

SKELETAL SYSTEM

Reading: Chapter 7

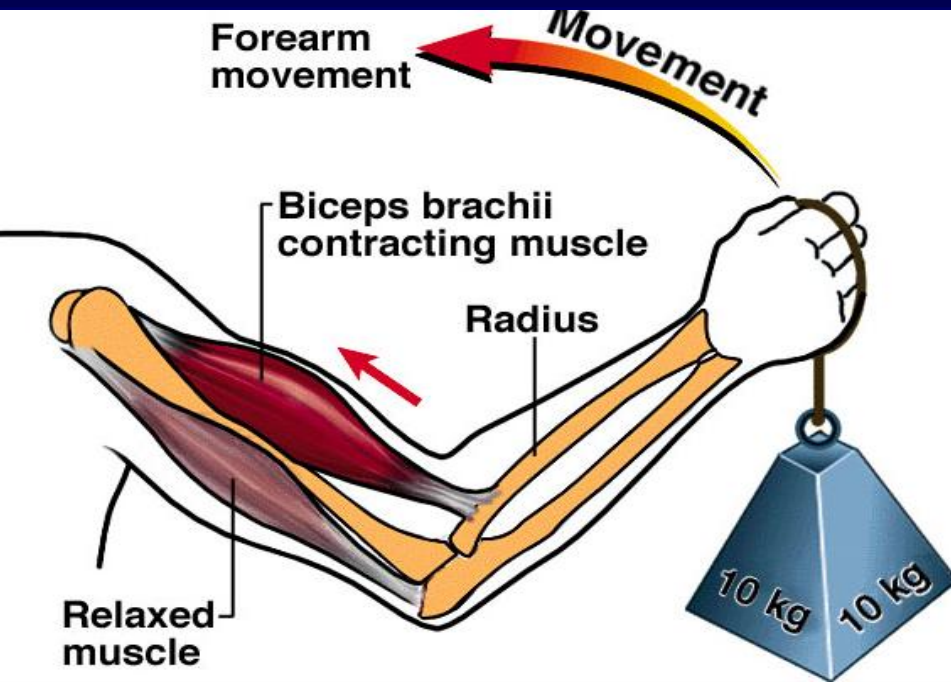
A. FUNCTION

- 206 bones important for:
 - * Shape & support
 - * Movement
 - * Protection of soft tissues
 - * Blood cell production
 - * Mineral storage

A. FUNCTION

Movement: levers working with skeletal muscle

Lever: -rod
-pivot
-object moved against resistance
-force that supplies energy



A. FUNCTION

1. Protection: (of soft tissue)

examples:

skull-

ribs & sternum-

vertebrae-

A. FUNCTION

2. Blood cell production (hemopoiesis):

- occurs in red bone marrow
- Adults: w/in skull, ribs, sternum, clavicles, vertebrae, pelvis
- Under age 25: proximal ends of humerus & femur also
- Infants: most bones

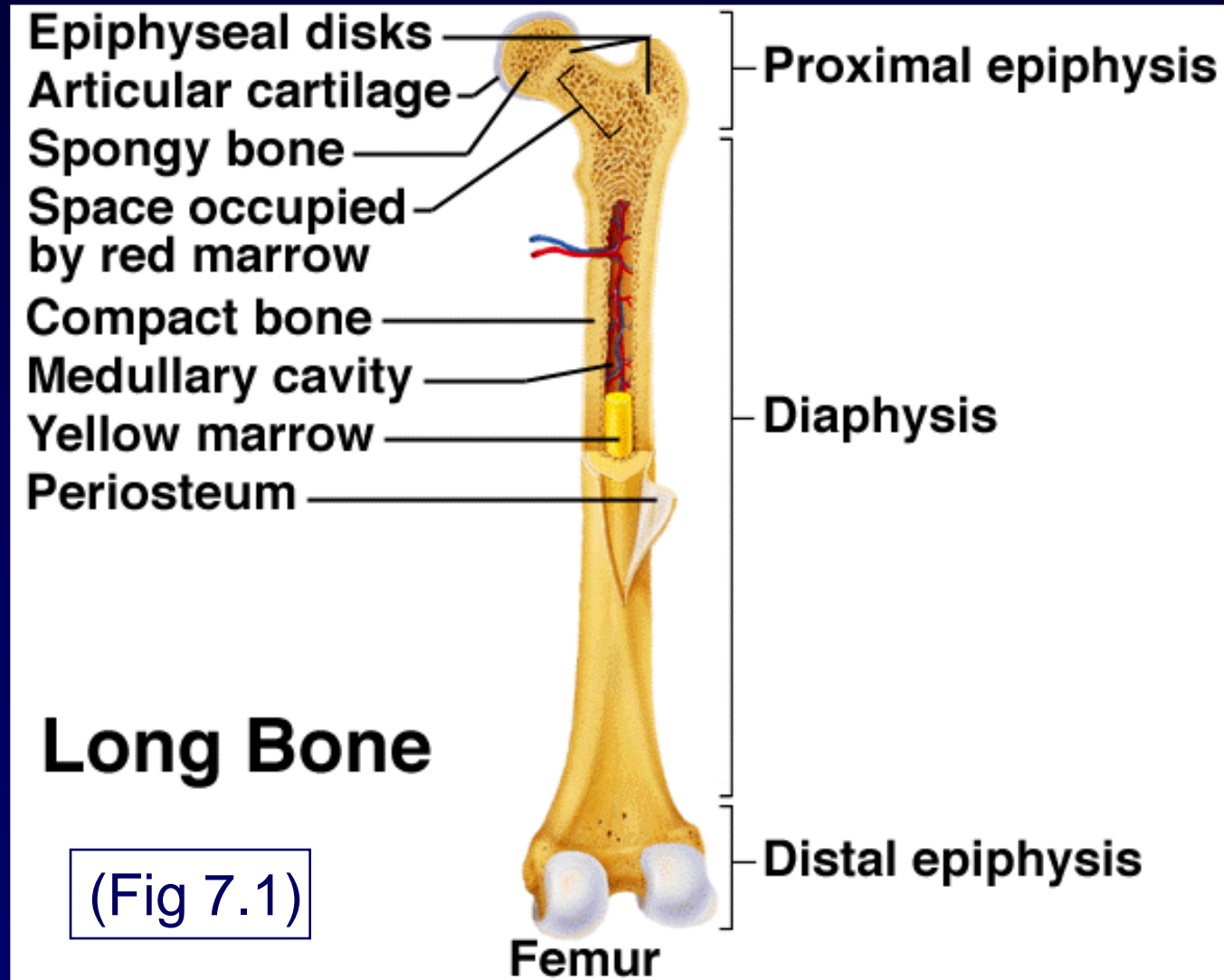
3. Mineral storage: -inorganic calcium salts (mainly calcium phosphate)

- calcium carbonate, magnesium hydroxide, fluoride, sulfate
- make bones hard & resistant to compression
- NOTE: collagen fibers give bone flexibility

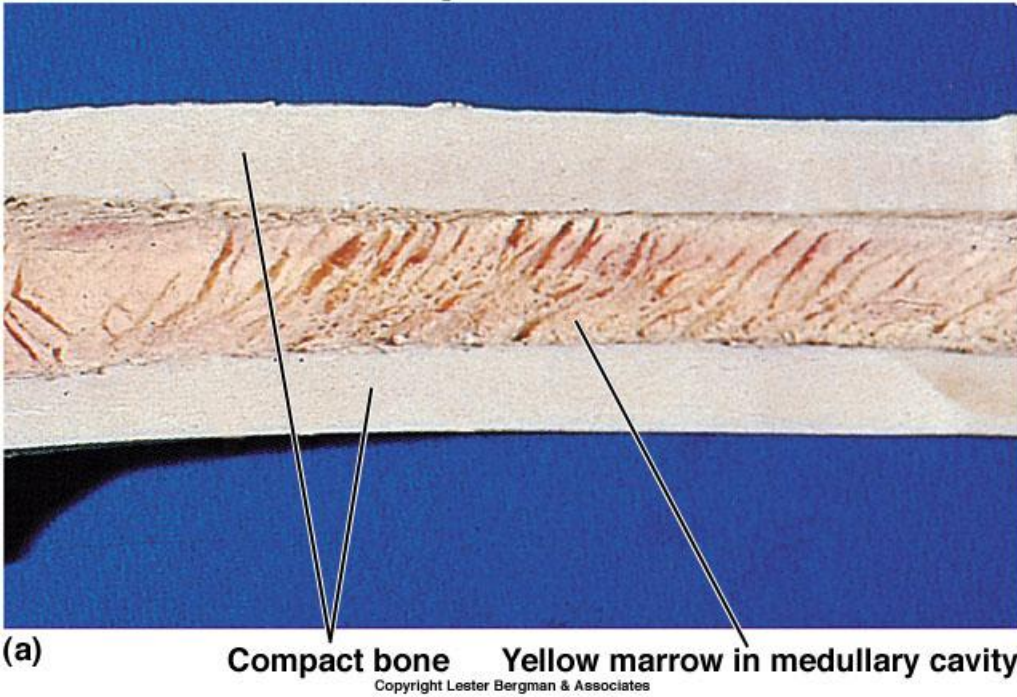
B. STRUCTURE of a LONG BONE

1) Macroscopic Structure

- diaphysis
- medullary cavity
- yellow bone marrow
- epiphysis
- epiphyseal disk (hyaline cartilage)
- epiphyseal line
- periosteum
- articular cartilage
- compact bone
- spongy bone



Compact Bone



Human femurs
(upper leg
bones)

Strong this way



Weaker this way

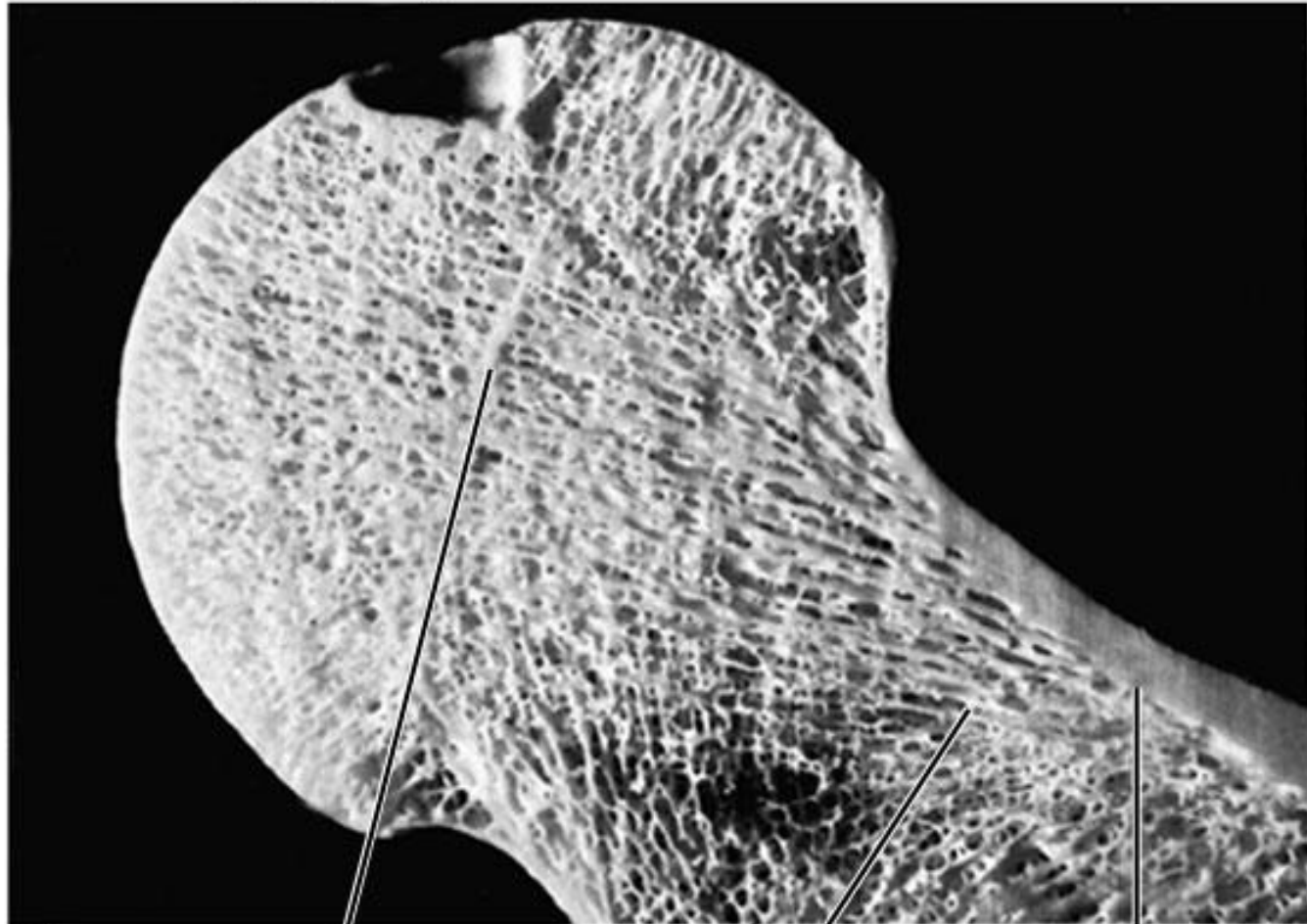
- The Haversian systems are all lined up the same way, so if you press in one direction it will be strong, but pressure from the side may cause a break.

Spongy (trabecular) bone

- No osteons.
- The lamellae form plates and struts called trabeculae, which branch.
- Open spaces are filled with living cells of the marrow...make blood cells.
- Lightweight.

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Epiphyses of the Femur



(b) Remnant of epiphyseal disk Spongy bone Compact bone

Courtesy of John W. Hole Jr.

Epiphyseal Disks in Child's Bone

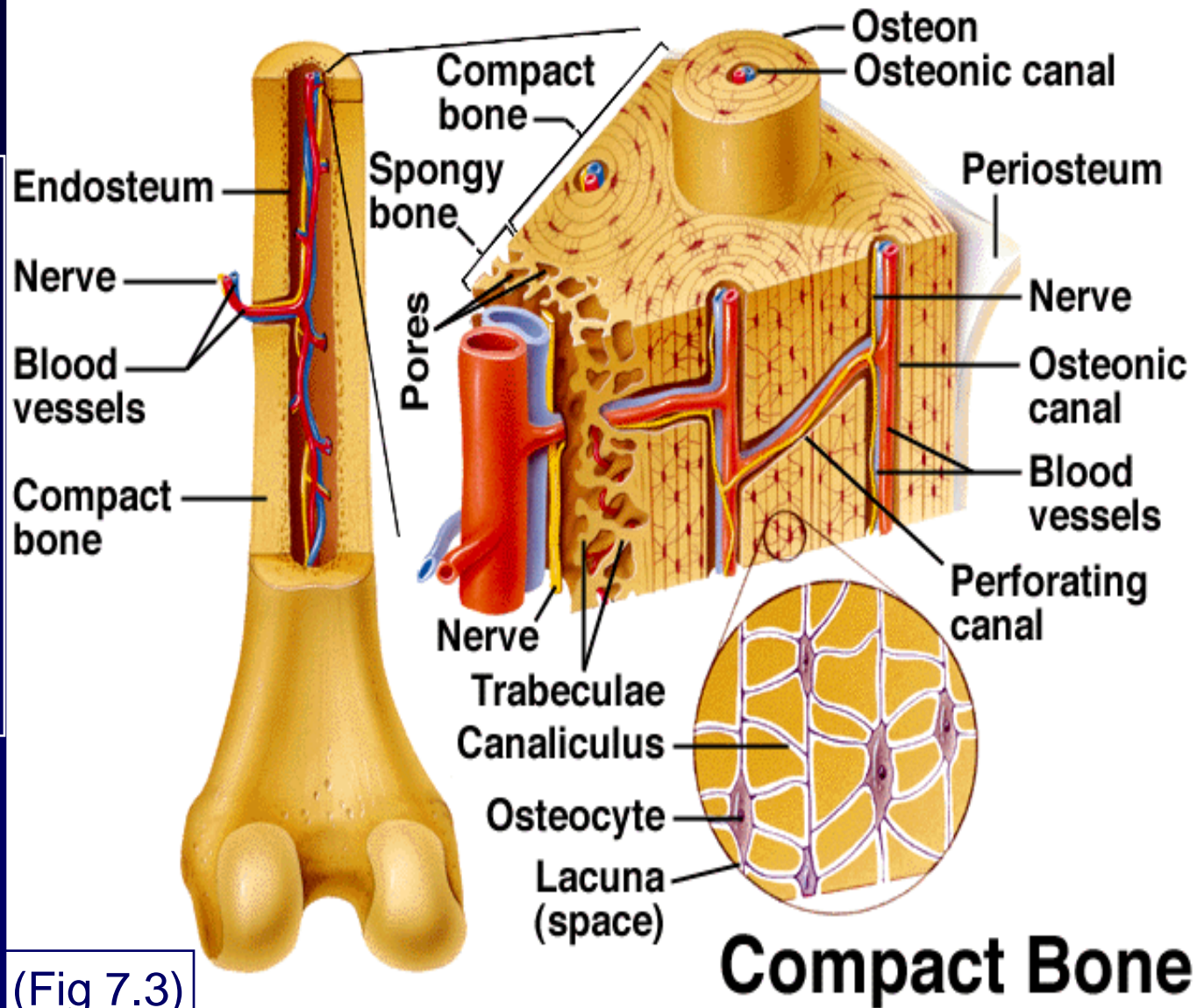


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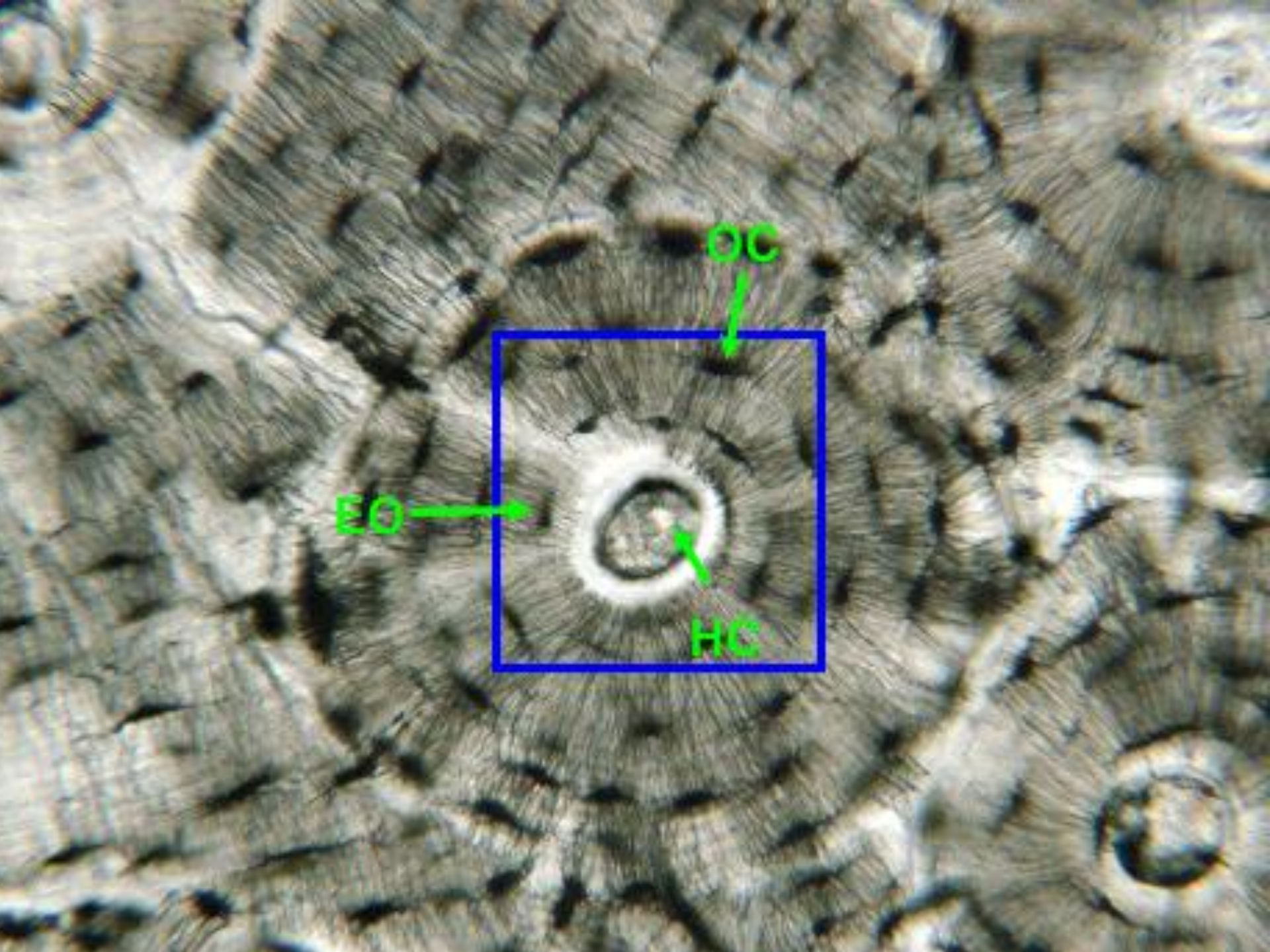
2) Microscopic Structure

Shier/Butler/Lewis, *Hole's Human Anatomy and Physiology*, 8th edition, Copyright © 1999, The McGraw-Hill Companies, Inc. All rights reserved.

- Haversian System = osteon
- Haversian Canal = central canal = osteonic canal
- Osteocyte
- Lacunae
- Canaliculi
- Perforating Canals = Volkmann's canals



(Fig 7.3)

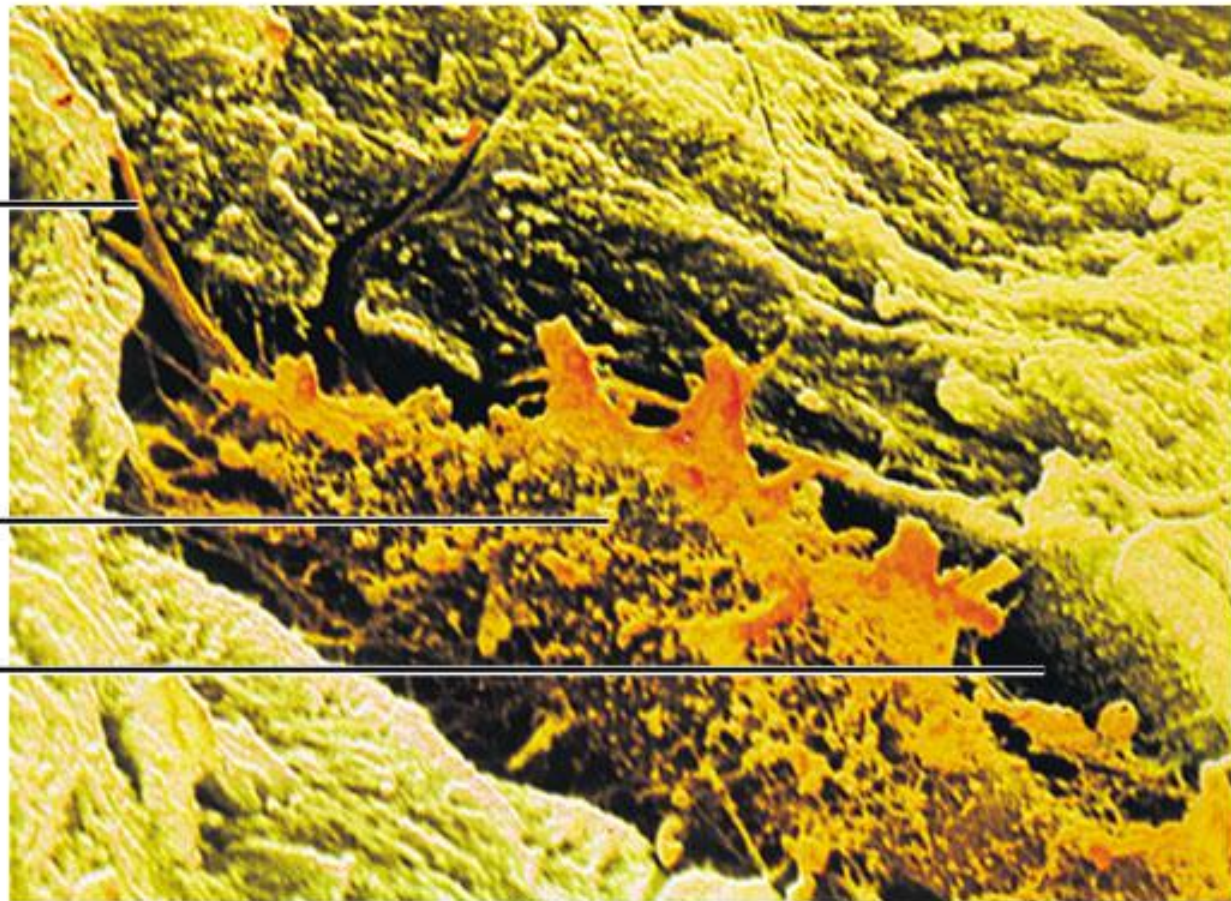


Osteocyte within Lacuna

Cell
process in
canaliculus

Osteocyte

Lacuna



3) BONE CELLS

a) osteocytes - mature bone cells

b) osteoblasts - immature bone cells
- make new bone, “bone formers”

c) osteoclasts - “bone eaters”
- secrete acid that dissolve calcified matrix

C. BONE FORMATION & GROWTH

1) INTRODUCTION

An embryo is made up of soft tissues that eventually become bone.

All bones begin as connective tissue.

**Fibrous CT (skull)*

**Hyaline cartilage (all others)*



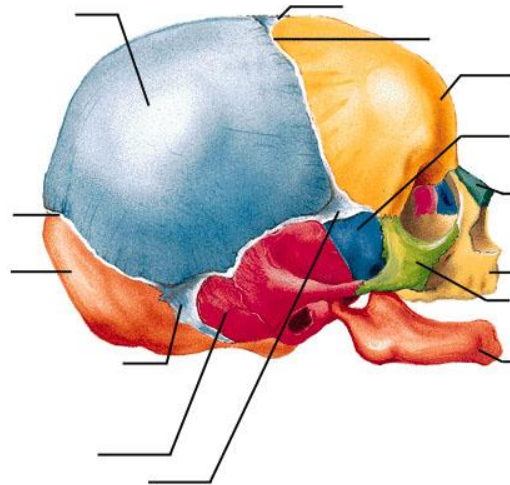
2) INTRAMEMBRANOUS FORMATION

-skull not completely formed at birth

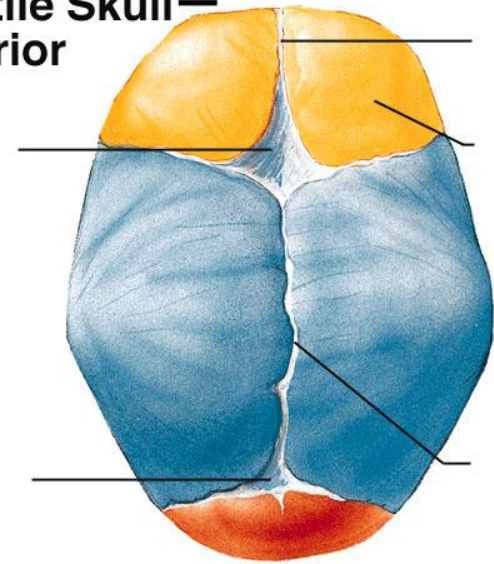
-fibrous C.T. found in some areas = fontanelles

Why are these so important?

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Infantile Skull—Lateral View



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**Infantile Skull—
Superior View**



(Fig 7.14)

3) ENDOCHONDRAL FORMATION

- Endochondral bones = the long bones.
- In the fetus = cartilage
- The cartilage is broken down and replaced with bone.
- The epiphyses remain cartilaginous and continue to grow throughout childhood.

Endochondral bone development

4) HORMONES important for bone growth

Some Hormones Stimulate Osteoblasts:

-
-

-How does this affect on blood calcium levels?

-How does this affect bone density?

Some Hormones Stimulate Osteoclasts:

-
-

-How does this affect blood calcium levels?

D. DISORDERS OF BONE

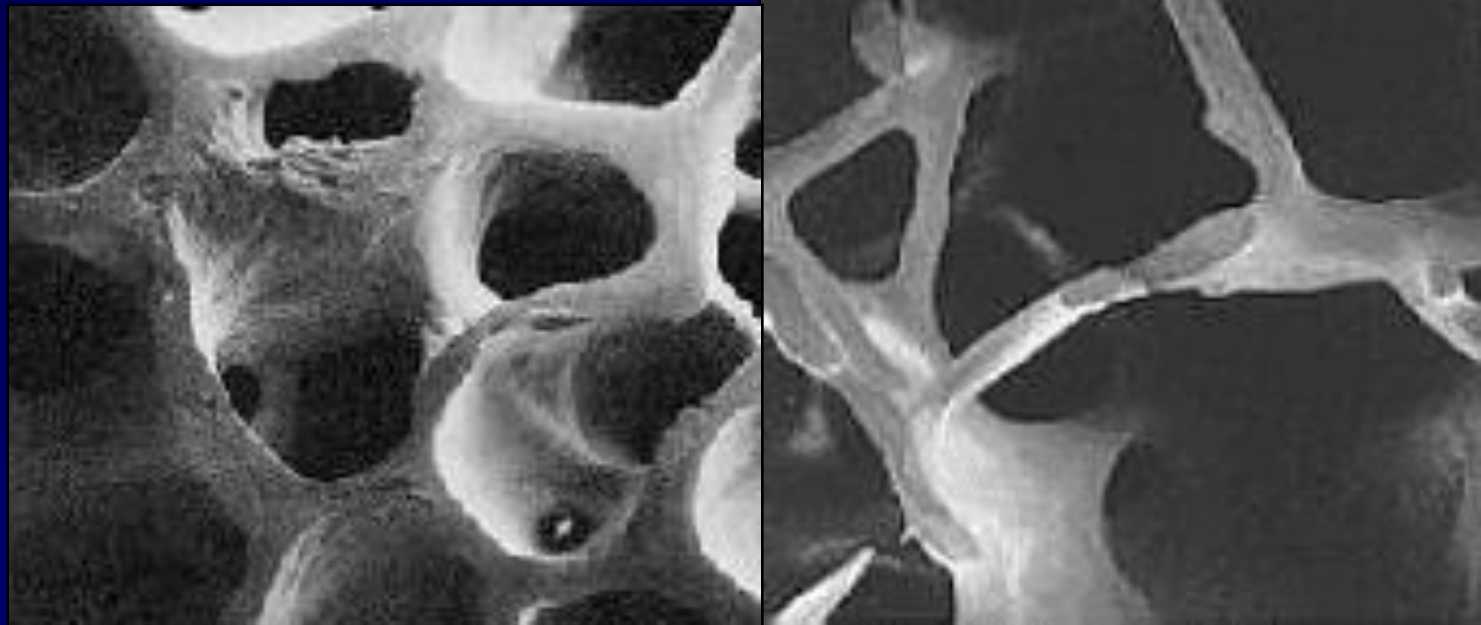
1) RICKETS

- Soft bones
- Due to:-lack of vitamin D
 - impaired Ca^{++} absorption in small intestine
- Treat with Vitamin D & UV exposure
- Called osteomalacia in adults (malnourished seniors)



2) OSTEOPOROSIS

- Common disease in mature individuals
- Osteoclast activity > osteoblast activity
- Bones = porous, weak, brittle
- Major Causes: 1) lack of bone use; 2) low estrogen
- Risk factors: diet low in Ca^{++} or Vit D; amenorrhea; gender; age (50+); build; smoking; genetics; race.



What can we do?

- Lift Weights
- Exercise
- 1200 mg Ca/day
- Vitamin D
- medication

3) OSTEOMYELITIS

("Osteo"=bone; "Mye"=marrow; "-itis" = inflammation)

- Inflammation of the bone marrow
- Due to trauma which allows bacteria to enter
- Or, due to bacterial invasion from an internal site via blood
- Treatment: _____

4) FRACTURES

Can be classified as:

- 1) simple – no skin puncture
- 2) compound - bone breaks through the skin
- 3) incomplete - “cracked” bone
- 4) complete – bone broken

4. Types of bone fractures

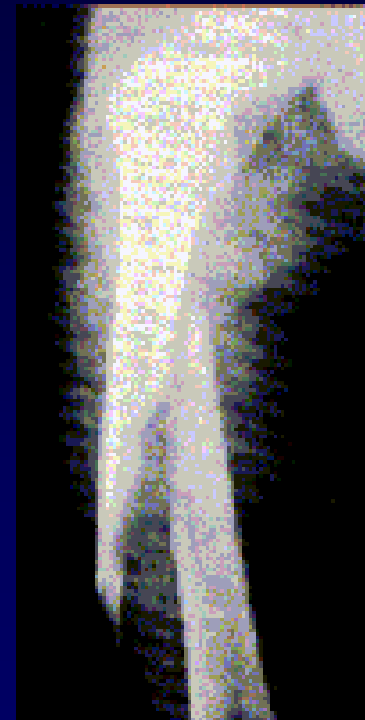
Closed, complete fracture

- 1) Complete (broken all the way through)
- 2) simple (closed). The surrounding muscles, tendons, etc. are undamaged. Usually heals well.



Types of bone fractures

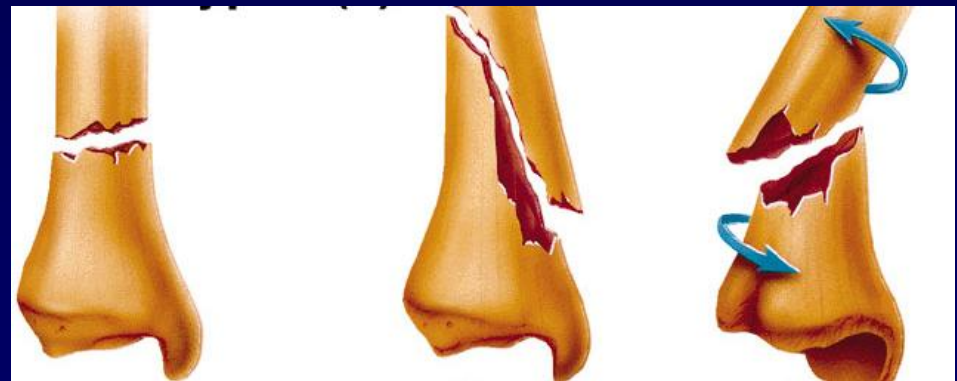
- 3) compound (open).
Bone breaks
through the skin.
Surgery required,
increased risk of
infection.



Types of Bone Fractures



Greenstick Fissured Comminuted



Transverse Oblique Spiral

ARTHROLOGY

THE STUDY OF JOINTS

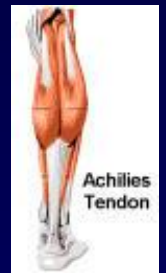
Joint Capsule = surrounds joints
fibrous CT
tendons & ligaments
outside

Three major types of joints:

- 1) Fibrous (immovable)
- 2) Cartilaginous (slightly moveable)
- 3) Synovial (freely movable)

Reminder

- Ligaments: connect bone to bone at joints.
- Tendons: connect bone to muscle.



FIBROUS JOINTS

- 1) Fibrous connective tissue between bones
- 2) No joint capsule
- 3) No movement

Ex: sutures of the skull

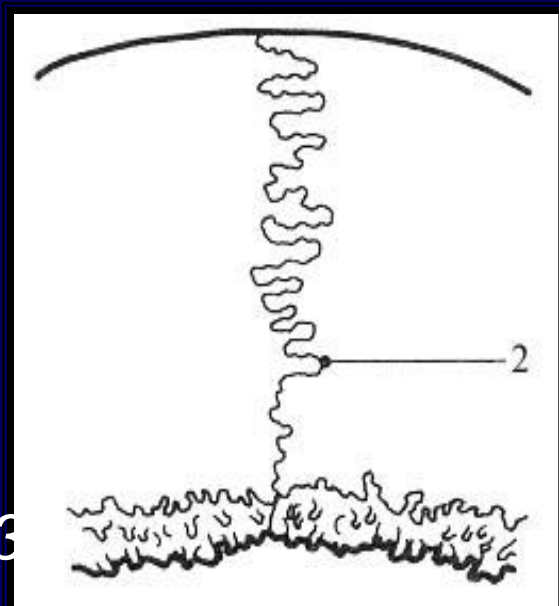
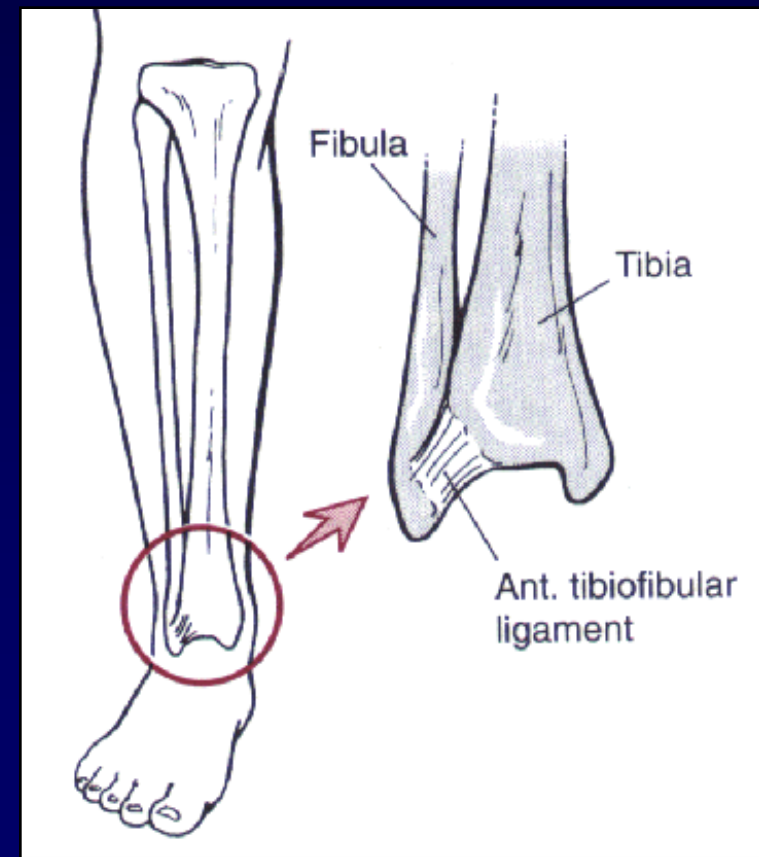
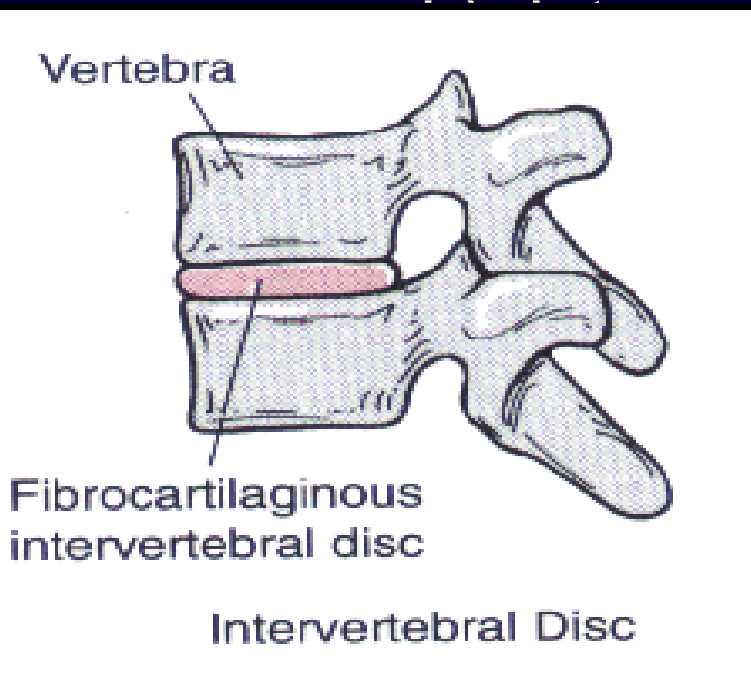


Fig 7.33



CARTILAGINOUS JOINTS

- 1) Hyaline and/or fibrocartilage between bones
- 2) No joint capsule.
- 3) Slightly movement/compression:
 - a) pubic symphysis



Intervertebral discs



SYNOVIAL JOINTS

- 1) Joint cavity filled w/ synovial fluid (lubricant & nourishing)
- 2) Some have fluid filled sac(s) called bursae
- 3) Hyaline cartilage at bone ends = “articular cartilage”
- 3) Freely movable (limited by _____, _____, and _____)

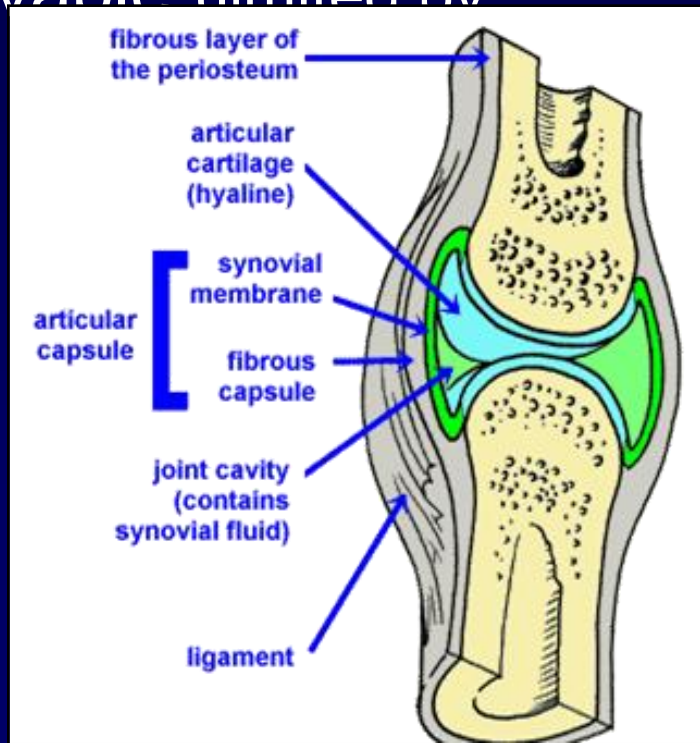


Fig 7.34

Movements at synovial joints: (usually pairs)

- a) Flexion = decreasing angle
Extension = increasing angle
- b) Abduction = away from mid-line
Adduction = toward mid-line

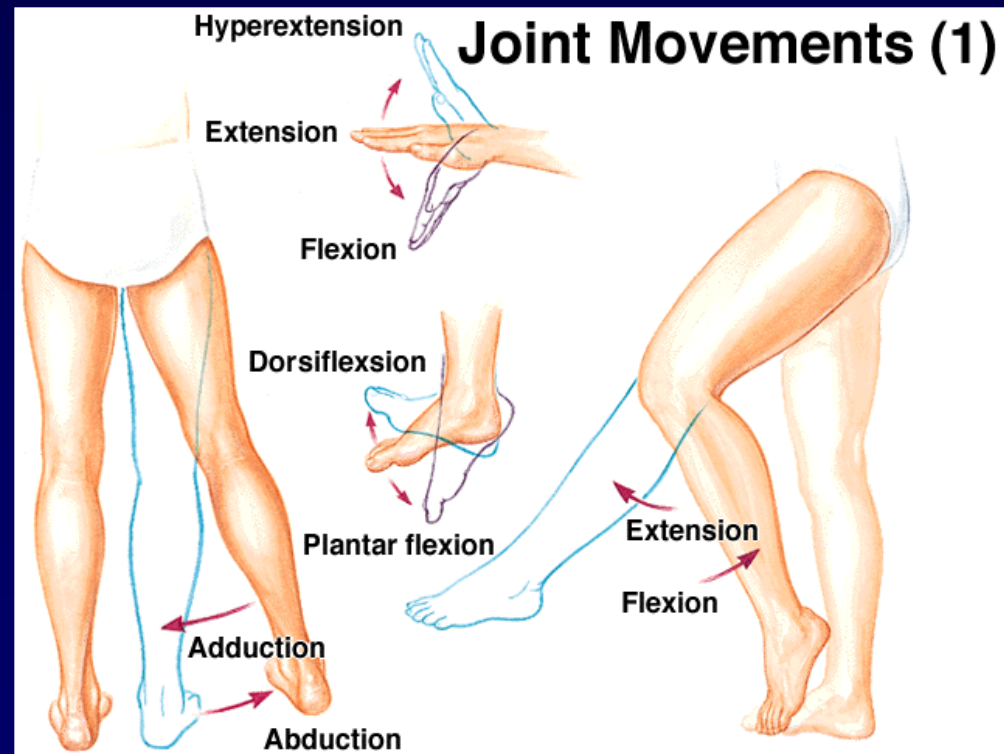


Fig 7.39

c) Supination = turn HAND palm forward
Pronation = turn HAND palm backward

d) Circumduction = rotating ARM in circle parallel to body

e) Rotation = rotating in the joint

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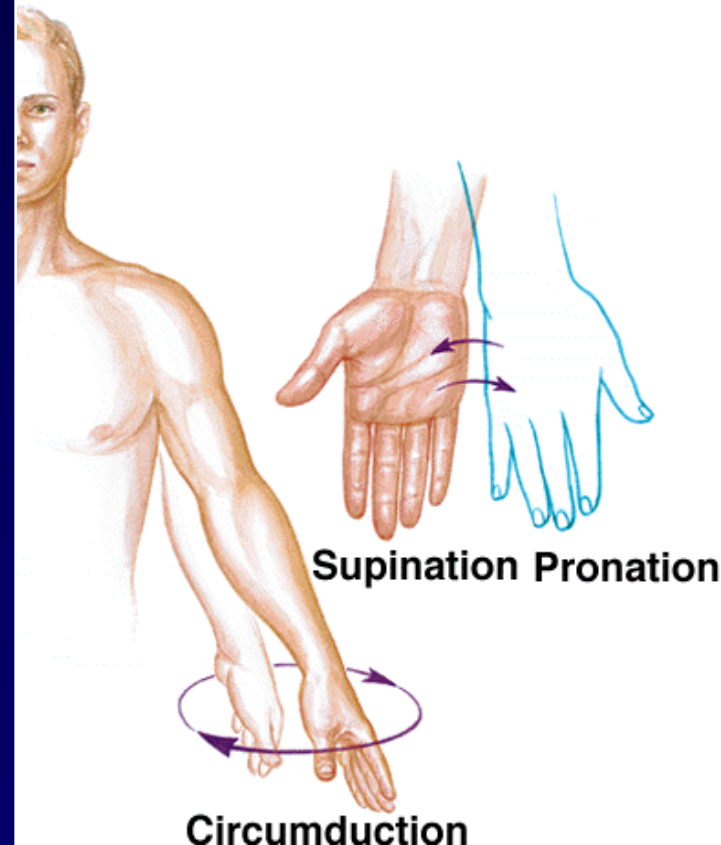


Fig 7.40

- f) Inversion = turn FOOT in
Eversion = turn FOOT out
- g) Elevation = movement in superior direction
Depression = movement in inferior direction
- h) Protraction = mvnt. forward, parallel to ground
Retraction = mvnt. backward, parallel to ground

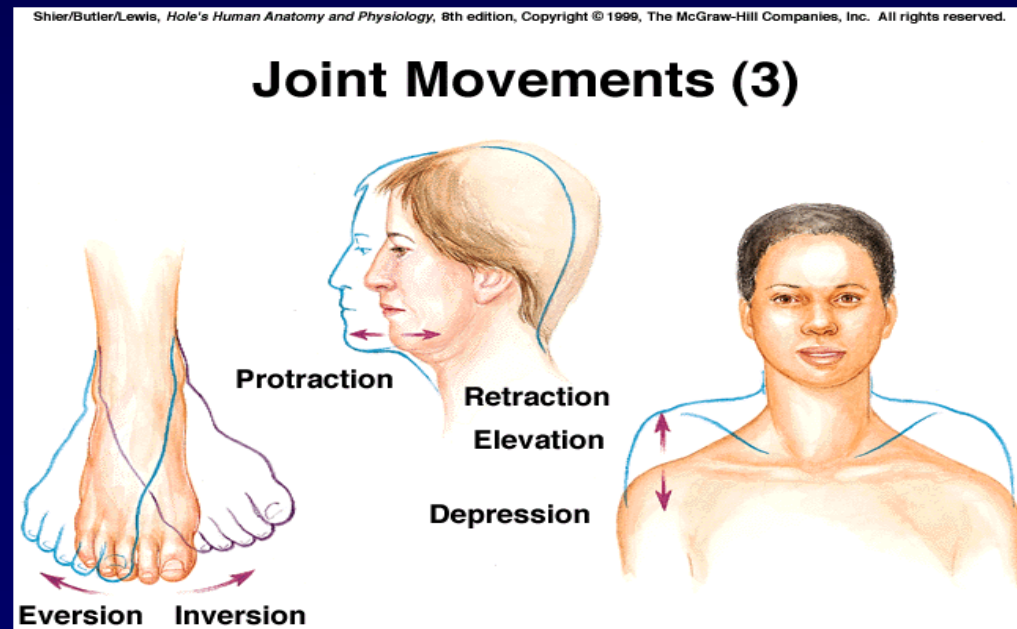


Fig 7.41

Types of synovial joints (by shape: Table 7.4)

a) Ball and Socket

-greatest range of motion (multiaxial)

Examples:



Fig 7.37

Types of synovial joints

b) Hinge

-monoaxial (moves 1 way, like door hinge)

-elbow, knee

Fig 7.38



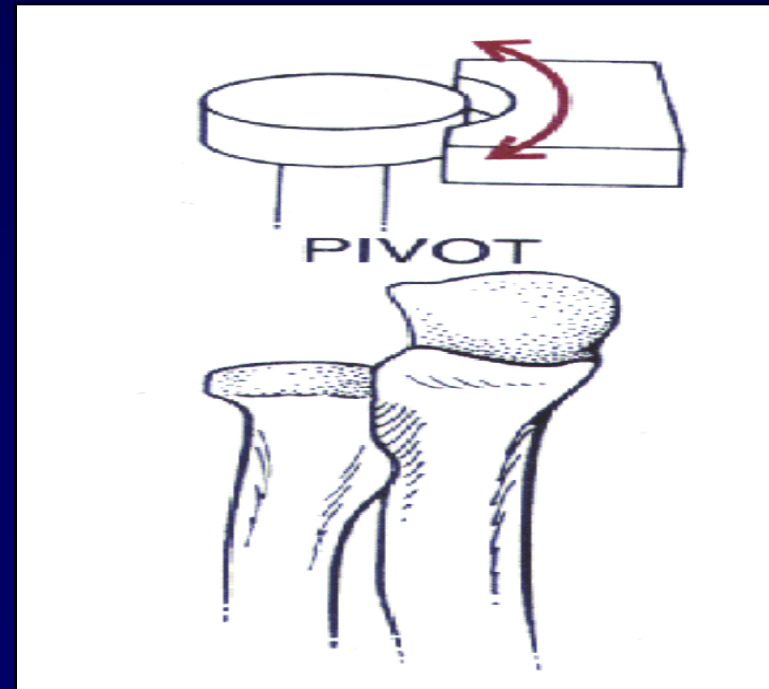
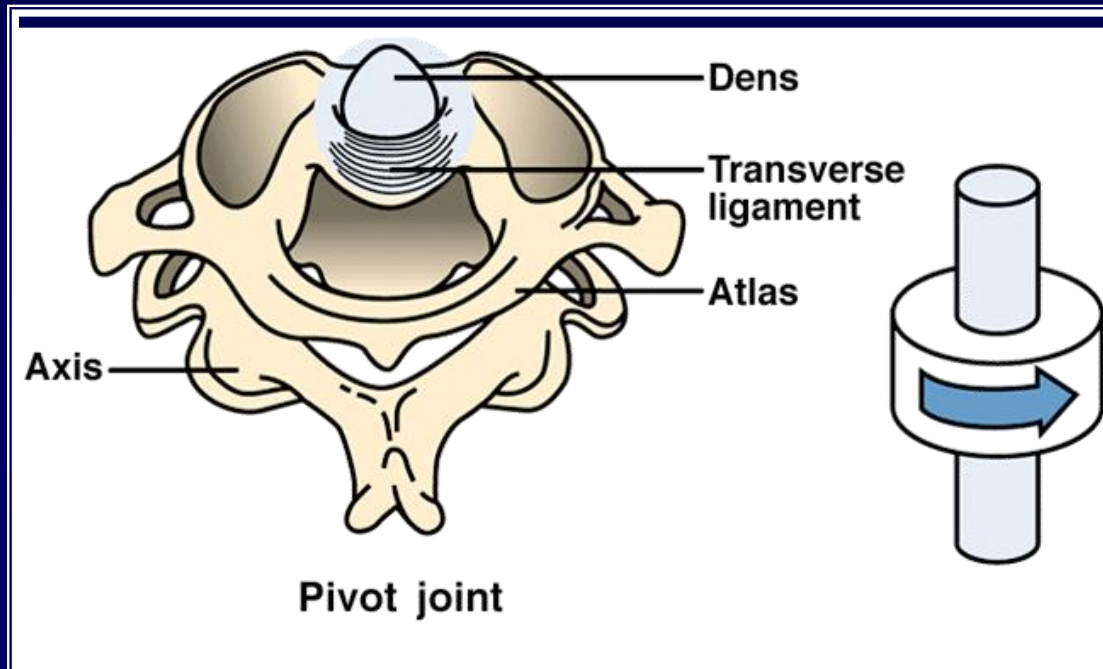
Types of synovial joints

c) Pivot

-cylinder & ring

-atlas & axis

Fig 7.24



Types of synovial joints

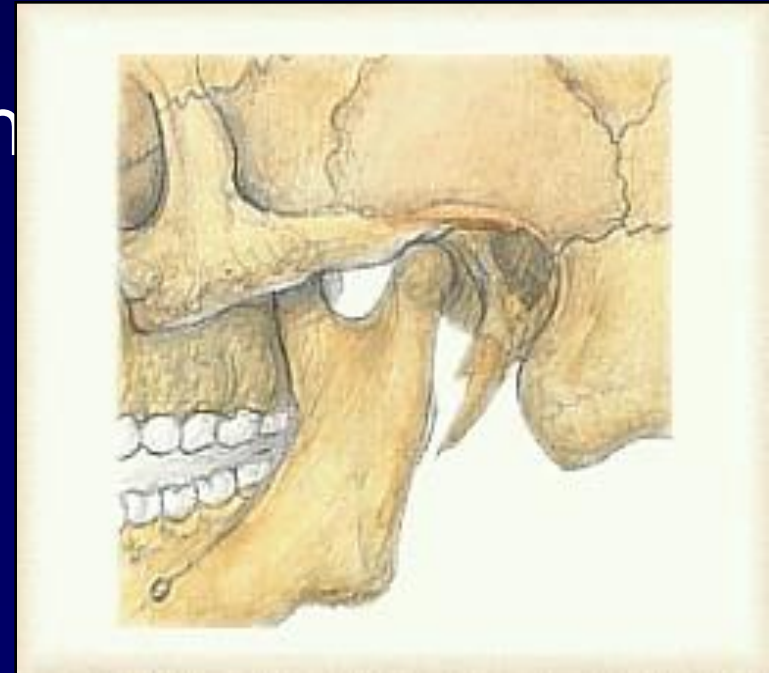
d) Condylloid (ovoid)

-movement in 2+ planes

-no rotation

-mandibular condyles w/ mandibular fossa

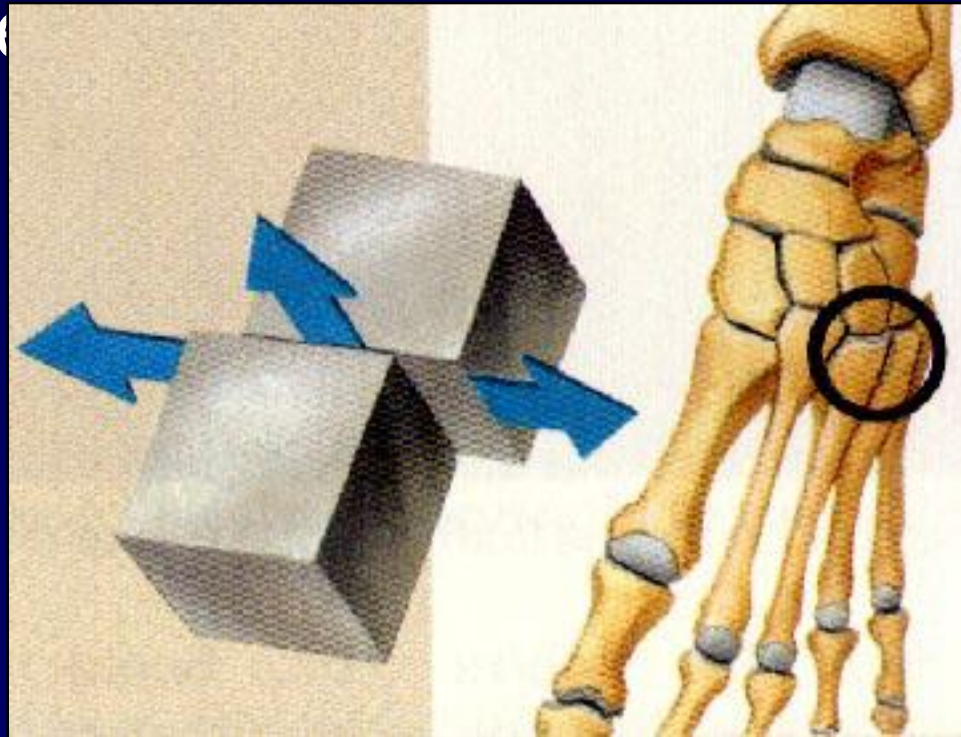
-carpals w/ radius & ulna



Types of synovial joints

e) Gliding

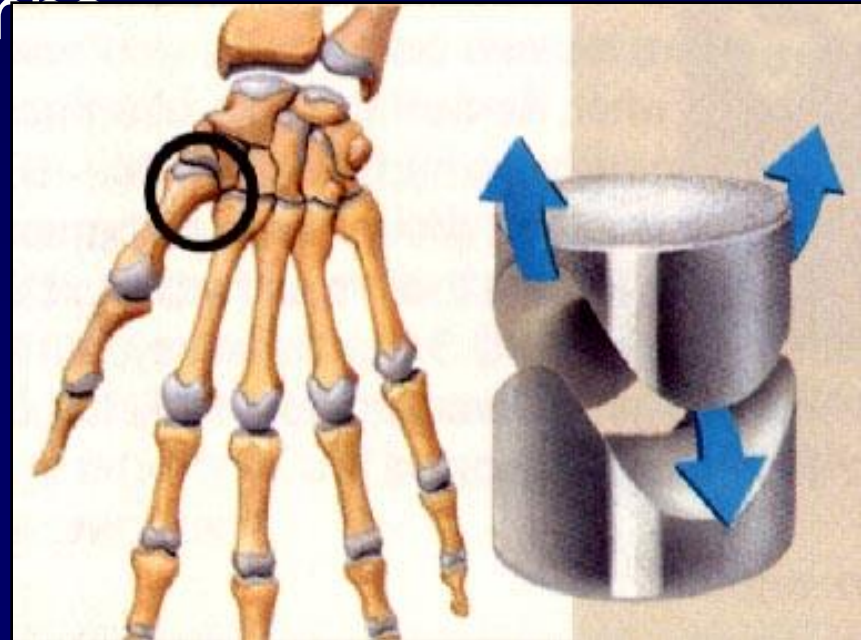
- 2 'flat' surfaces glide over one another
- sliding & twisting
- adjacent vertebrae



Types of synovial joints

f) Saddle

- articulating surfaces are concave AND convex
- articulation b/w 1st metacarpal and carpal (trapezium)
- basis for opposable thumb



JOINT DISORDERS

1) Sprains

-joint limits have been exceeded

-soft tissue damage (tendon, ligament, joint capsule)

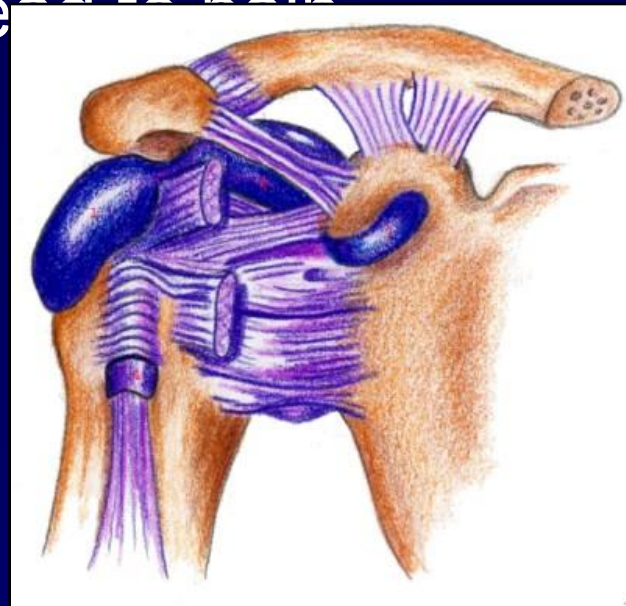
-R-I-C-E



JOINT DISORDERS

2) Bursitis

- inflammation of bursa (synovial membrane)
- common friction is high (knee, elbow, shoulder).
- extra fluid is produced = inflammation
- if chronic, Ca^{++} deposits can lead to pain and stiffness



JOINT DISORDERS

3) Arthritis

- Inflamed joints, many different causes.
- Rheumatoid arthritis is an autoimmune disease.



JOINT DISORDERS

3) Arthritis

- Osteoarthritis: joint degradation with age. Painful joints, and deposition of excess bone at joints (nodules)



JOINT DISORDERS

3) Arthritis

- Gout: deposition of uric acid in joints. Painful joints, swelling, especially in toes and fingers.



END of ARTICULATIONS