

Gross Anatomy and Embryology of the Joints

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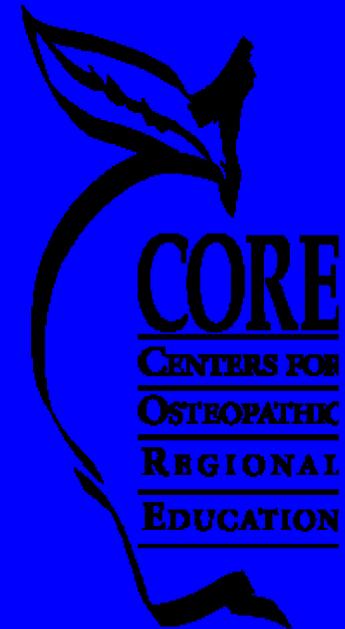
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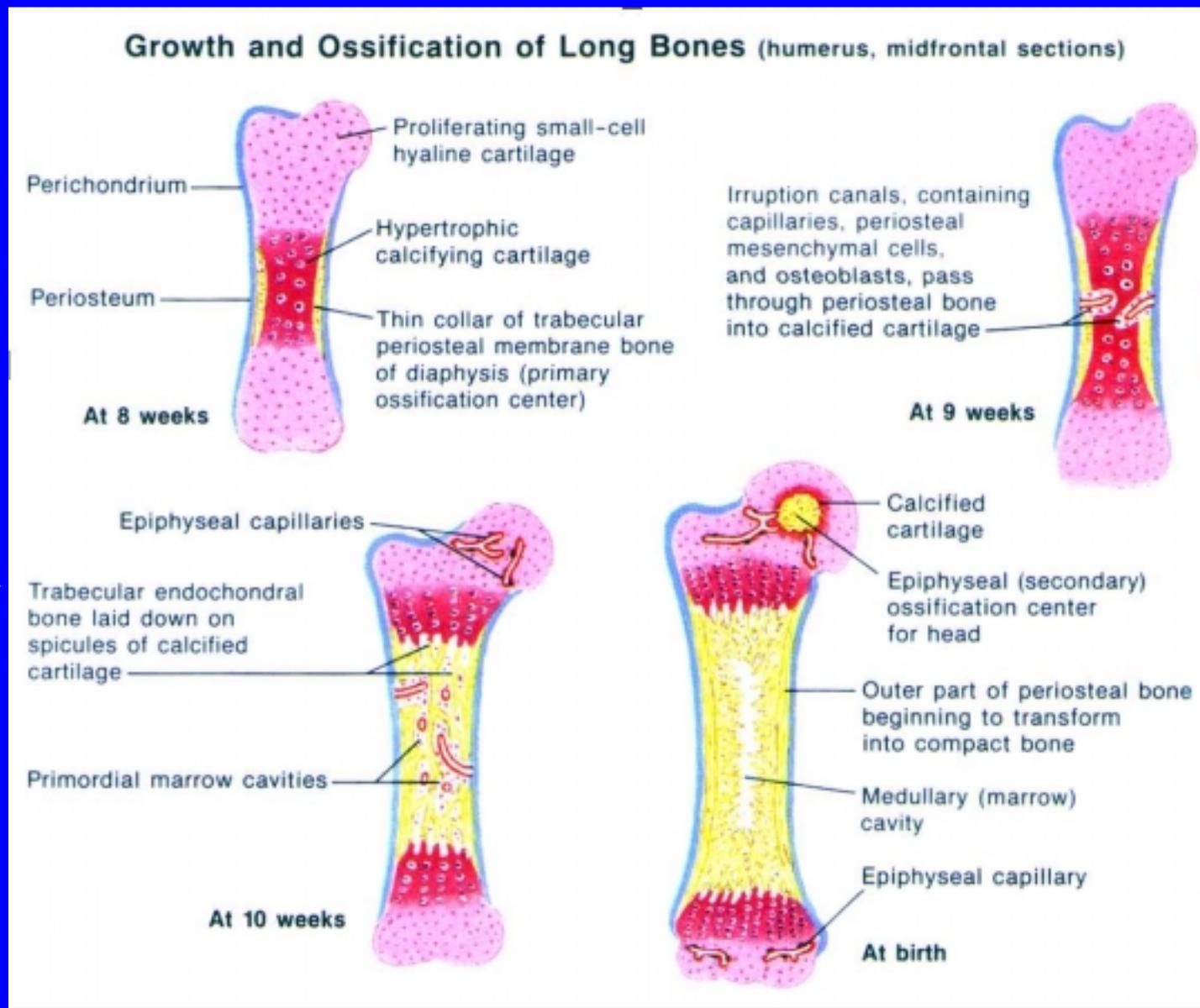
Ossification, Growth, and the Epiphyseal Plate

Bone Formation:

- Intramembranous
- Endochondral

Endochondral:

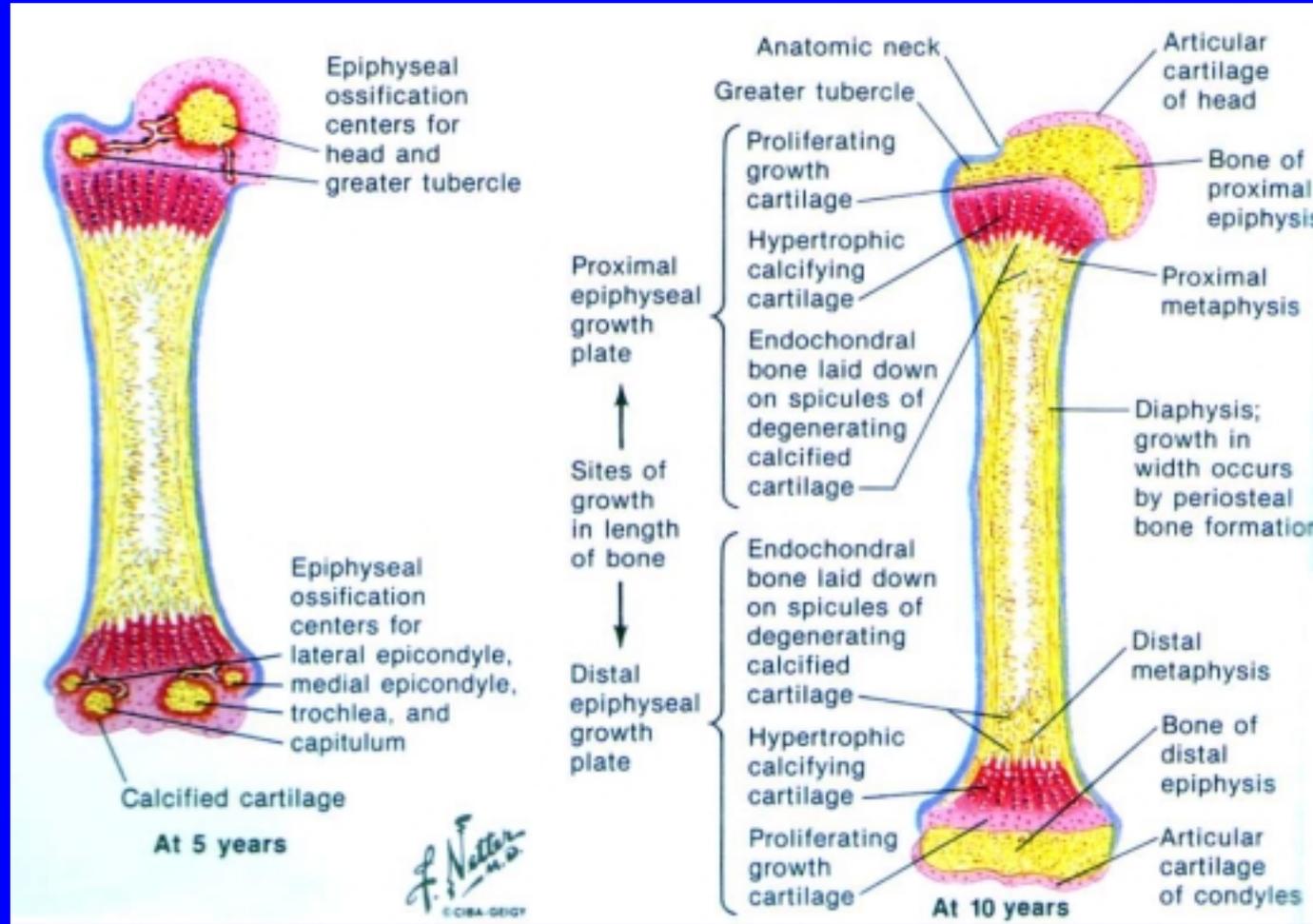
- Hyaline cartilage precursor
- Primary center in diaphyseal collar
- Secondary center in epiphysis
- Epiphyseal plate: betw. epiphysis and diaphysis



Ossification, Growth, and the Epiphyseal Plate

Epiphyseal plate:

- aka growth plate or physis
- Allows elongation
- Chondrocytes proliferate on epiphys. side
- Hypertrophy & calcification progressively towards the diaphyseal side
- Ossification within the metaphysis
- Growth ceases with fusion of epiphysis and diaphysis, obliterating the growth plate

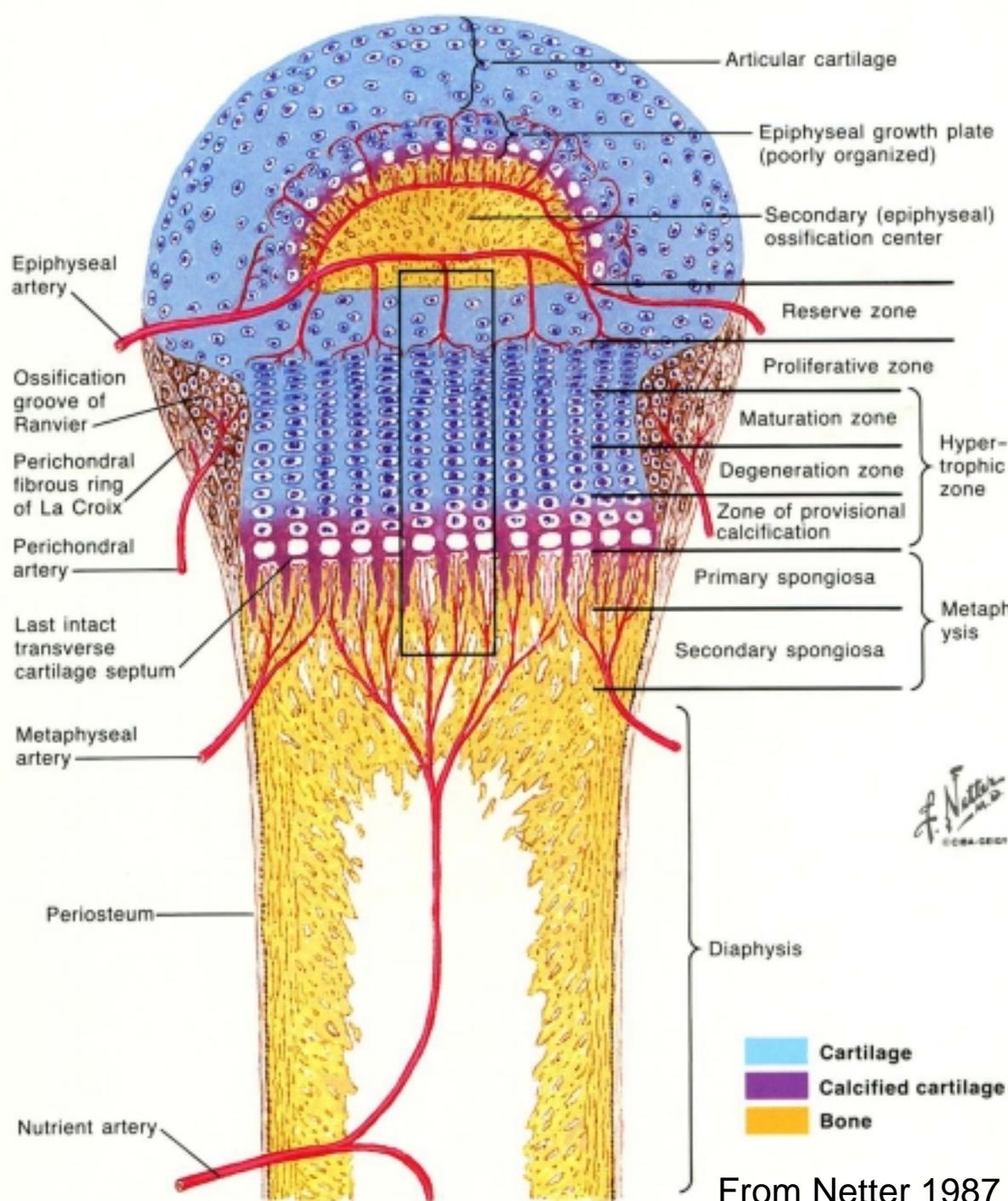


From Netter 1987

Epiphyseal Plate (= *Physis*)

Epiphyseal plate:

- Epiphyseal cartilage has its own vascular supply
- Chondrocytes proliferate on epiphyseal side
- Hypertrophy & calcification progressively towards the diaphyseal side
- Ossification within the metaphysis



fetal

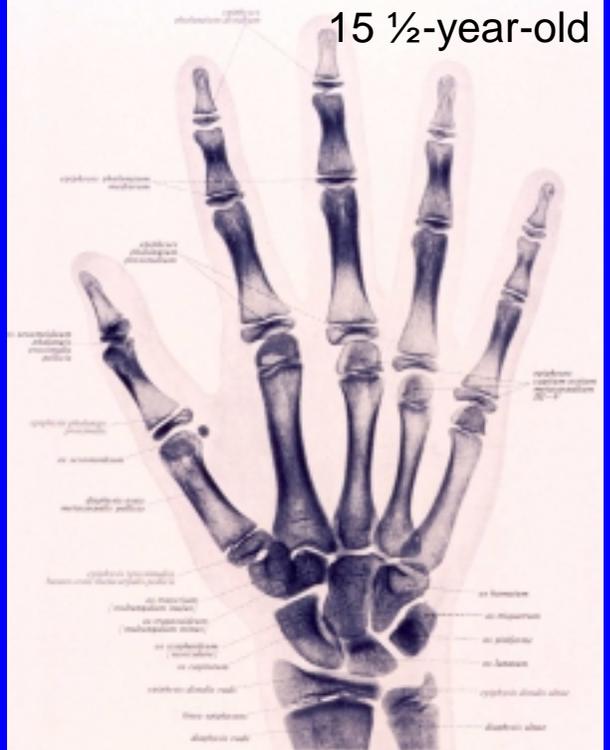


Examples of Normal Epiphyseal Plate Development and Fusion

5 1/2-year-old



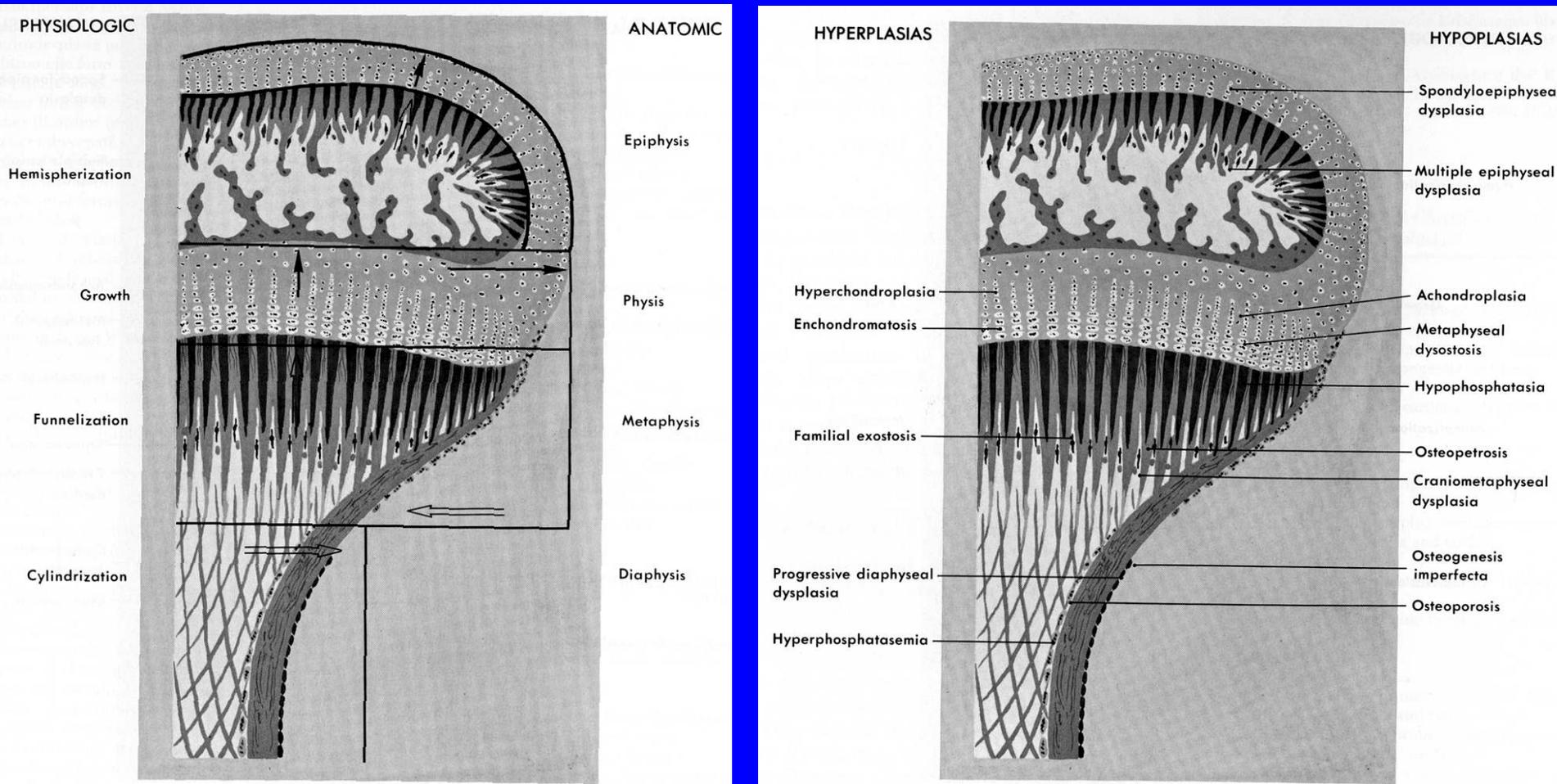
15 1/2-year-old



adult

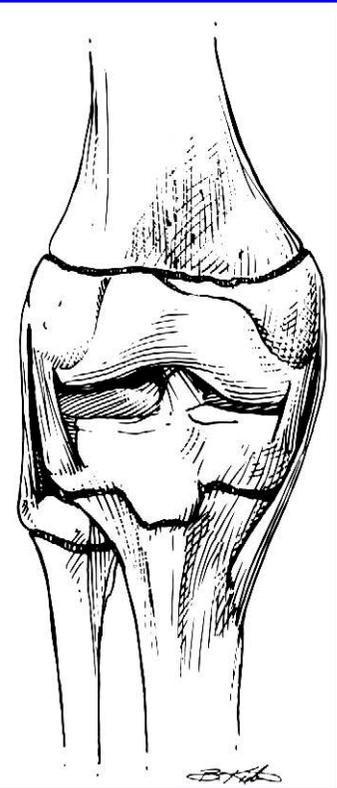


Epiphyseal Plate Development and Bone Dysplasias



From Tachdjian (1990)

Epiphyseal Fractures



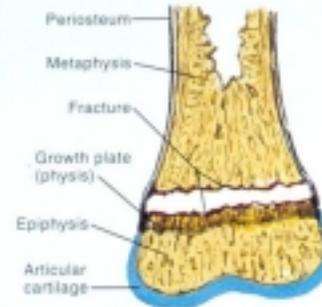
“Physis in danger”

- Epiphyses located at joints (i.e., sites of stress, motion)
- Epiphyses are attachment sites for muscles and ligaments
- Growth plate is “weak link”
- Growth plate is particularly weak in torsion

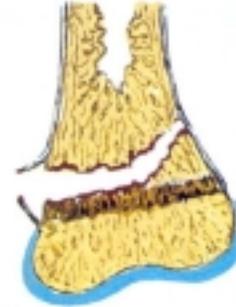
Salter-Harris Classification

- Type I: neonates
- Type II: 90% of growth plate fractures
- Types I & II heal well
- Other types may require open reduction and alignment; poorer prognosis

Injury to Growth Plate (Salter-Harris Classification, Rang Modification)



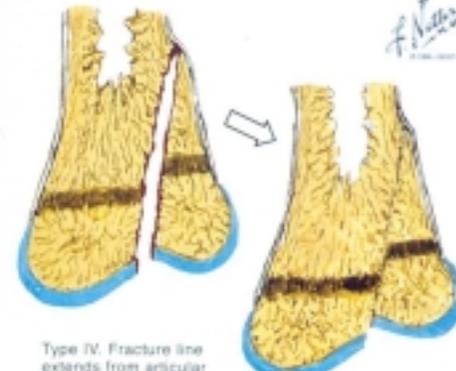
Type I. Complete separation of epiphysis from shaft through calcified cartilage (growth zone) of growth plate. No bone actually fractured; periosteum may remain intact. Most common in newborns and young children



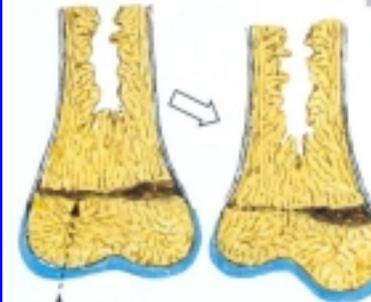
Type II. Most common. Line of separation extends partially across deep layer of growth plate and extends through metaphysis, leaving triangular portion of metaphysis attached to epiphyseal fragment



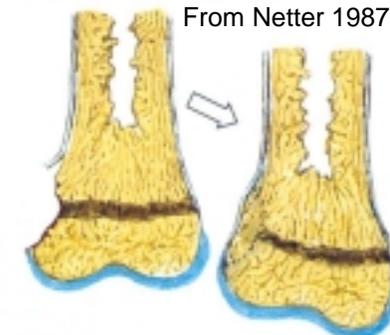
Type III. Uncommon. Intra-articular fracture through epiphysis, across deep zone of growth plate to periphery. Open reduction and fixation often necessary



Type IV. Fracture line extends from articular surface through epiphysis, growth plate, and metaphysis. If fractured segment not perfectly realigned with open reduction, osseous bridge across growth plate may occur, resulting in partial growth arrest and joint angulation



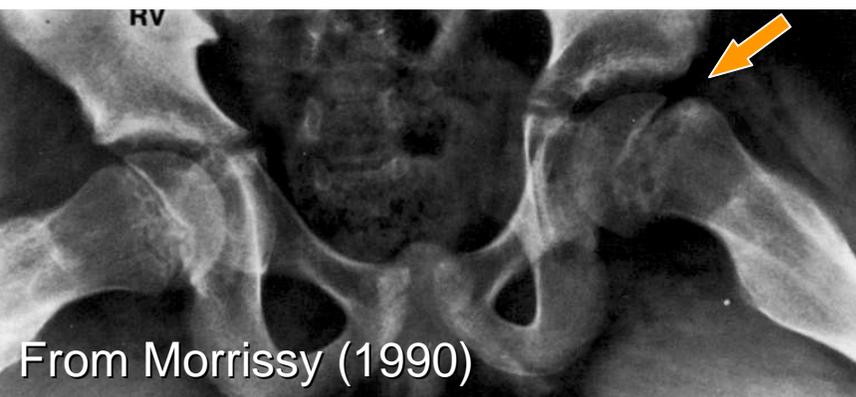
Type V. Severe crushing force transmitted across epiphysis to portion of growth plate by abduction or adduction stress or axial load. Minimal or no displacement makes radiographic diagnosis difficult; growth plate may nevertheless be damaged, resulting in partial growth arrest or shortening and angular deformity



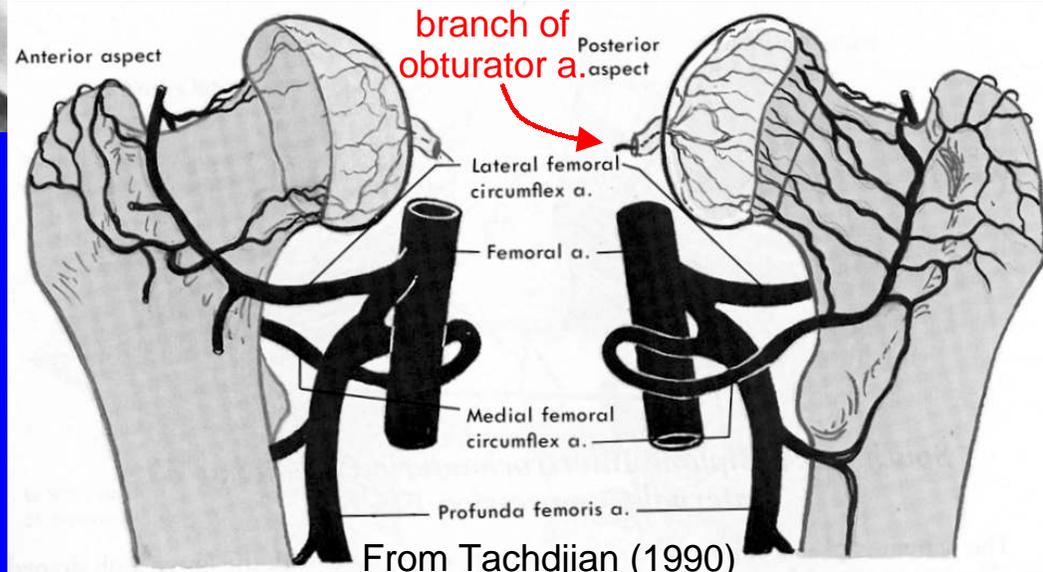
Type VI. Portion of growth plate sheared or cut off. Raw surface heals by forming bone bridge across growth plate, limiting growth on injured side and resulting in angular deformity

From Netter 1987

Slipped Capital Femoral Epiphysis (SCFE)



- Slippage of epiphysis relative to neck & remainder of femur
- Most common adolescent hip disorder
- Etiology unknown—endocrine factors implicated
- Four different classes of SCFE
- Hip is externally rotated (particularly on flexion); little internal rotation possible



Complication: avascular necrosis of epiphysis due to compression of retinacular blood vessels

From Tachdjian (1990)

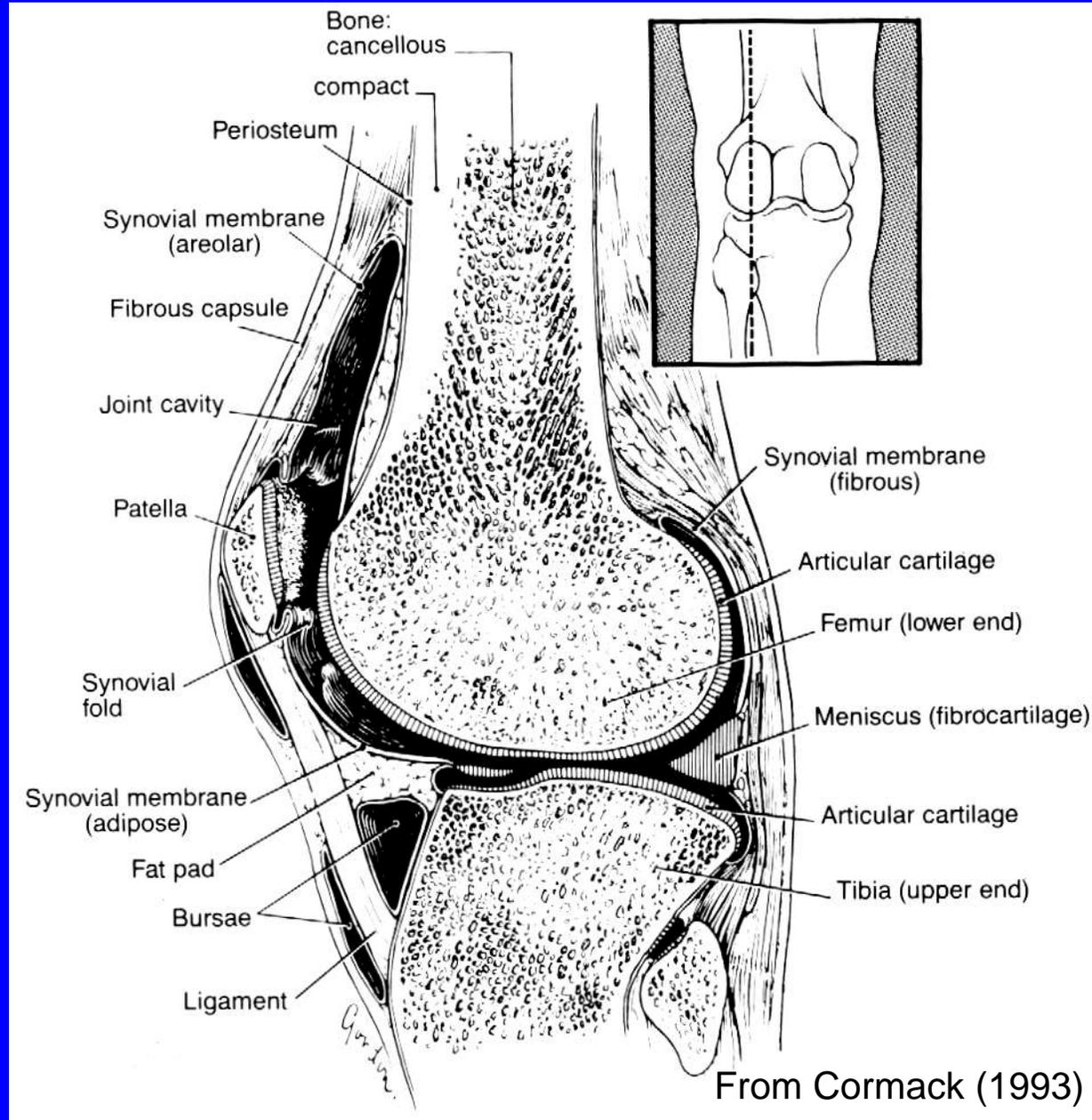
Joint and their General Structure

Joint Types:

- Fibrous: skull bones
- Cartilaginous: pubic symphysis
- **Synovial**: knee, etc.

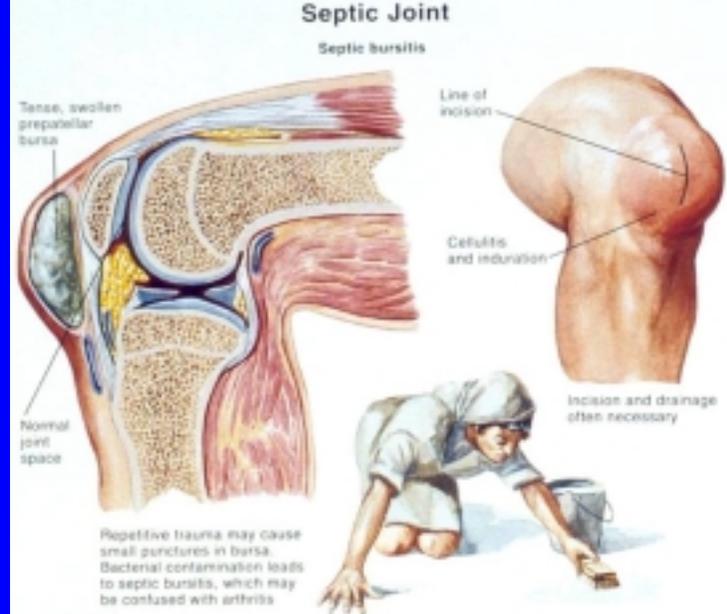
Anatomical Structures:

- Fibrous capsule
- Synovial membrane
 - Highly vascular
 - Doesn't cover art. cart.
 - Fibrous, areolar, fatty regions
- Intrinsic & extrinsic ligg.
- Articular cartilage: hyaline, avascular
- Articular discs & menisci: fibrocartilage
- Bursae: may or may not communicate w/ jt. cav.

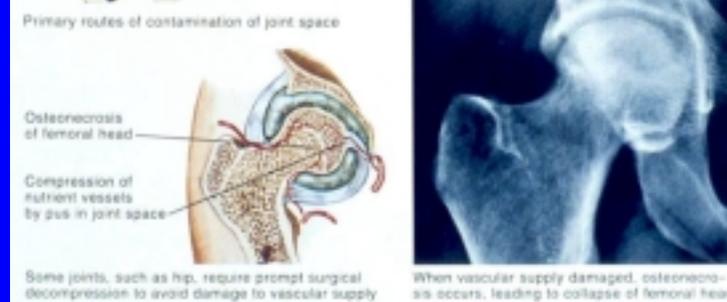
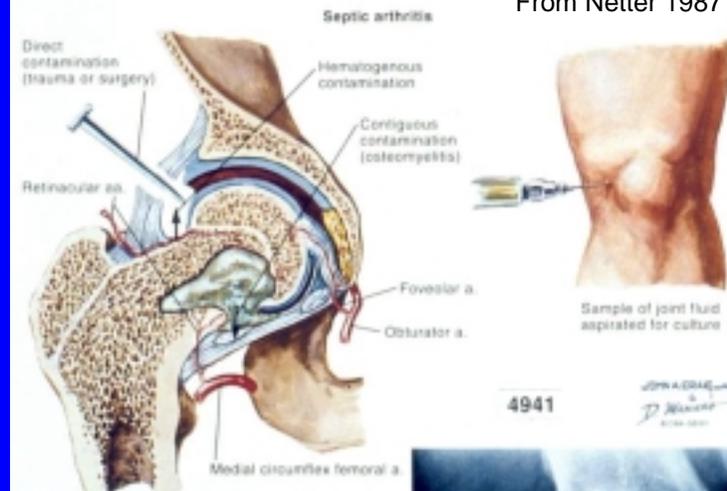


Joint Spaces & Infection

- Knowledge of communication of synovial spaces around a joint is relevant for understanding source & spread of infection
- Septic bursitis: may or may not involve main joint cavity, depending on communications
- Septic arthritis
 - Source: trauma, surgery, hematogenous, osteomyelitis
 - Hematogenous septic arthritis of hip
 - Prevalent in children
 - Dangerous: pus accumulation leads to high intracapsular pressures, compressing retinacular vessels and leading to CFE necrosis



From Netter 1987

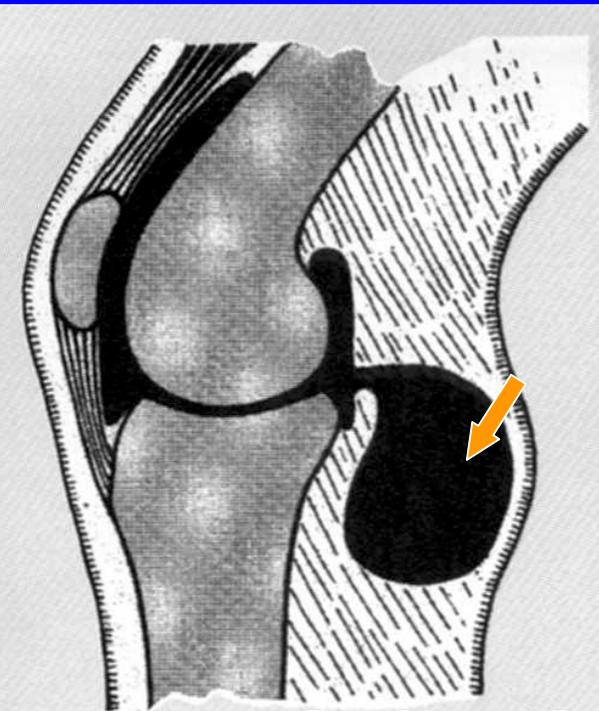


Popliteal (Baker's) Cyst

- More common in children (boys)
- Sources
 - Distention of bursae (gastroc. or semimembranosus)
 - Herniation of synovial membr. thru posterior capsule
- Secondary to chronic knee joint effusion



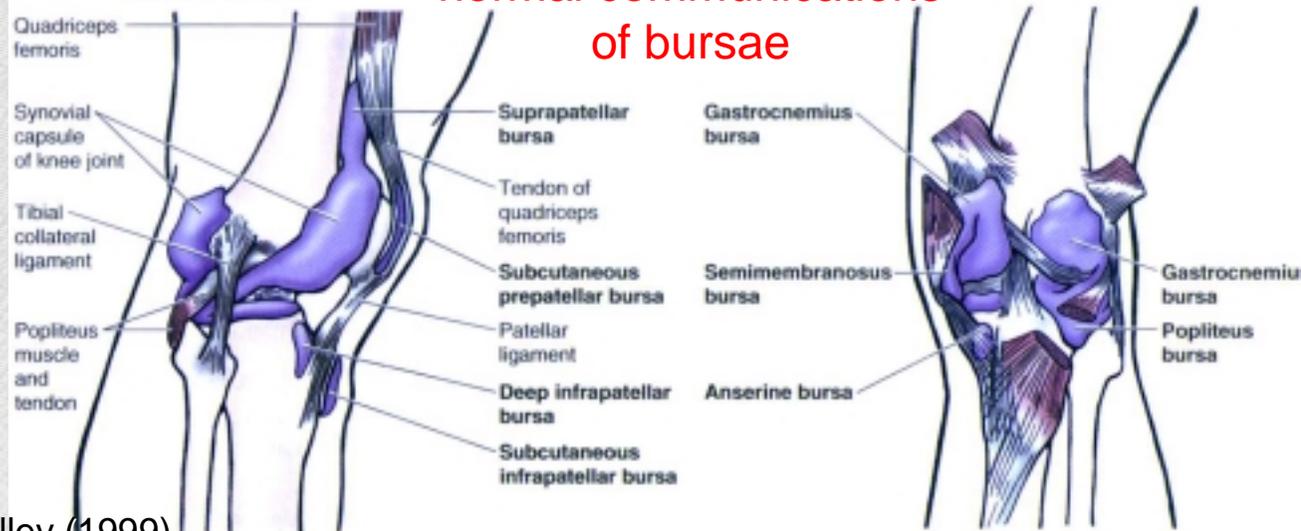
From Tachdjian (1990)



From Moore & Dalley (1999)

Popliteal cyst

Table 5.15. Bursae of the Knee



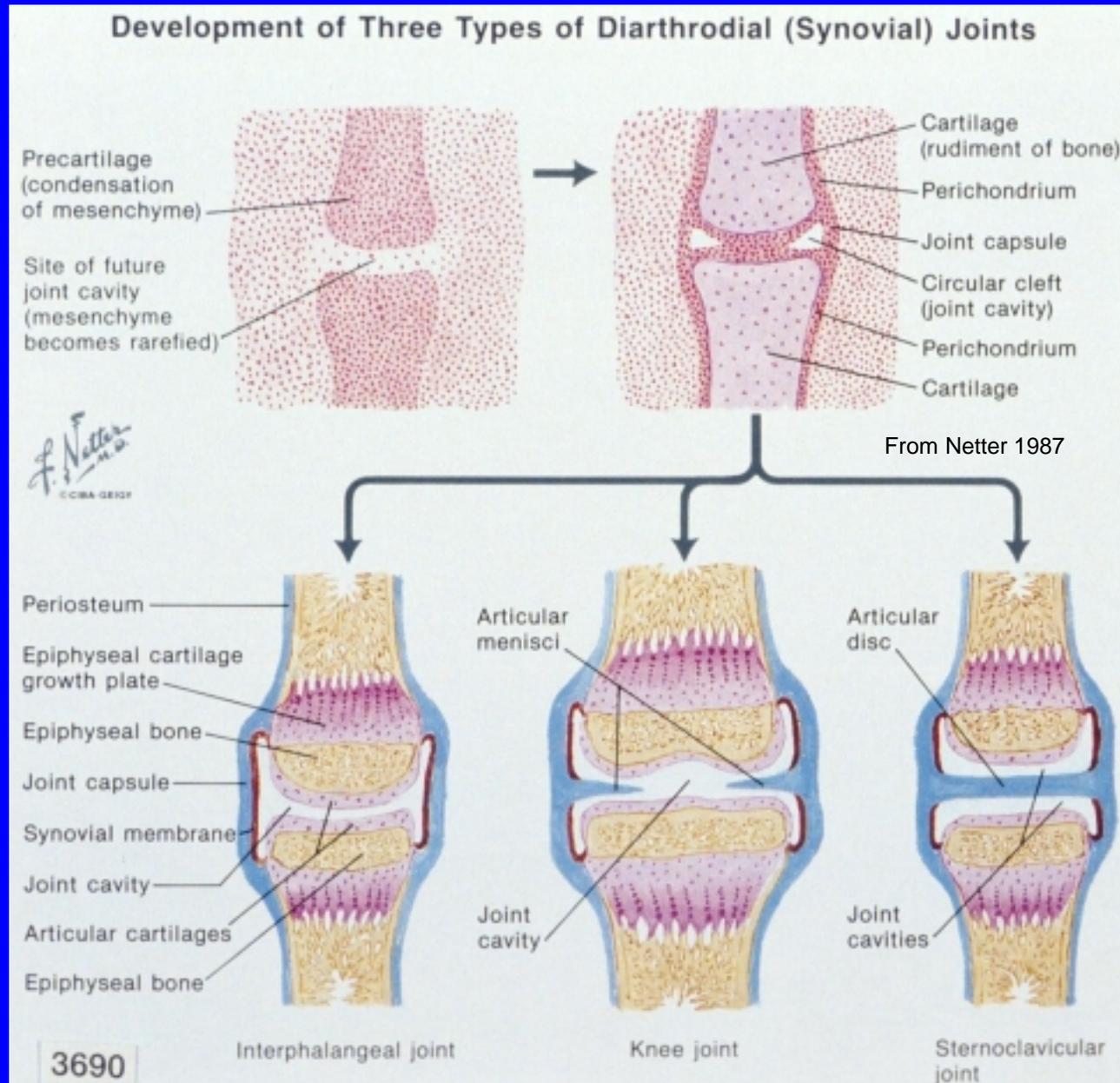
normal communications
of bursae

(A) Lateral view

(B) Posterior view

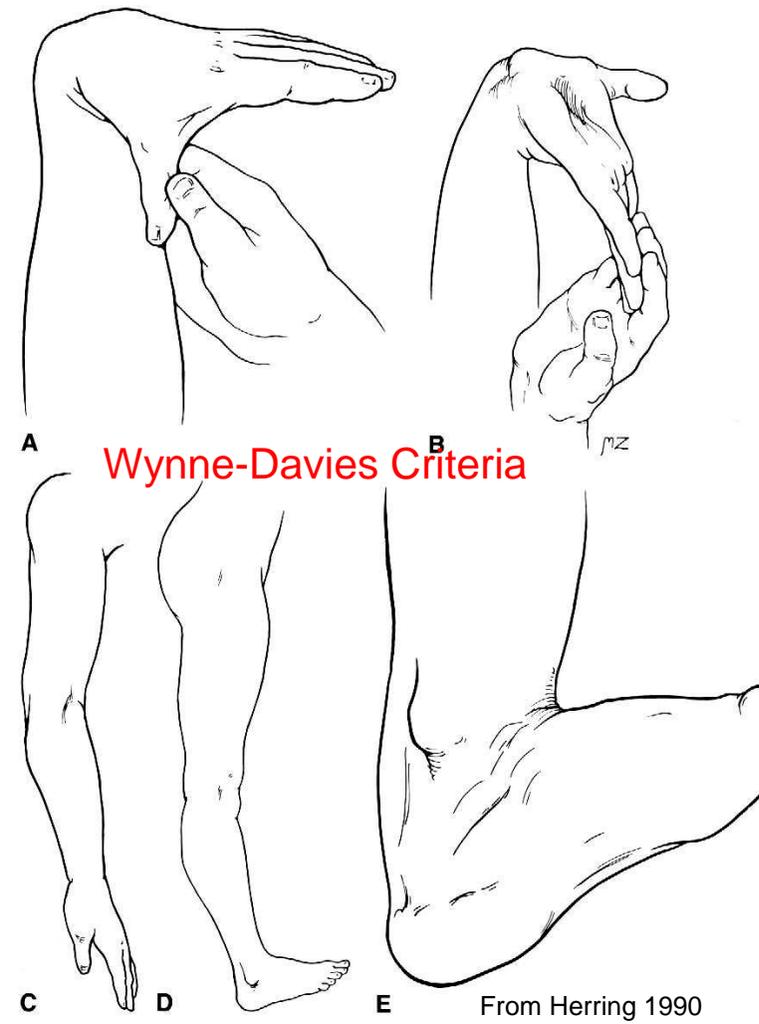
Development of Joints

- Originally, mesenchyme of bone rudiments are continuous
- Joint cavity appears by programmed cell death
- Fibrous capsule remains continuous with perichondrium
- Original cartilage of rudiment remains as the articular cartilage
- Fate of intracapsular mesenchyme:
 - Resorbed: simple joint cavity
 - Complete fibrous sheet: articular disc
 - Incomplete fibrous sheet: menisci



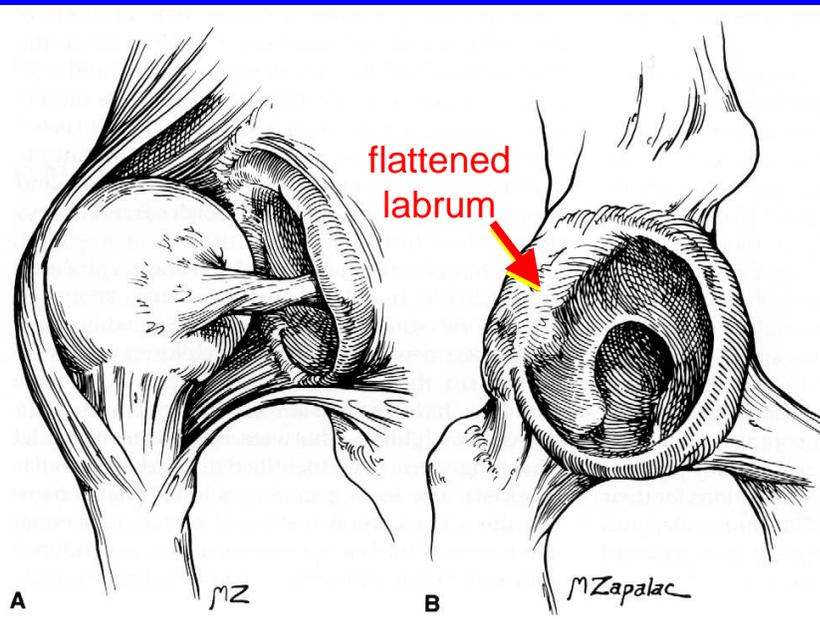
Laxity of Joints

- Ligamentous laxity: looseness of fibrous capsule
- Generalized ligamentous laxity: fairly common and variable in extent
- Ehlers-Danlos Syndrome: rare; general soft-tissue laxity
- Perinatal ligamentous laxity: due to circulating maternal hormones

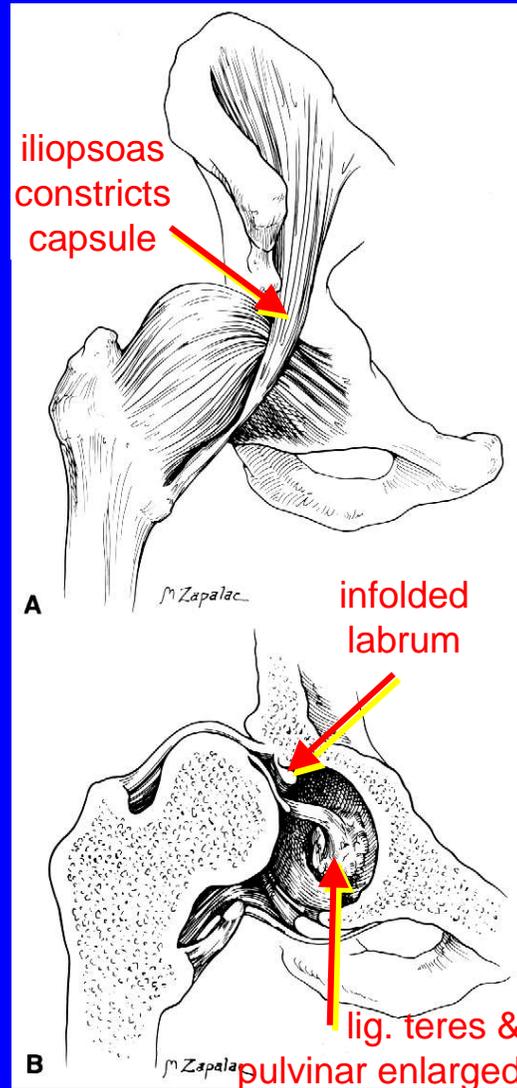


Developmental Dysplasia of the Hip (DDH)

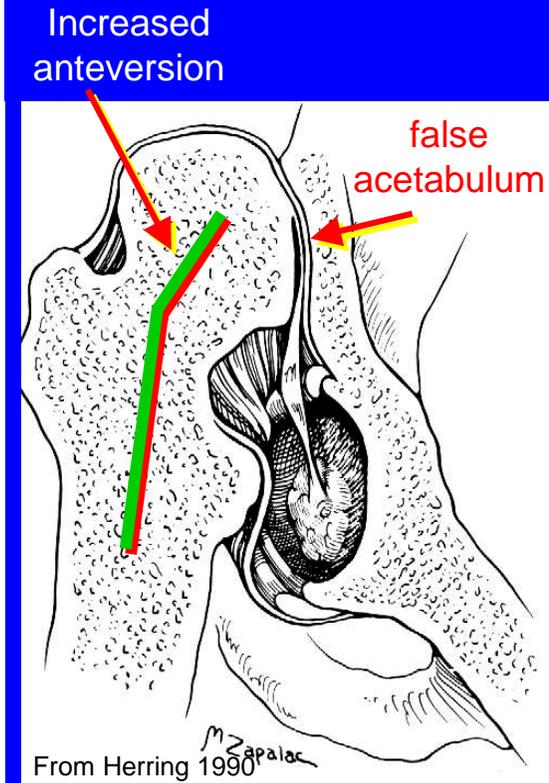
- a.k.a. congenital dislocation of the hip (CDH)
- Anatomical progression



Unstable hip of newborn



Established dislocation



Long-term dislocation

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