Gross Anatomy and Embryology of the Joints

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Lawrence M. Witmer, PhD
Department of Biomedical Sciences
College of Osteopathic Medicine
Ohio University
Athens, Ohio 45701
witmer@exchange.oucom.ohiou.edu

CORE
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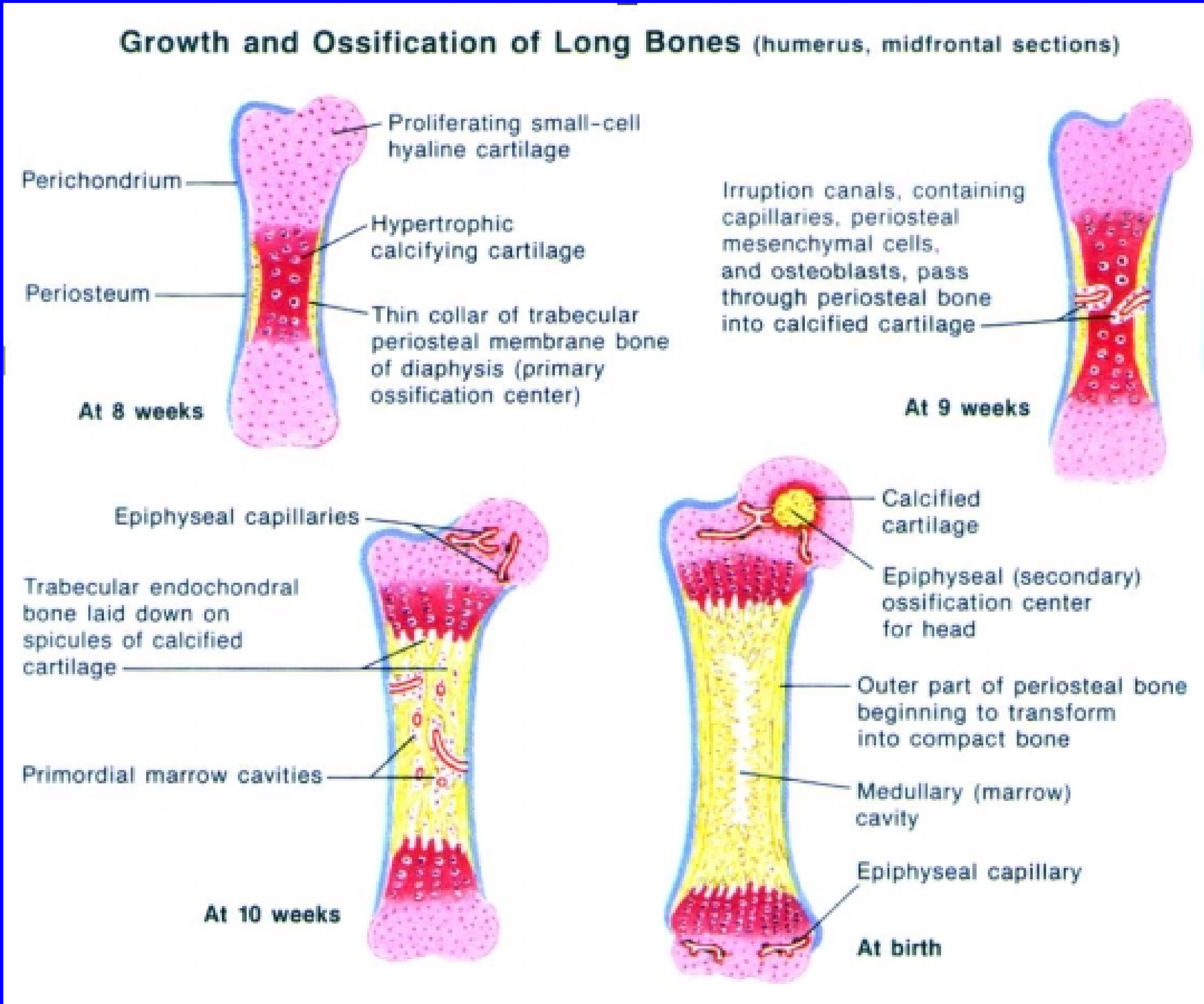
Ossification, Growth, and the Epiphyseal Plate

Bone Formation:
- Intramembranous
- Endochondral

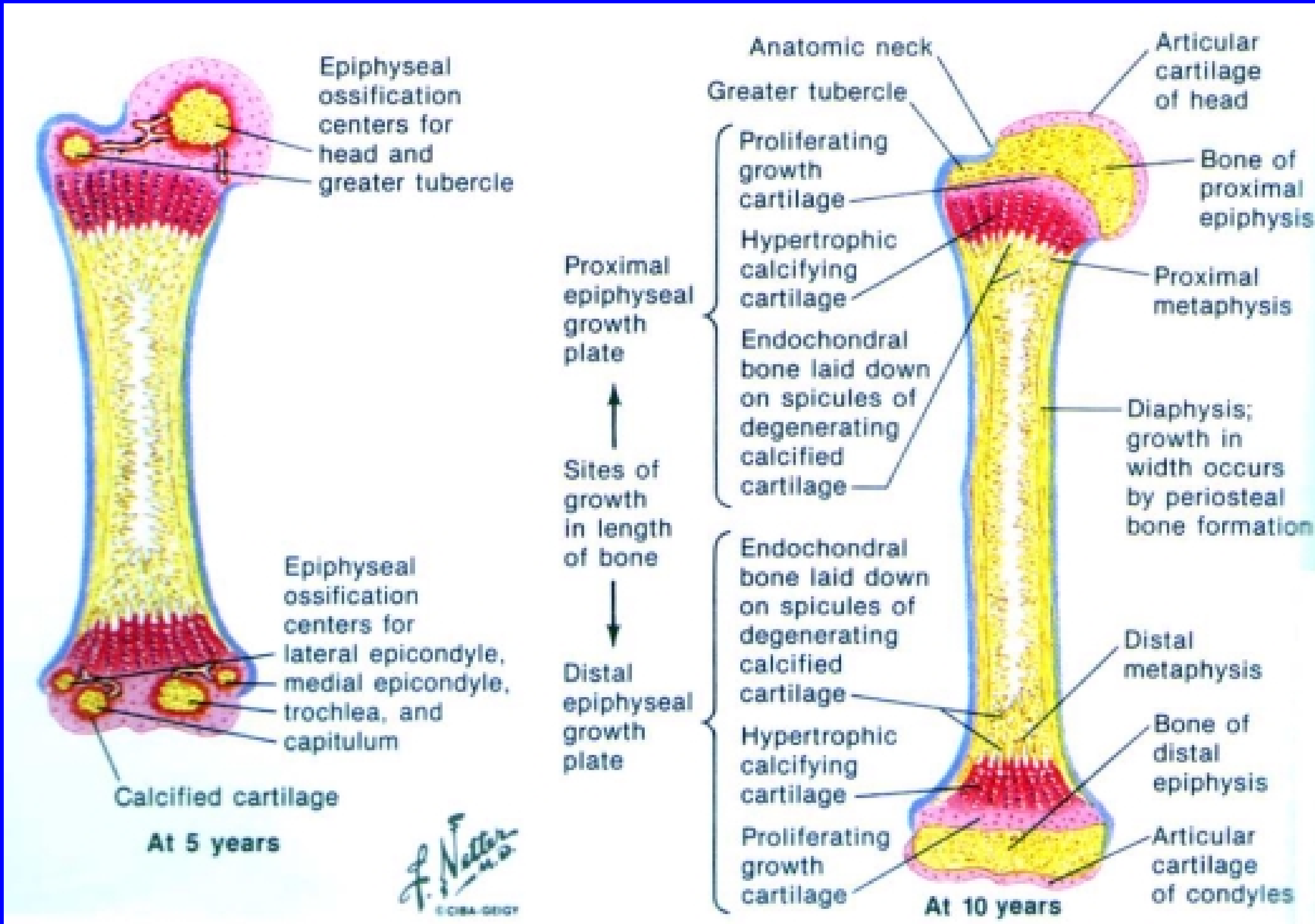
Endochondral:
- Hyaline cartilage precursor
- Primary center in diaphyseal collar
- Secondary center in epiphysis
- Epiphyseal plate: betw. epiphysis and diaphysis



From Netter 1987

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

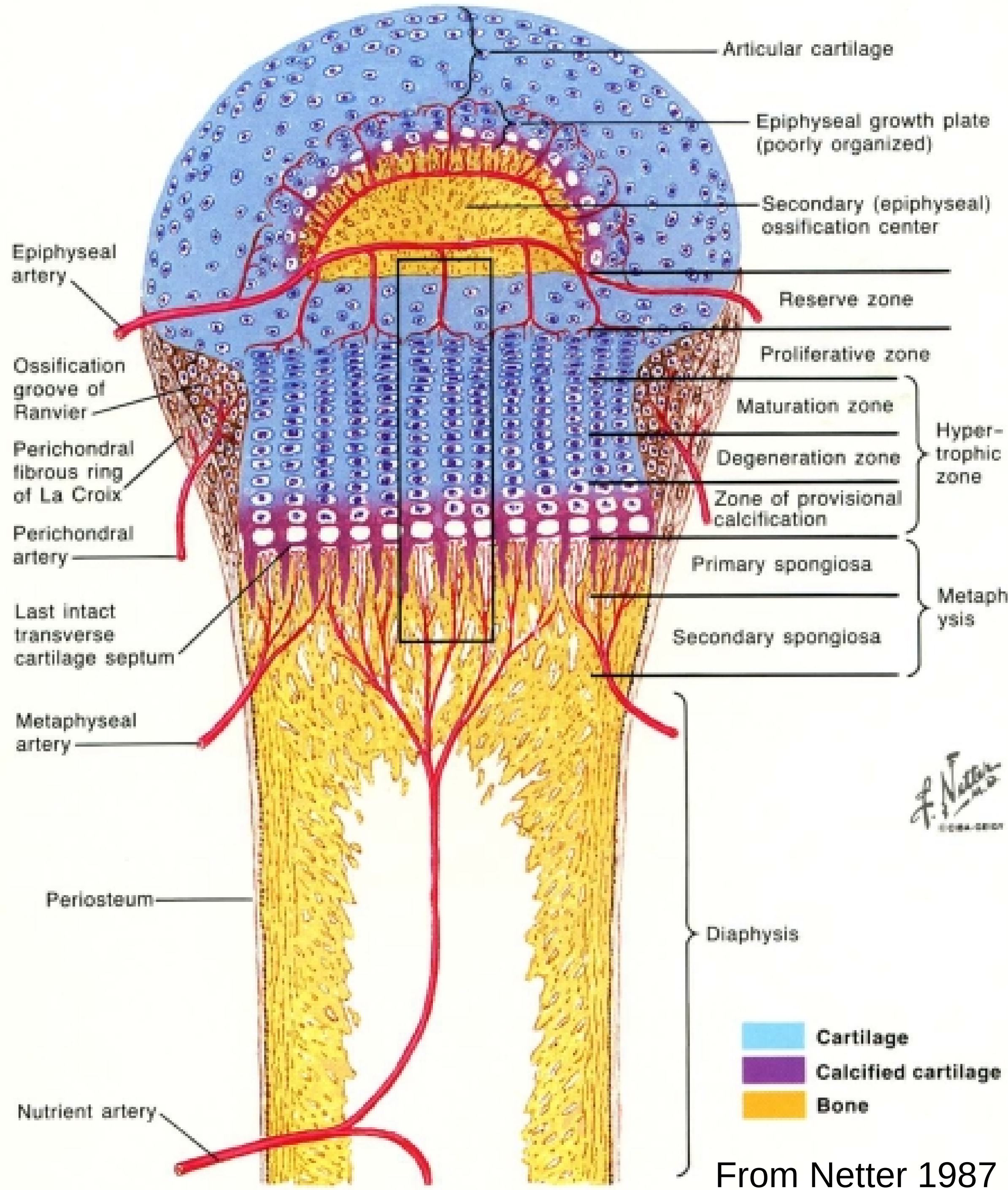


From Netter 1987

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



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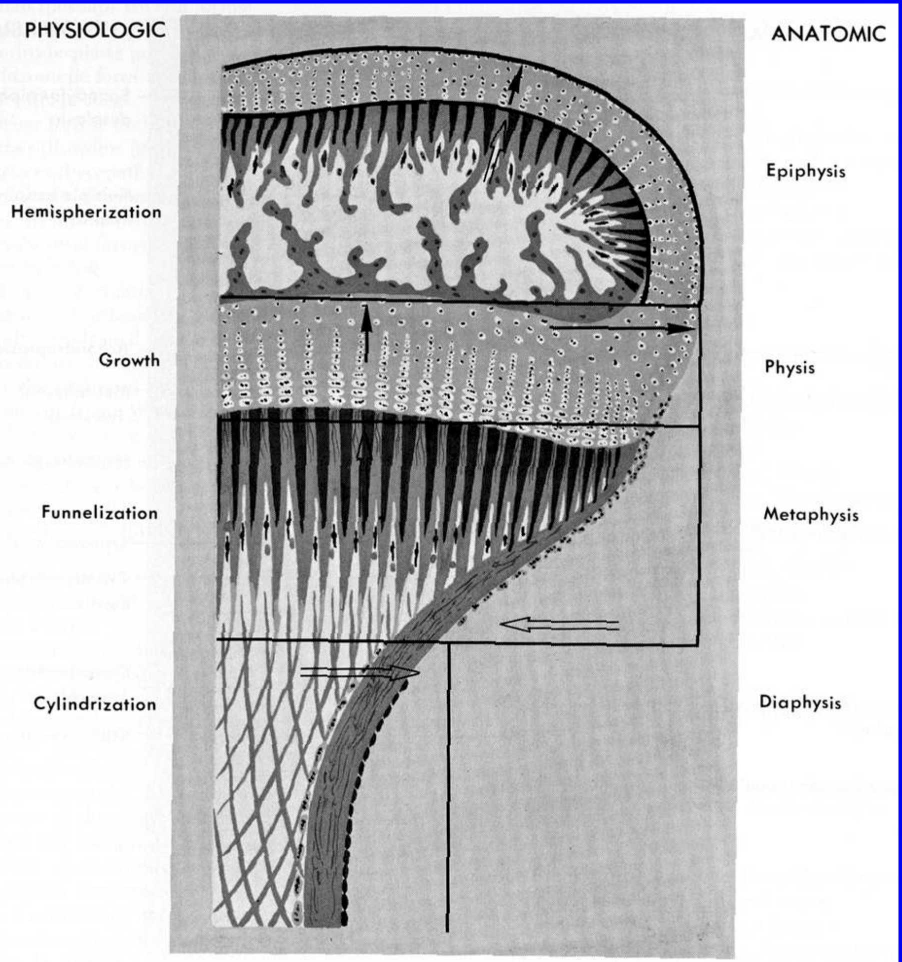
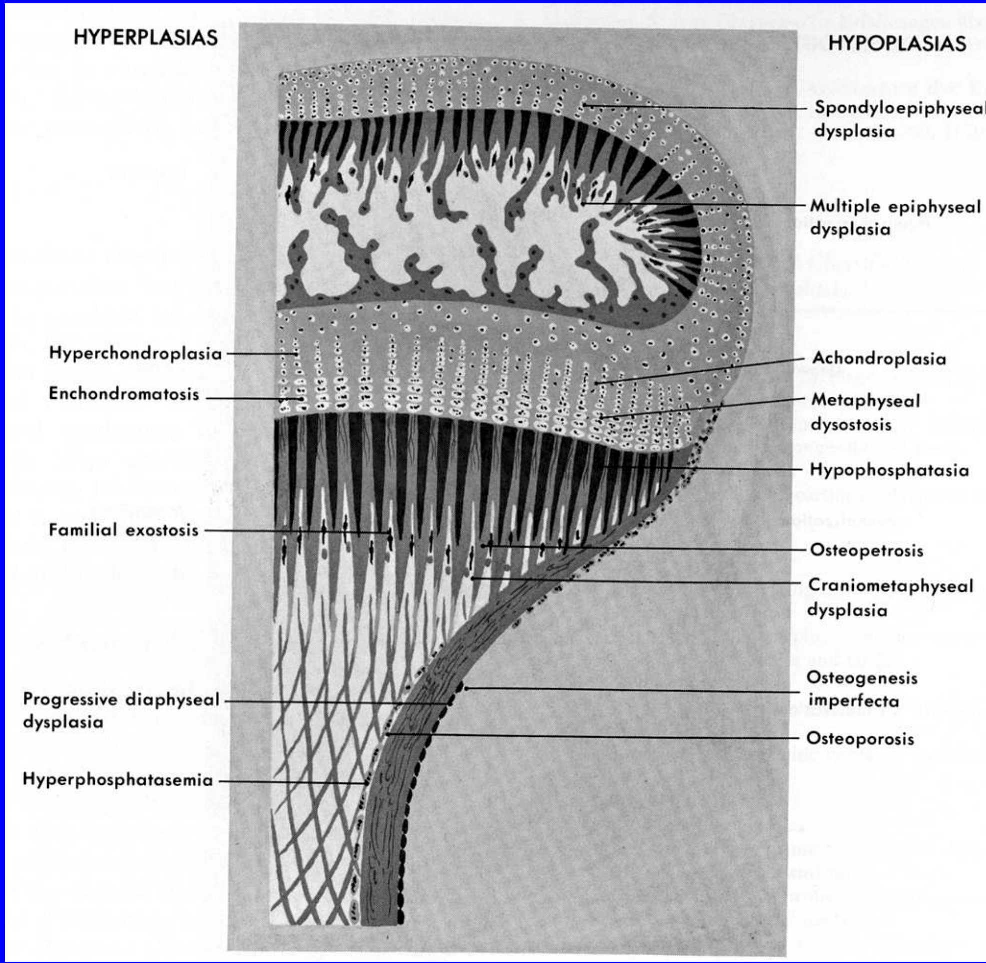
Examples of Normal Epiphyseal Plate Development and Fusion

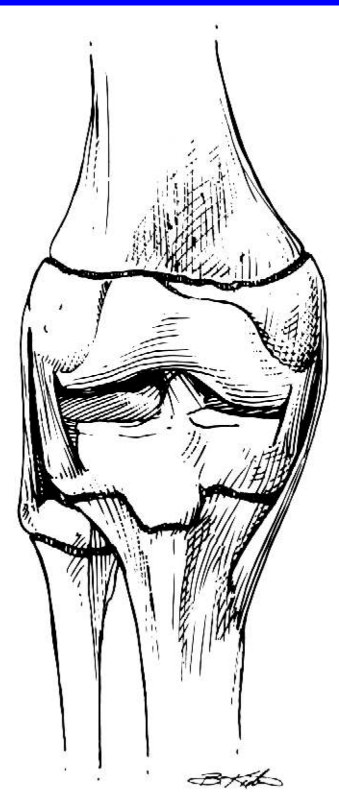
Epiphyseal Plate Development and Bone Dysplasias





From Tachdjian (1990)

Epiphyseal Fractures



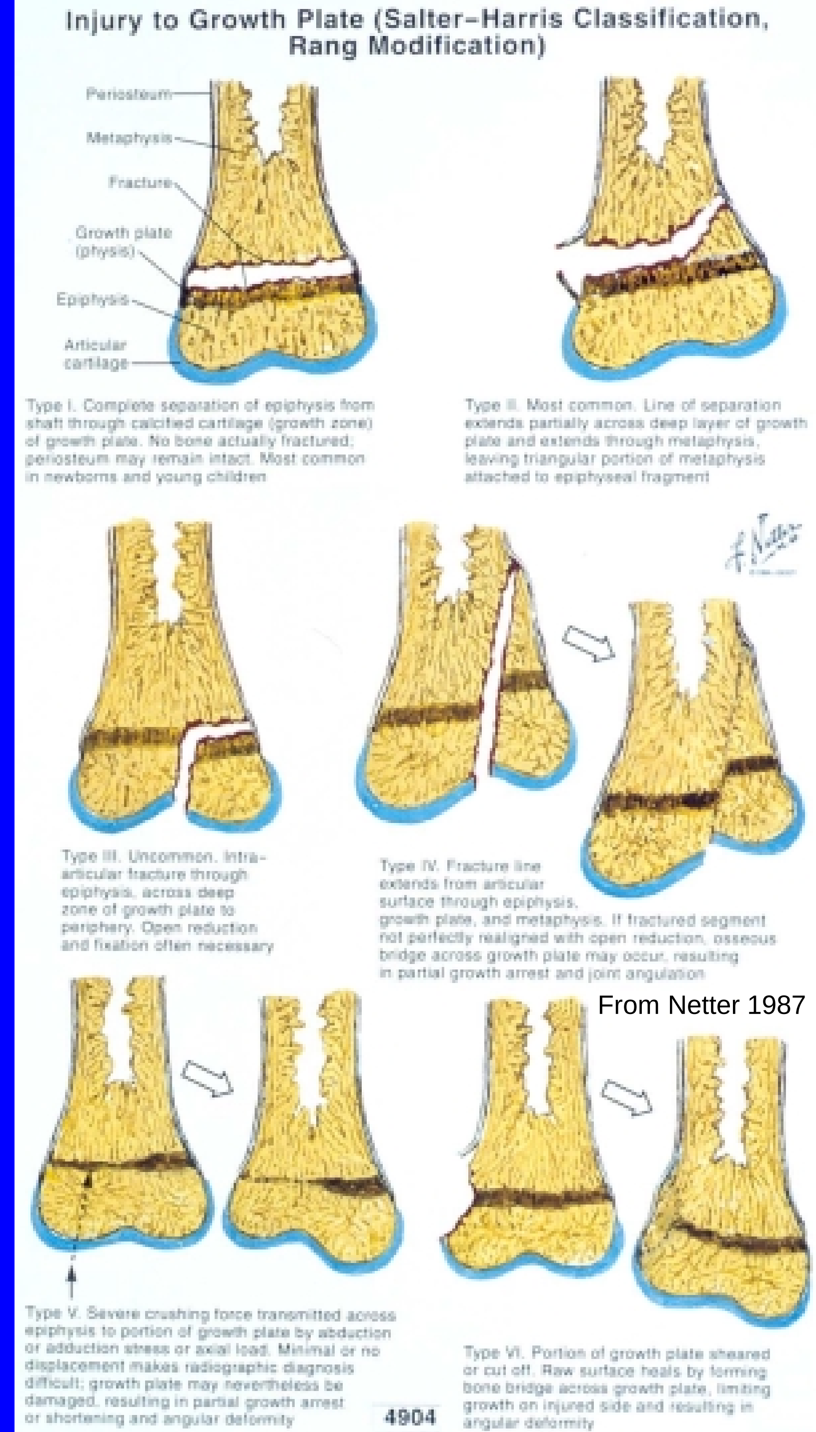
From Busch (1990)

"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

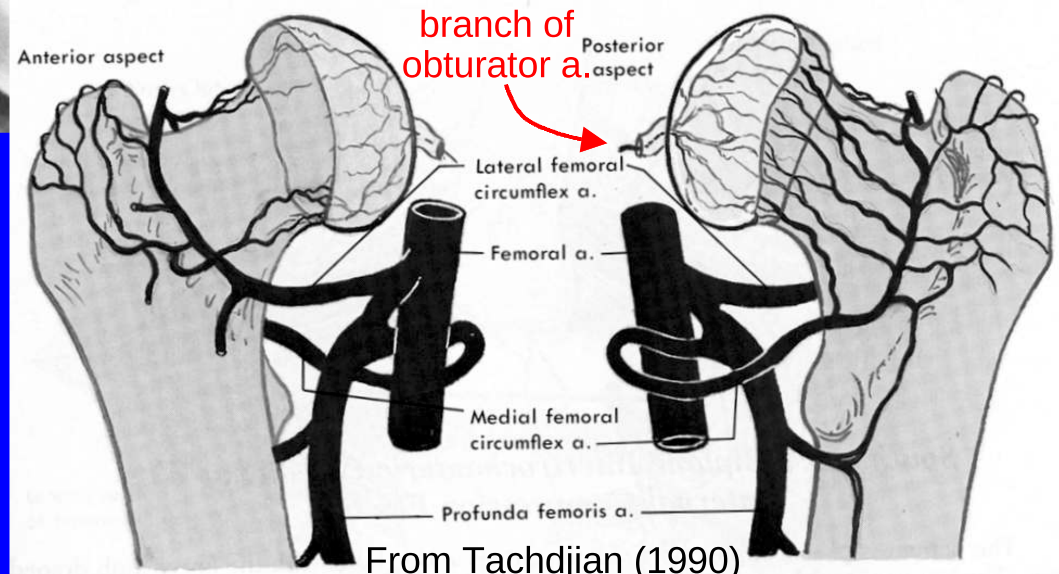


From Netter 1987

Slipped Capital Femoral Epiphysis (SCFE)

From Morrissy (1990)

- 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



From Tachdjian (1990)

<u>Complication:</u> avascular necrosis of epiphysis due to compression of retinacular blood vessels

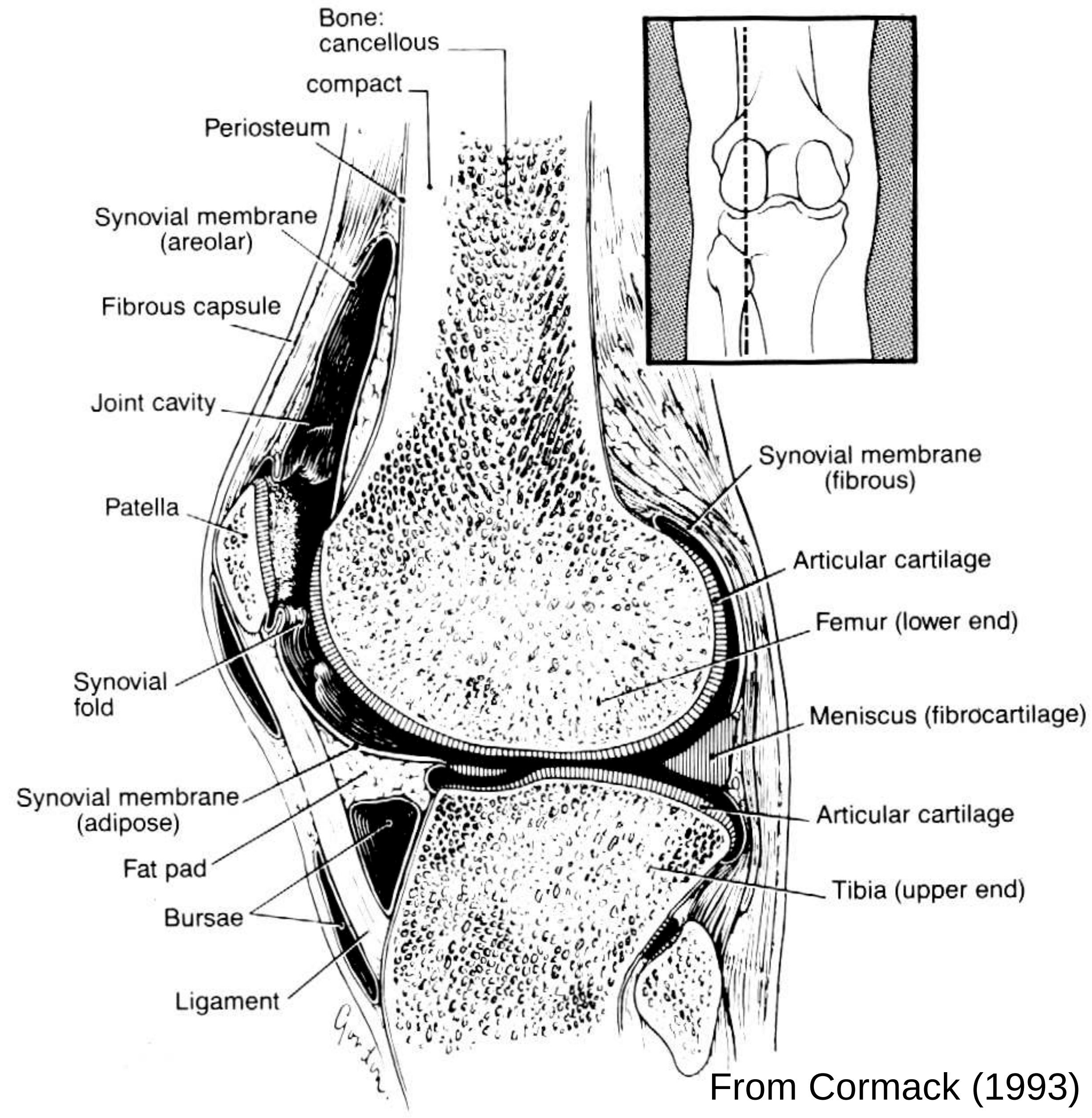
Joints and their General Structure

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.

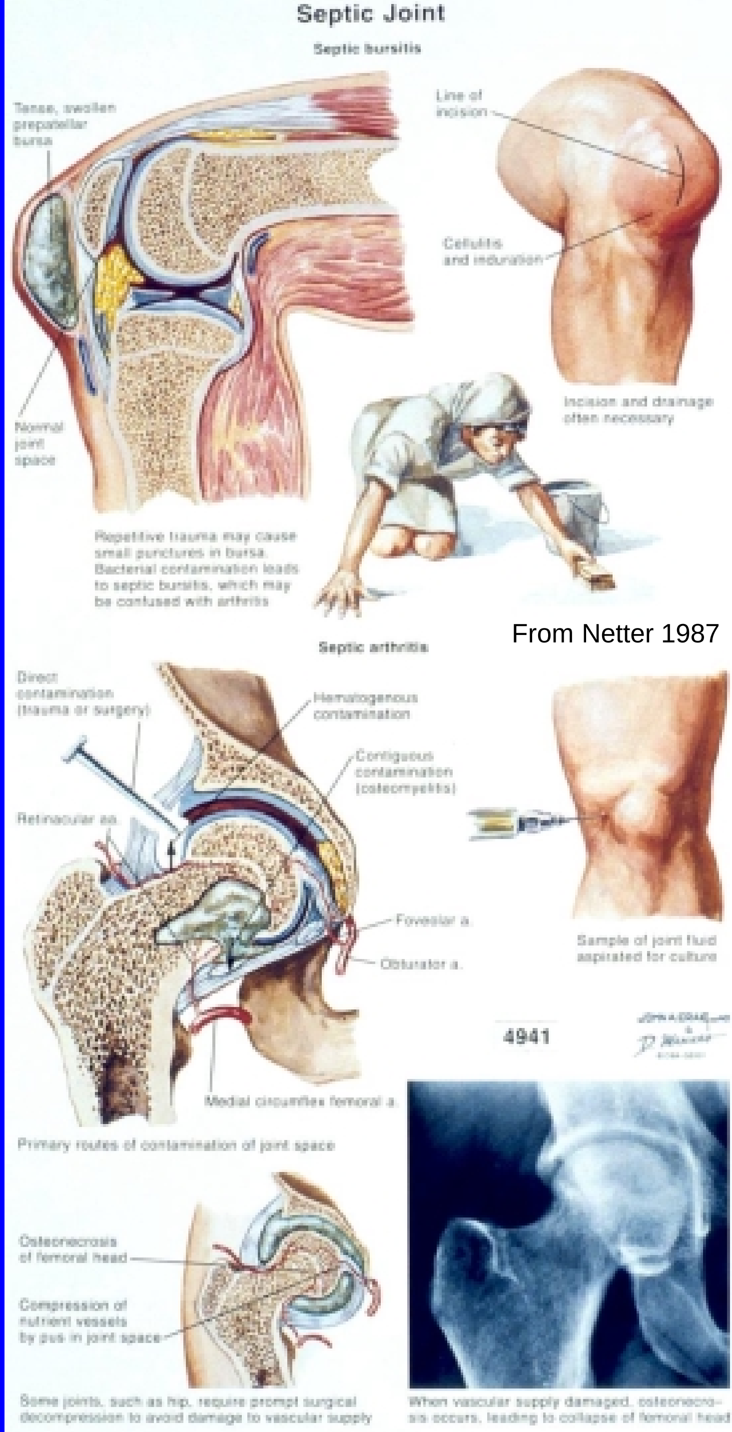


From Cormack (1993)

Joint Spaces & Infection

- Knowledge of communication of synovial spaces around a joint is relevant for understanding source & spread of infection

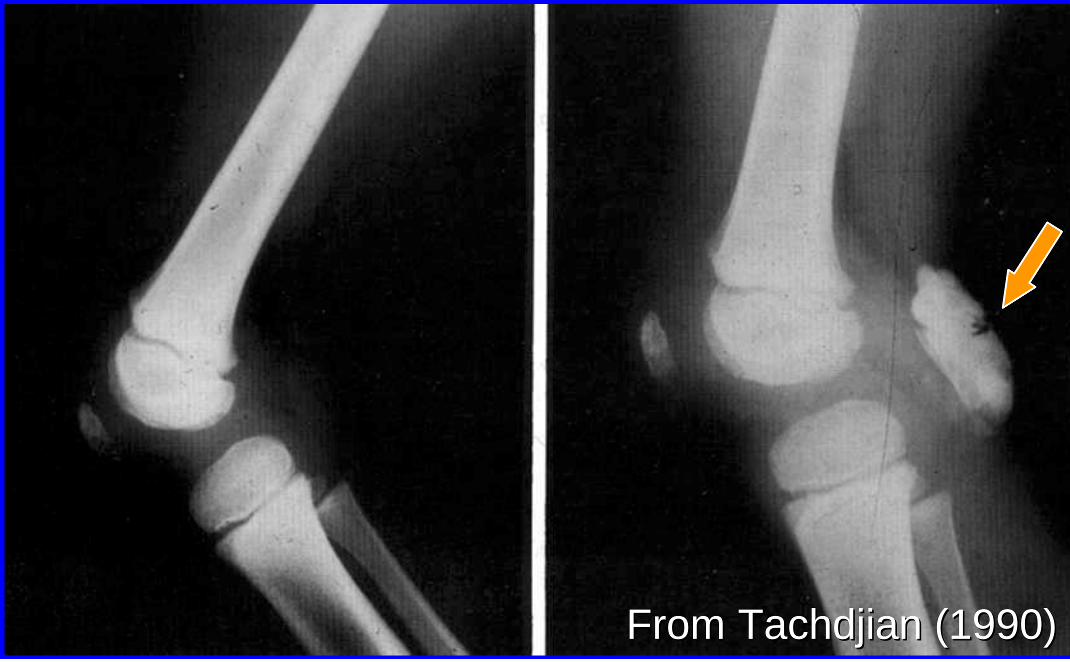
- Septic bursitis: may or may not involve main joint cavity, depending on communications
- Septic arthritis
  - Source: trauma, surgery, hematogenous, osteomyelitis
  - Hematogenous septic arthritis of hip
    - Prevalent in children
    - Dangerous: pus accumulation leads to high intracapsular pressures, 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



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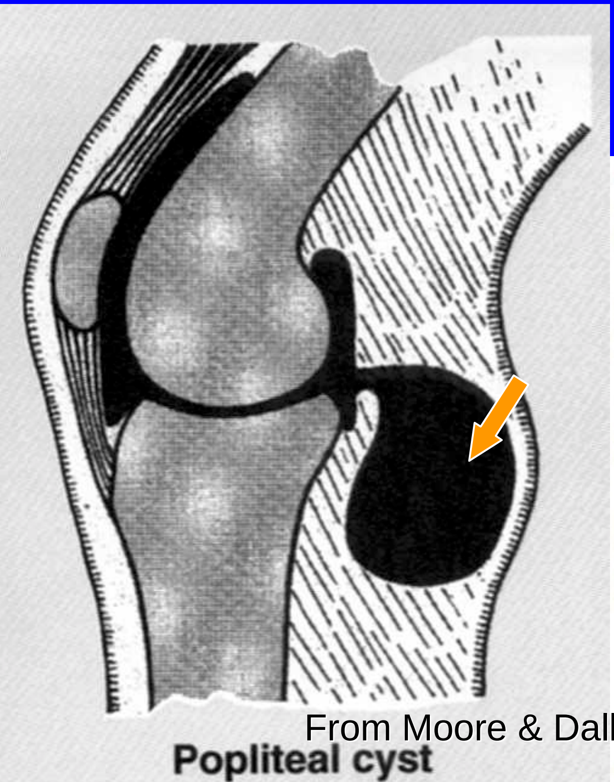
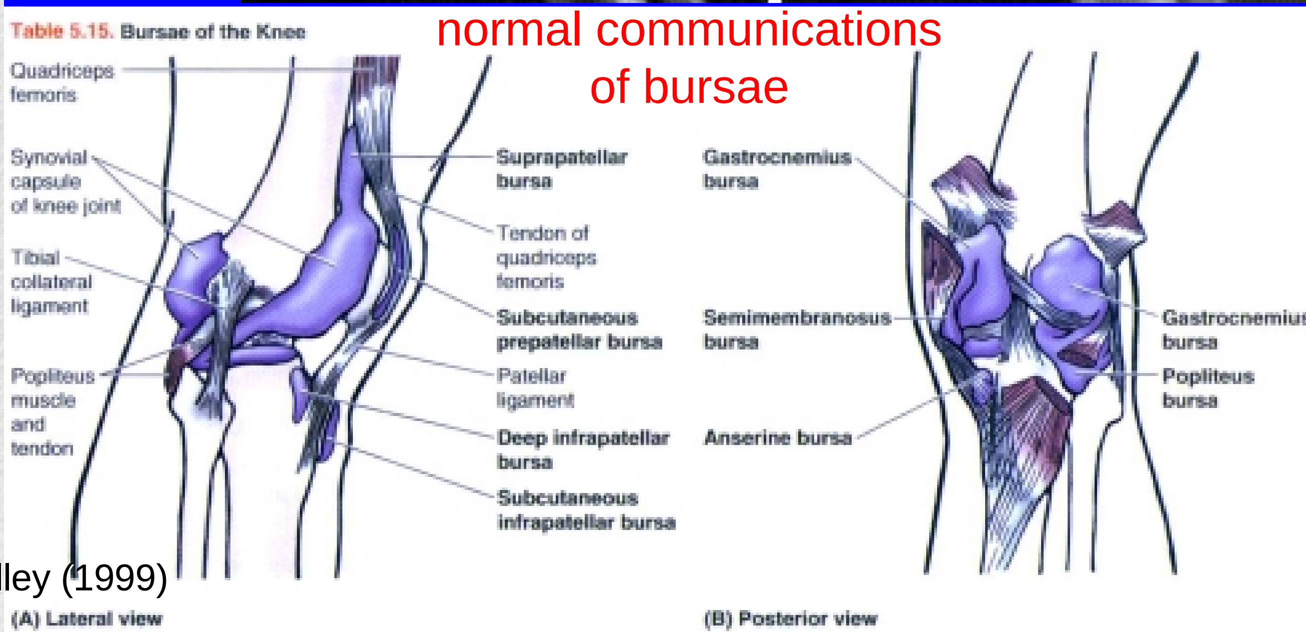
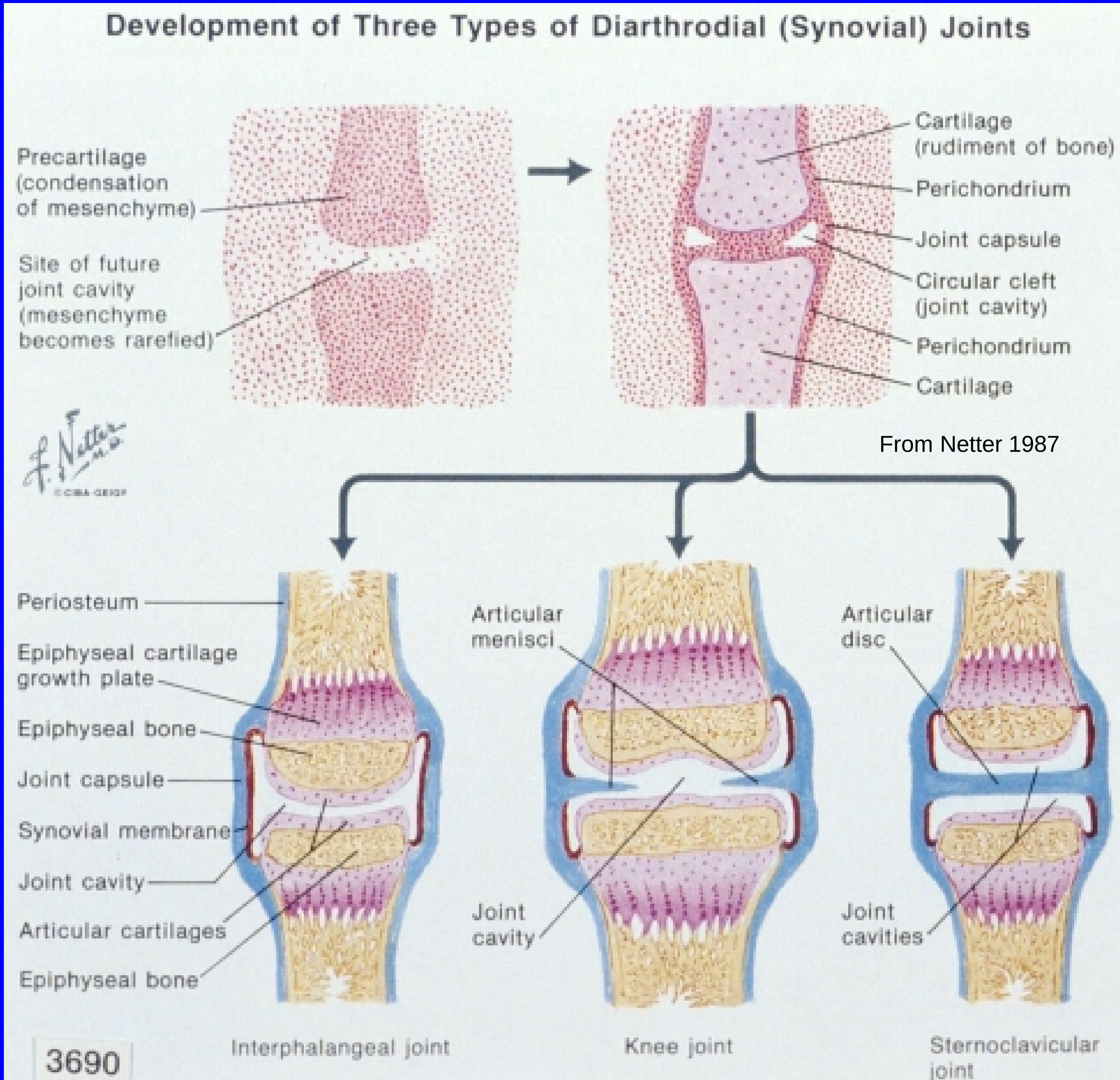


From Moore & Dalley (1999)



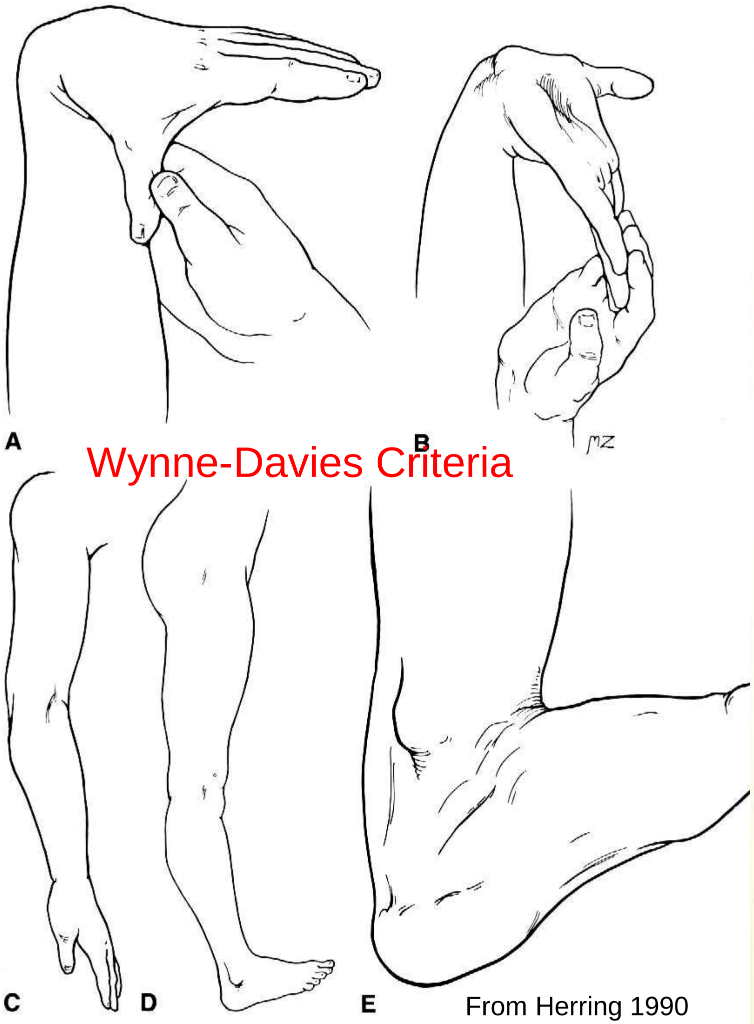
Development of Joints

- 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



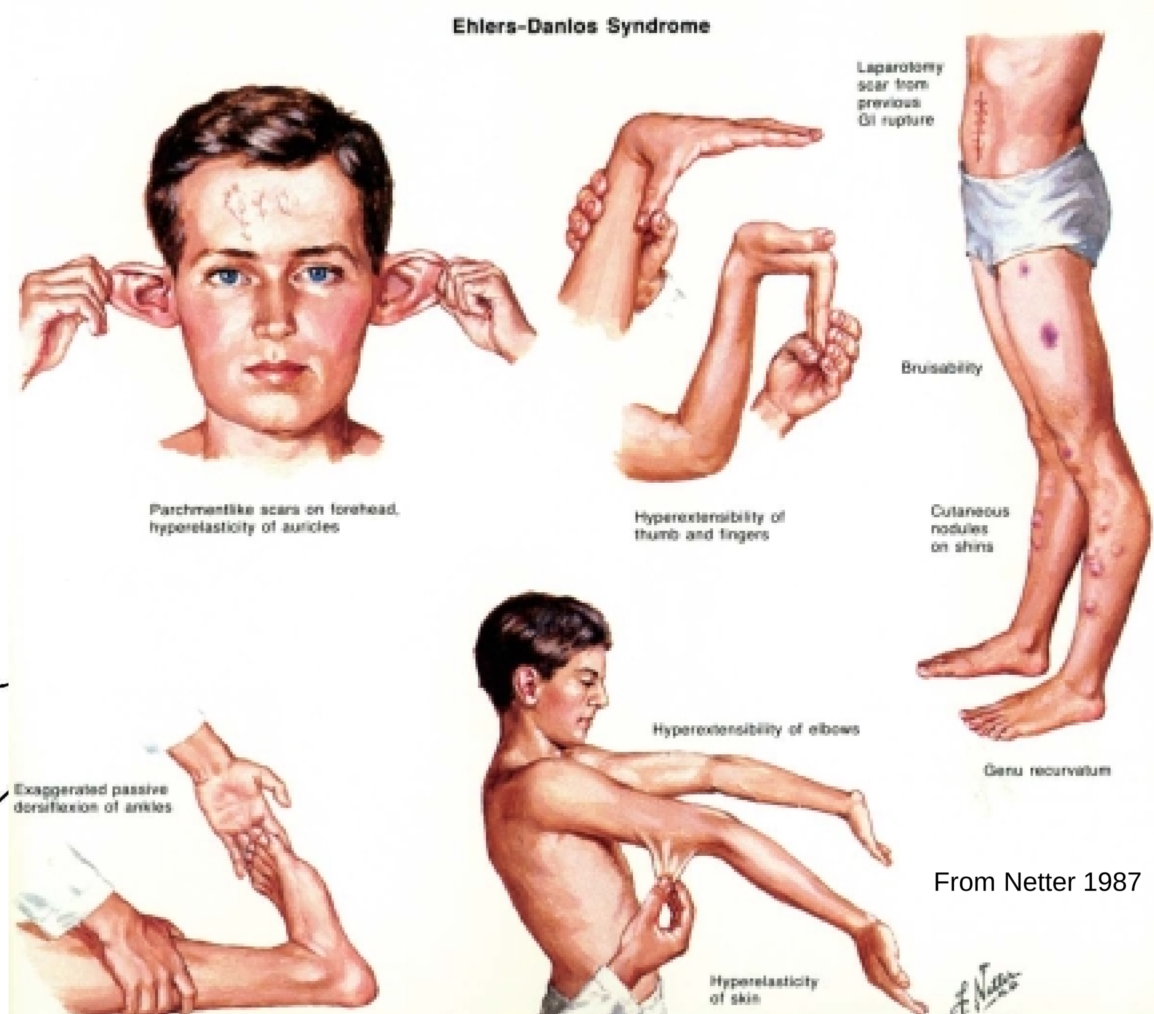
Laxity of Joints

- 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



Wynne-Davies Criteria

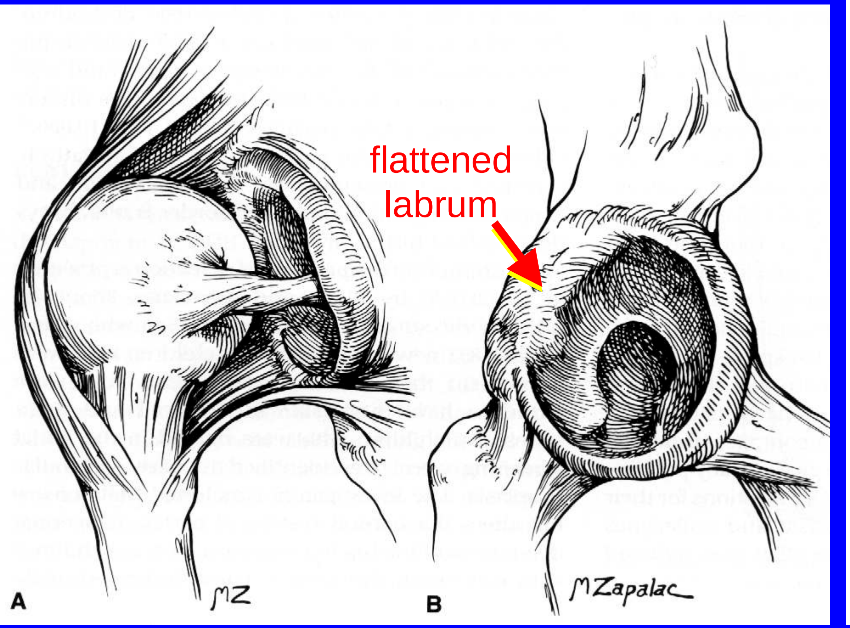
From Herring 1990



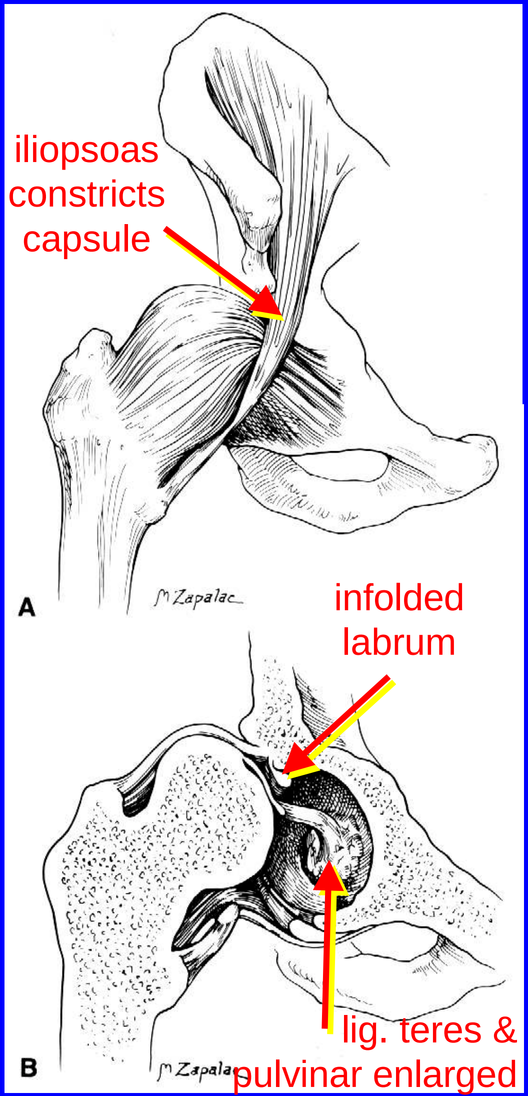
From Netter 1987

Developmental Dysplasia of the Hip (DDH)

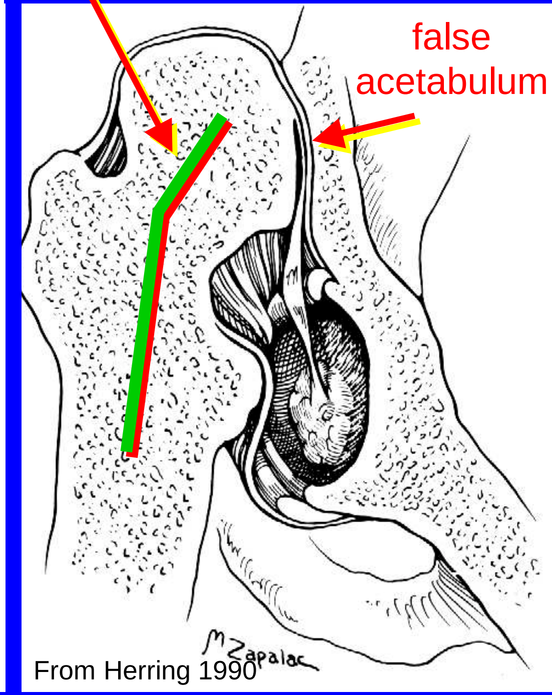
- a.k.a. congenital dislocation of the hip (CDH)
- Anatomical progression



Unstable hip of newborn



Established dislocation



Long-term dislocation

References

Bannister, L. H., et al. 1995. Gray's Anatomy, 38th Edition. Churchill Livingstone, New York.

Busch, M. T. 1990. Sports medicine in children and adolescents, pp. 1091–1128 *in* R. T. Morrissy (ed.), Lovell and Winter's Pediatric Orthopaedics, Volume 2, 3rd Edition. Lippincott, Philadelphia.

Cormack, D. H. 1993. Essential Histology. Lippincott, Philadelphia.

Herring, J. A. 1990. Congenital dislocation of the hip, pp. 815-850 *in* R. T. Morrissy (ed.), Lovell and Winter's Pediatric Orthopaedics, Volume 2, 3rd Edition. Lippincott, Philadelphia.

Moore, K. L. and A. F. Dalley. 1999. Clinically Oriented Anatomy. Lippincott, Williams, & Wilkins, Baltimore.

Morrissy, R. T. 1990. Slipped capital femoral epiphysis, pp. 885–904 *in* R. T. Morrissy (ed.), Lovell and Winter's Pediatric Orthopaedics, Volume 2, 3rd Edition. Lippincott, Philadelphia.

Netter, F. H. 1987. The CIBA Collection of Medical Illustrations, Volume 8: Musculoskeletal System. CIBA-Geigy, Summit.

Staubesand, J. 1990. Sobotta Atlas of Human Anatomy. Urban & Schwarzenberg, Baltimore.

Tachdjian, M. O. 1990. Pediatric Orthopedics, Volumes 1–4, 2nd Edition. W. B. Saunders, Philadelphia.

Thompson, G. H. & P. V. Scoles. 1999. Bone and joint disorders, pp. 2055-2098 *in Nelson's Textbook of Pediatrics*. Saunders, Philadelphia.