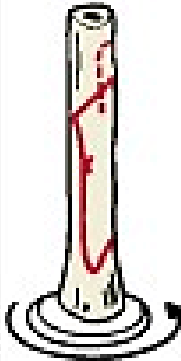
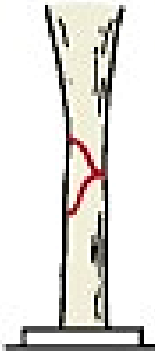
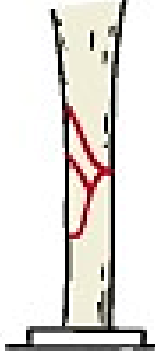
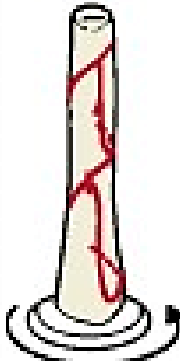
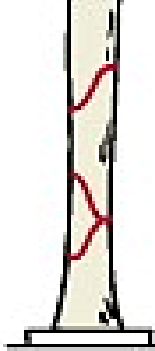

Tibial Shaft Fractures

> Mechanism of Injury

- Can occur in lower energy, torsion type injury (e.g., skiing)
- More common with higher energy direct force (e.g., car bumper)
- Open fractures of the tibia are more common than in any other long bone



Johner and Wruh's Classification

FRACTURE PATTERN	SIMPLE			BUTTERFLY			COMMINUTED		
	A1	A2	A3	B1	B2	B3	C1	C2	C3
	Spiral	Oblique	Transverse	Butterfly by torsion	Butterfly by bending one	Butterfly by bending several	Comminuted by torsion	Segmental fracture	Crush
									
TYPICAL CAUSE	Slipping Skiing	Motorcycle Car crash	Soccer Motorcycle	Skiing	Car bumper Motorcycle		High-speed skiing	Car bumper	Industry MVA War
MECHANISM	Torsion	Uneven bending	Pure bending	Torsion + bending	Bending + compression Low speed	High speed	High-speed torsion	Four-point bending	Crush

(From: Johner, R.; Wruhs, O. Clin Orthop 178:7–25, 1983.)

Ankle Fractures

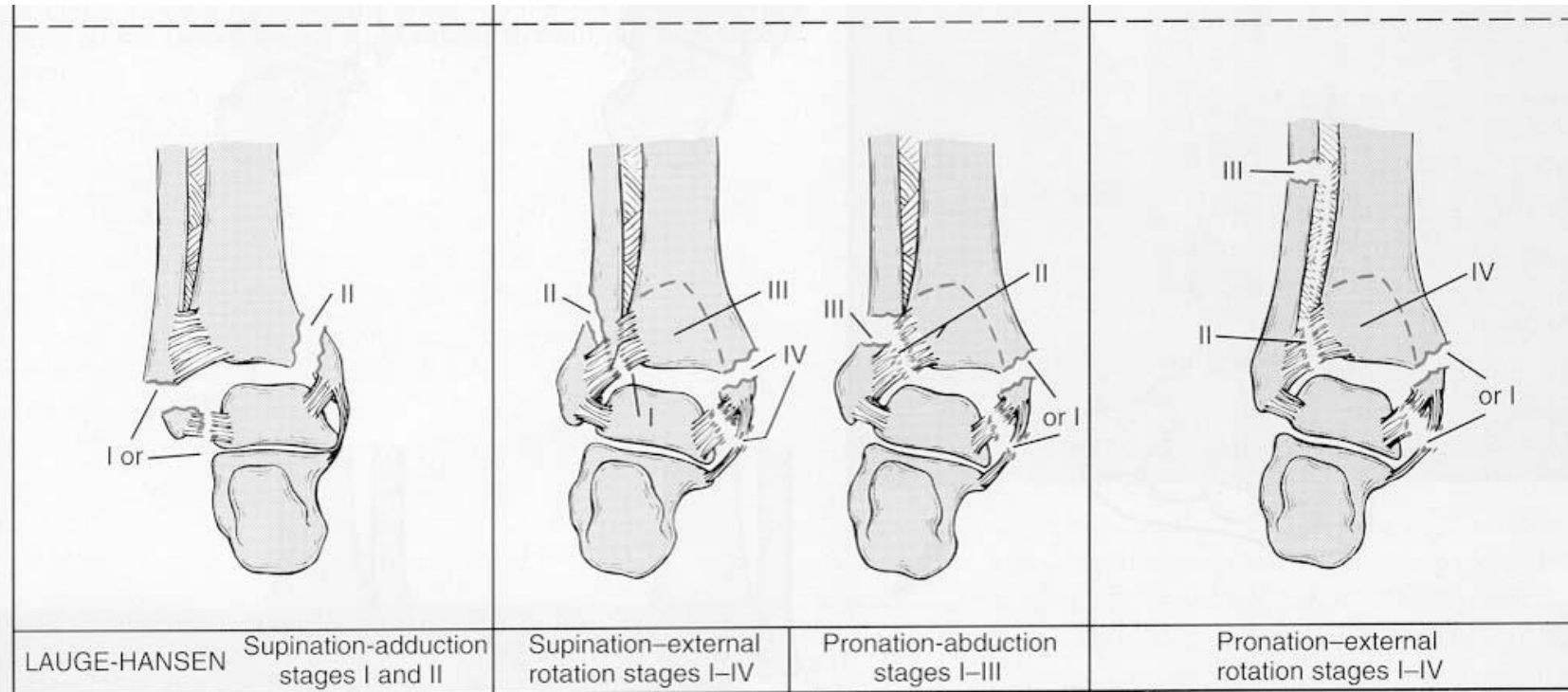
> History

- Mechanism of injury
- Time elapsed since the injury
- Soft-tissue injury
- Has the patient ambulated on the ankle?
- Patient's age / bone quality
- Associated injuries
- Comorbidities
 - (DM, smoking)



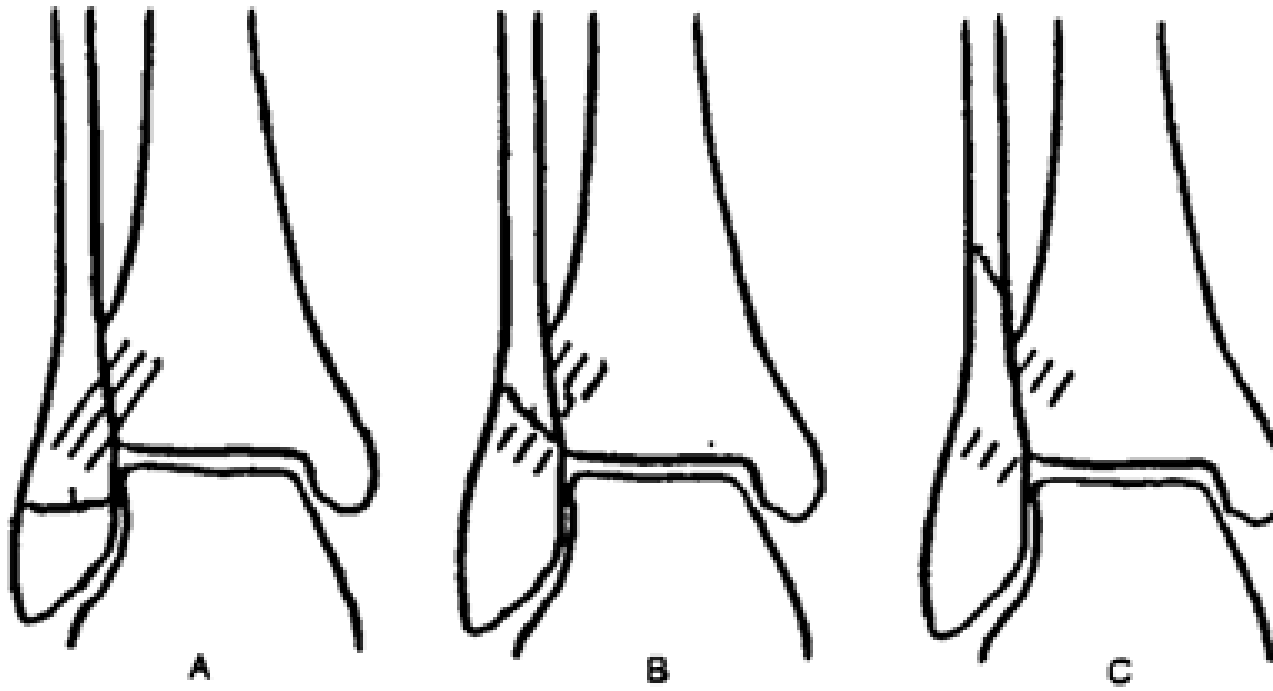
Classification Systems (Lauge-Hansen)

- › Based on cadaveric study
- › First word refers to position of foot at time of injury
- › Second word refers to force applied to foot relative to tibia at time of injury



Classification Systems (Weber-Danis)

- › A: Fibula Fracture distal to mortise
- › B: Fibula Fracture at the level of the mortise
- › C: Fibula Fracture proximal to mortise



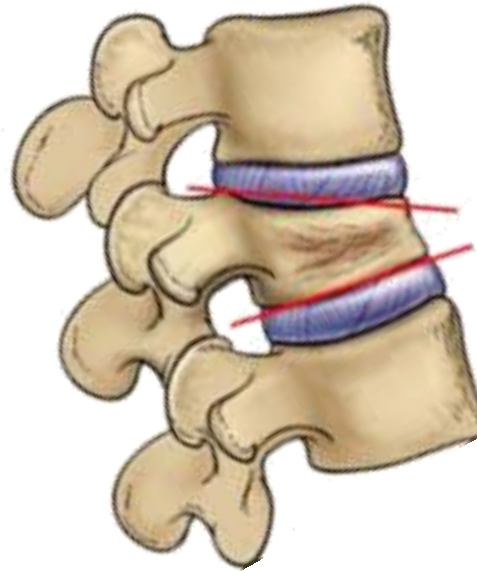


Investigating Falls

- Follow path of energy through body
- Fall Onto Buttocks
 - Pelvic fracture
 - Coccygeal fracture
 - Lumbar compression fracture
- Fall Onto Feet
 - Bilateral heel fractures
 - Compression fractures of vertebrae
 - Bilateral Colles' fractures

This picture represents which type of injury?

- A) Tibial Plateau Fracture
- B) Burst Fracture
- C) Colle's Fracture
- D) Wedge Fracture



REVIEW
QUESTION

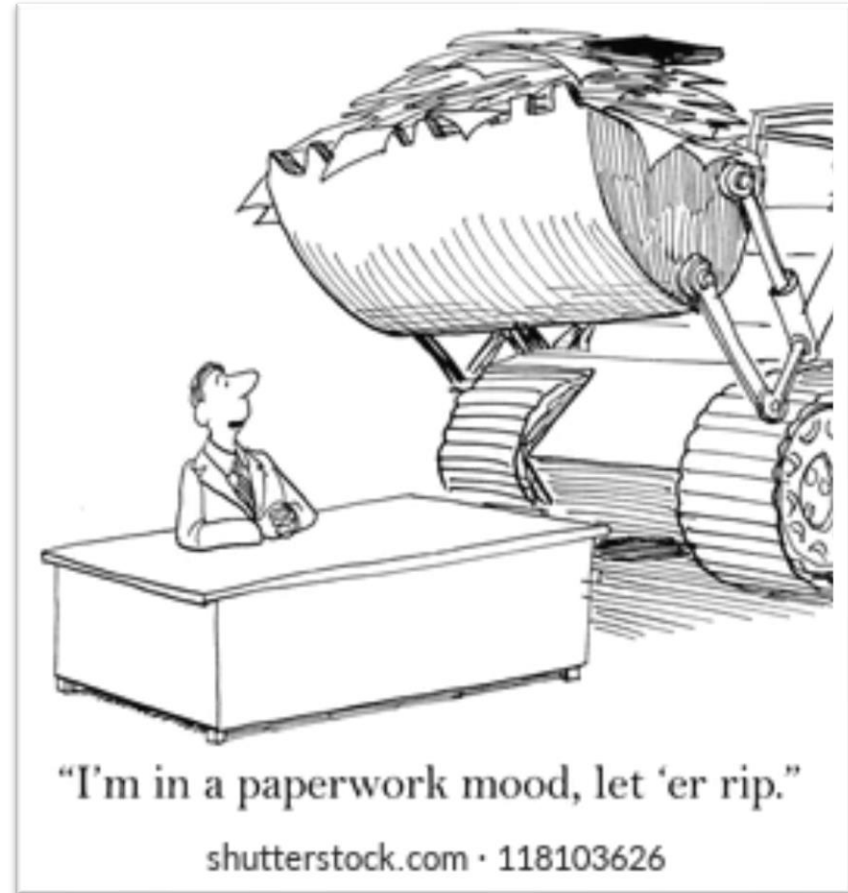
This picture represents which type of injury?

- A) Tibial Plateau Fracture
- B) Burst Fracture
- C) Colle's Fracture
- D) Wedge Fracture**



REVIEW
QUESTION
ANSWER

Claim Analysis & Reporting





Documentation standards for medical related BI claims

› Medical Record Documentation

- ER records
- Medical Tx patterns
- Provider type
- Tx duration and frequency
- Pain mgt.
- SOAP Notes

› Performance Measure

› Baseline Data

› Record of Visits



Review Medical Records / Procedures

- Original Medical Assessment (ER, Occ Med)
- Surgical Tx
- Rehabilitation (outpatient & inpatient procedures: PT, OT, ST)
- FCEs
- IMEs



In Summary

- › The body is mechanically modeled as a system of rigid links connected a joints
- › Physical principles of kinetic energy, Laws of motion and conservation of energy govern the types of injury sustained by the ridged links and soft tissue structures of the human body
- › When assessing an injury scenario follow the path of energy through the body



In Summary

- Identify and assess risks / causation
 - Posture? / Force?
 - Repetition? / Duration?
 - Environment?
- Use information from reports from the scene, ER records, medical treatment patterns, SOAP notes
- Do records match the mechanism?

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QUESTIONS ?



THANK YOU !



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UNIVERSITY

SMALLER. SMARTER.

genex.

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In the Corporate/Industrial Setting Athletic Trainers:

- possess confidant evaluation skills, and an understanding of orthopedic protocols for acute, chronic and post surgical rehabilitation.
- perform an ergonomic assessment of both static and dynamic activities, establish functional capacity exam standards
- fit employees with proper personal protective equipment (PPE),
- develop a line of communication when dealing with an employee incident
- develop and record an accurate assessment of job duties & instruct employees in proper task performance
- understand established safety issues and OSHA guidelines
- professionally research topics, create a presentation and present material to pertinent parties

