Bone-Specific Reactions to Injury

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Tissue response to Injury

Degeneration

Necrosis

Inflammation

Vascular disturbance

Disturbance of growth

Minerals/pigments

Disturbance of structure

(independent of cause)

Major Bone Disease Categories (from McCarthy and Frassica)

1. Congenital
2. Metabolic
3. Traumatic
4. Circulatory
5. Neoplastic
6. Infectious
7. Responses to systemic disease

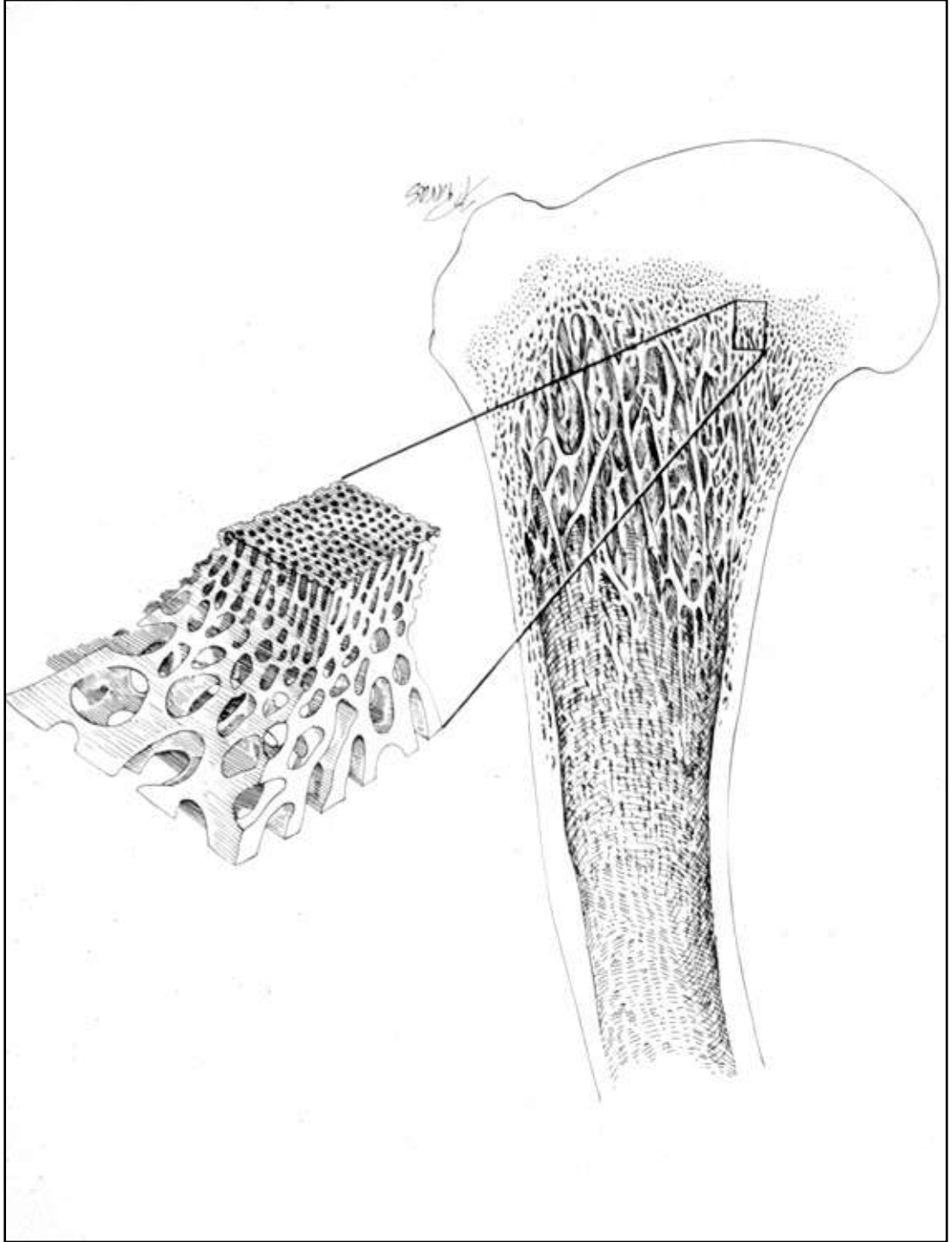
(mixes causes and responses)

Specific Reactions of Bone to Injury (Modified from Palmer)

- Disruption of endochondral ossification.
- Modeling in response to structural damage and abnormal use (Wolff's Law).
- Remodeling in response to abnormal use and systemic disease.
- Repair bone/rapidly deposited bone is woven rather than lamellar
- Periosteum responds to injury usually by formation of woven bone.

Abnormal Endochondral Ossification

Failure to Form Endochondral Bone



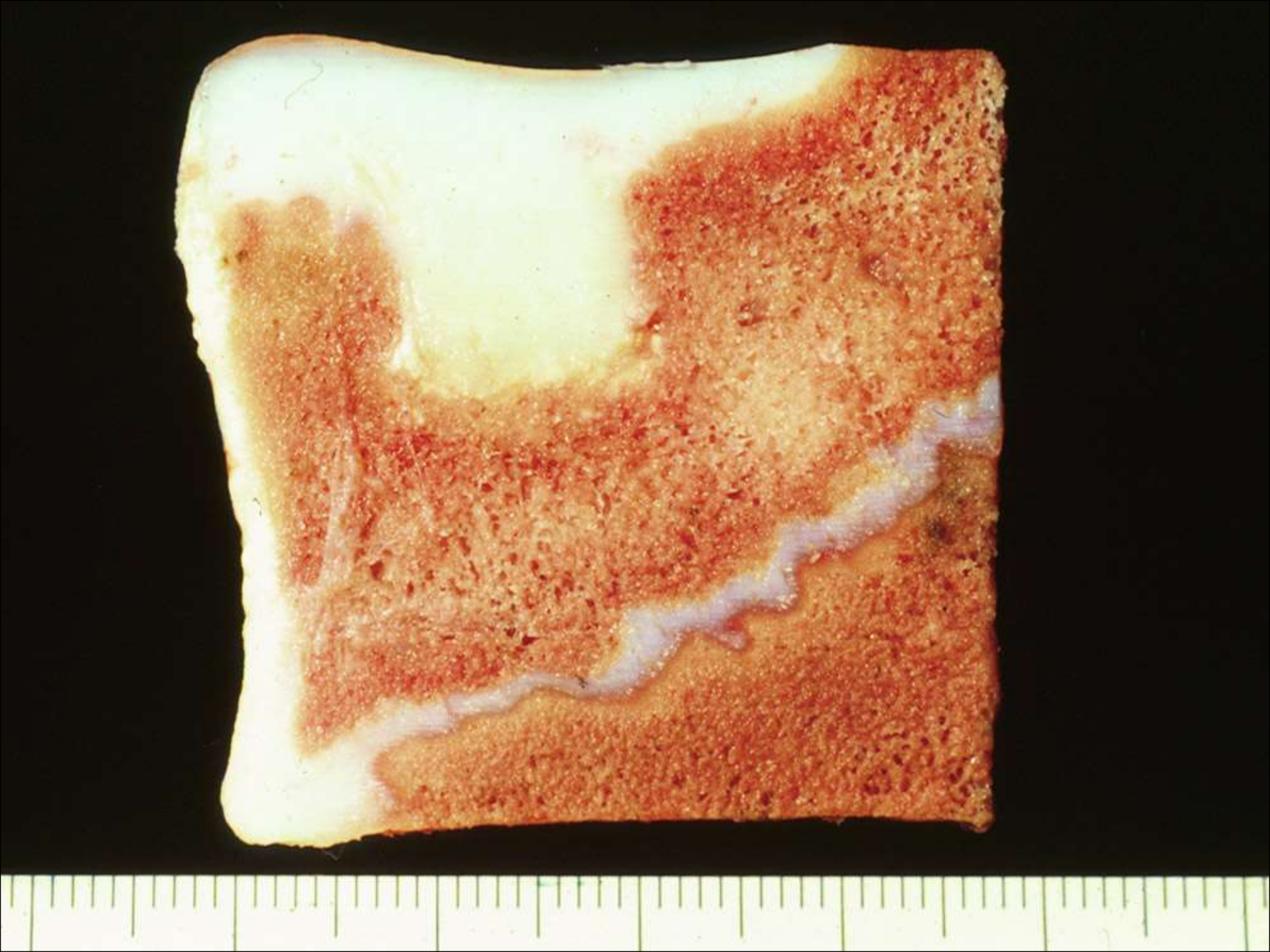
Retained Growth Cartilage

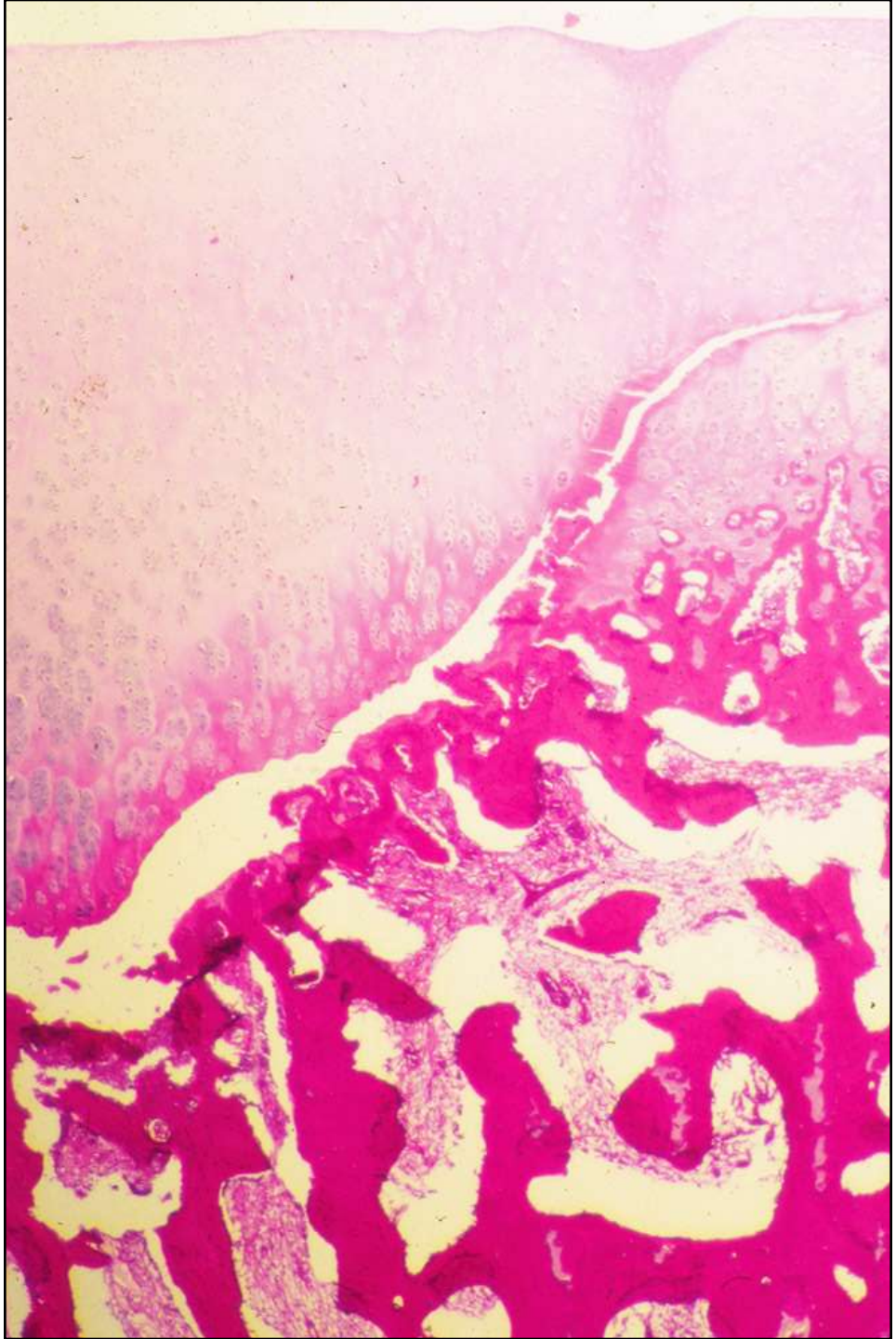
- Primary and idiopathic – osteochondrosis
- Secondary impaired vascular invasion of plate due to inflammation
- Secondary impaired vascular invasion of plate due to trauma

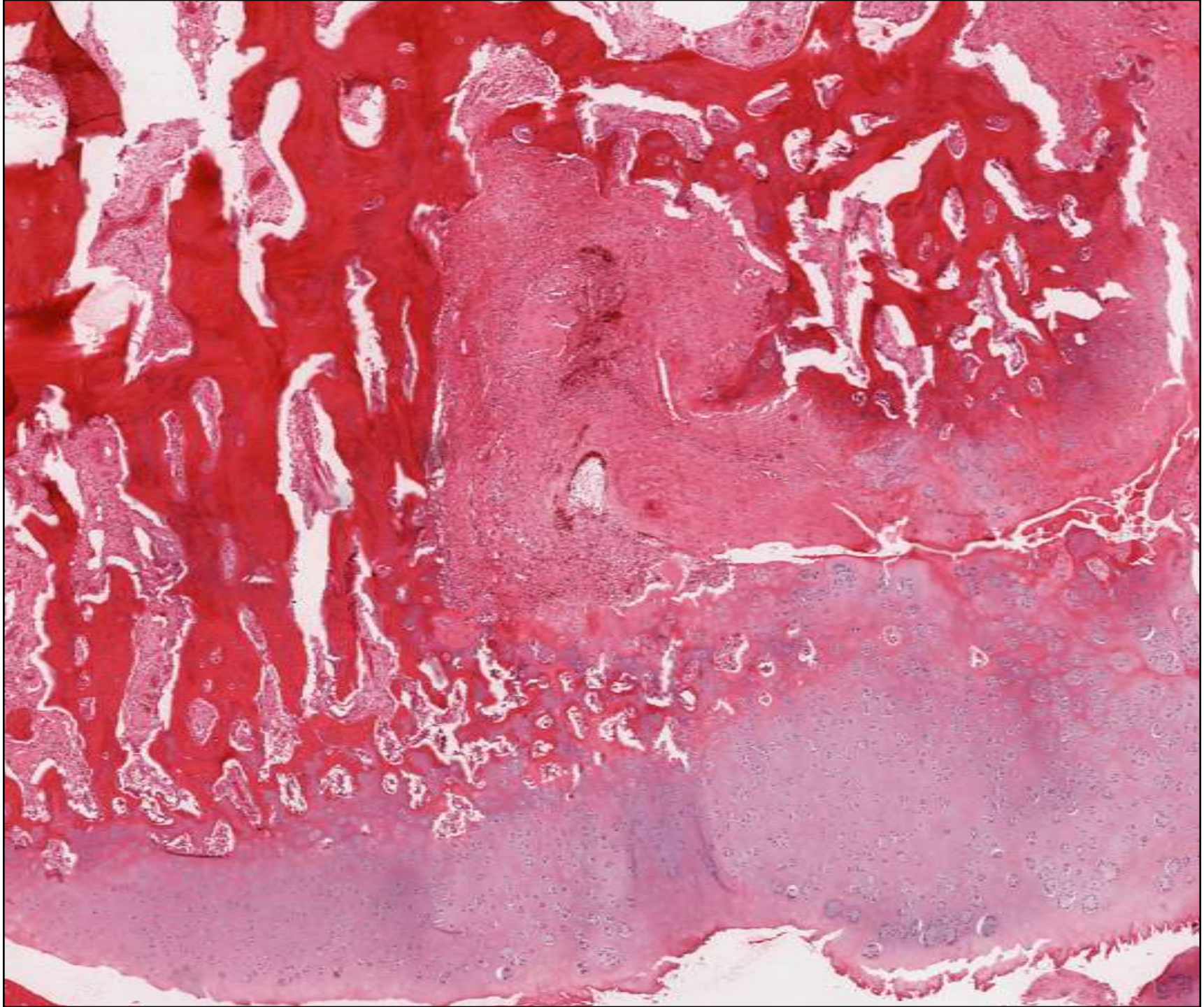
Retained Growth Cartilage: Osteochondrosis

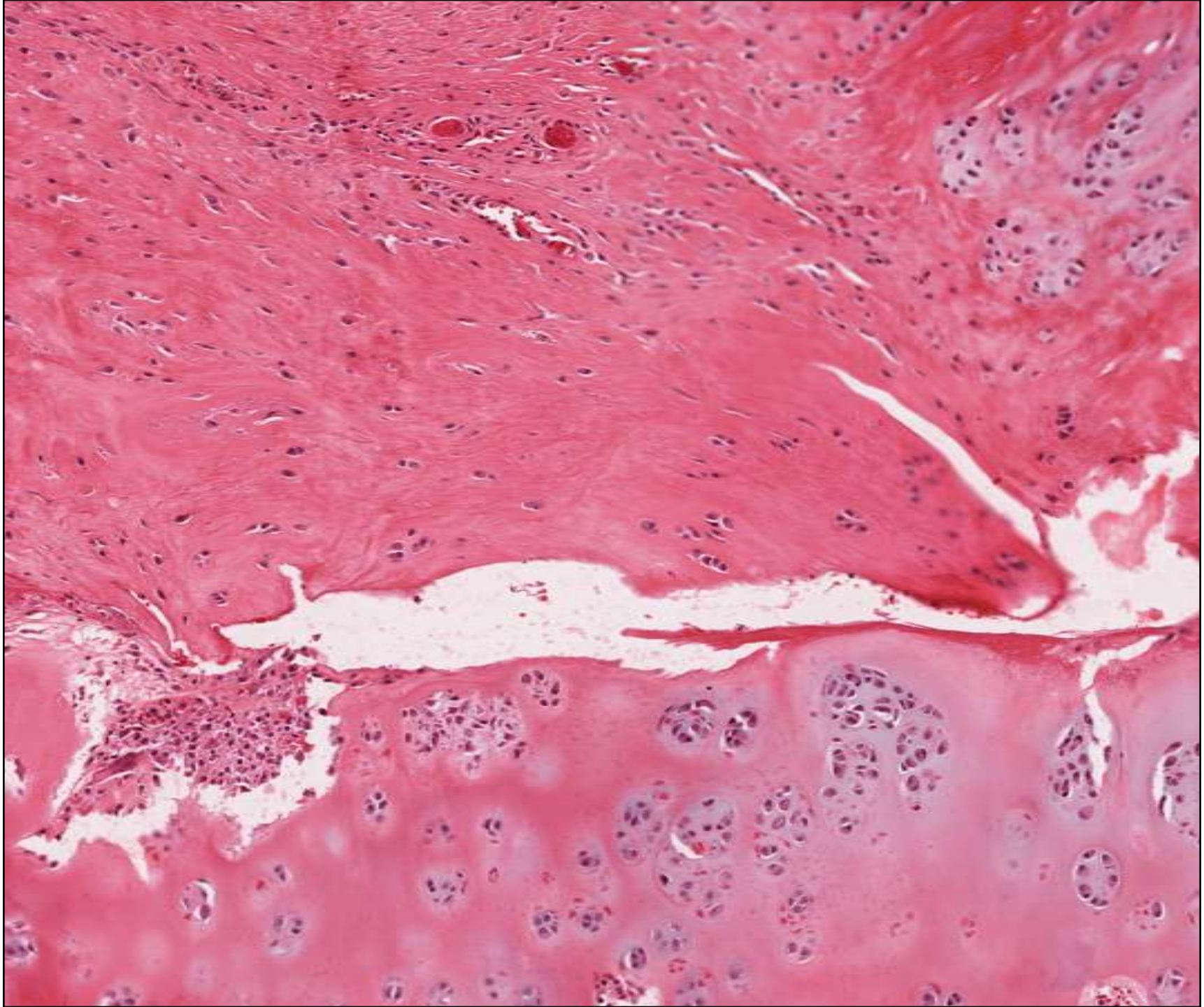
Physeal Dysplasia

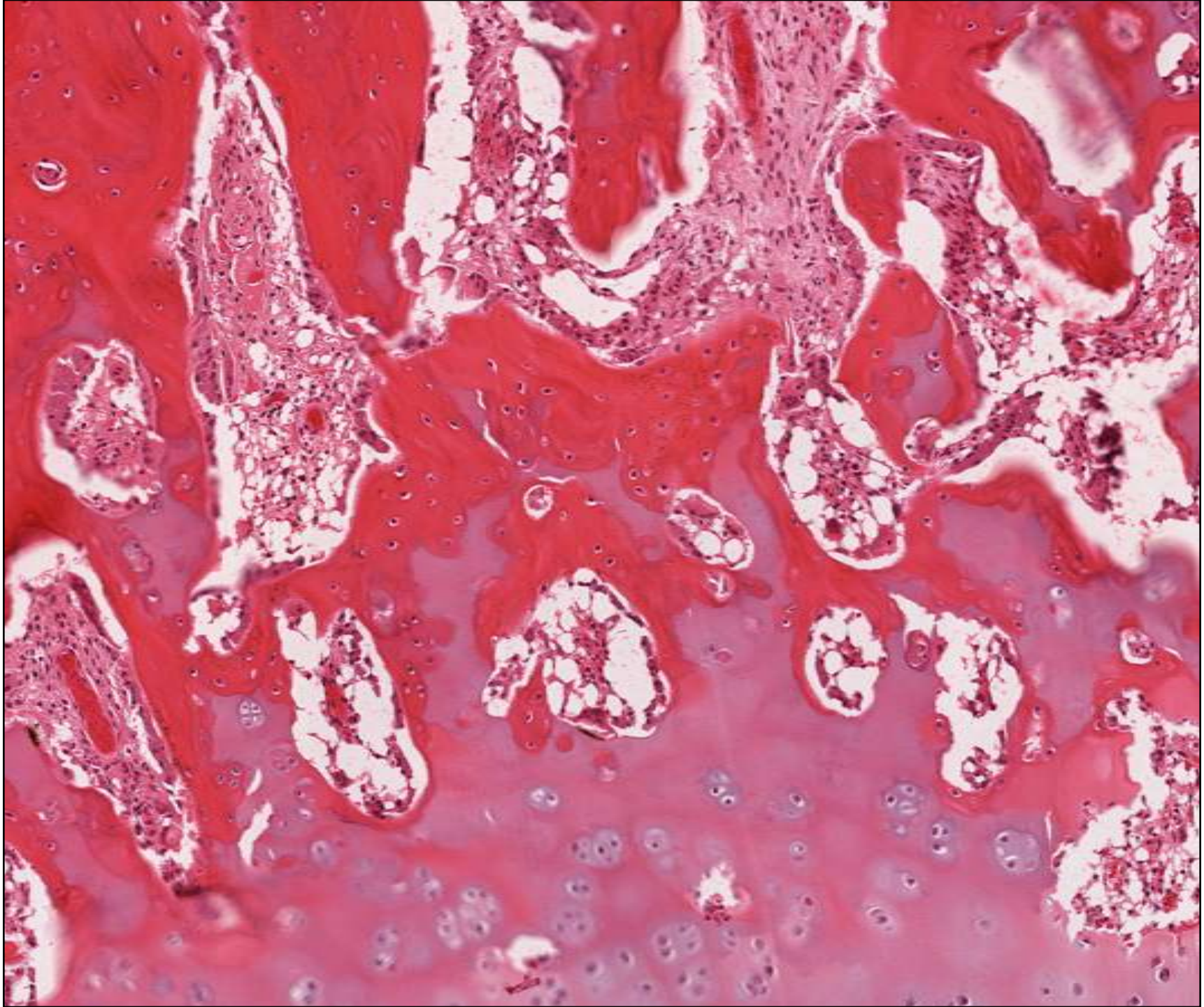
AE Complex Dysplasia







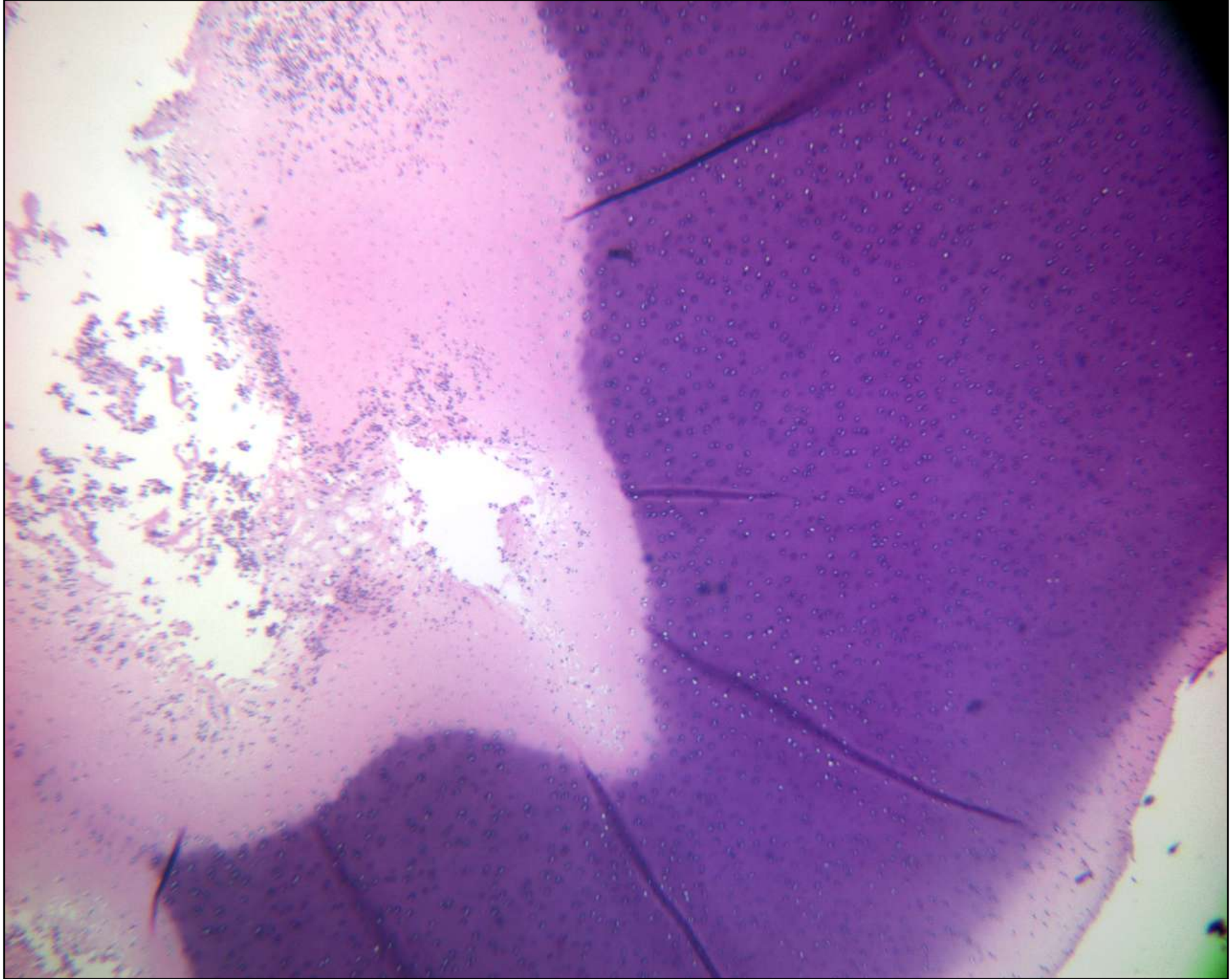




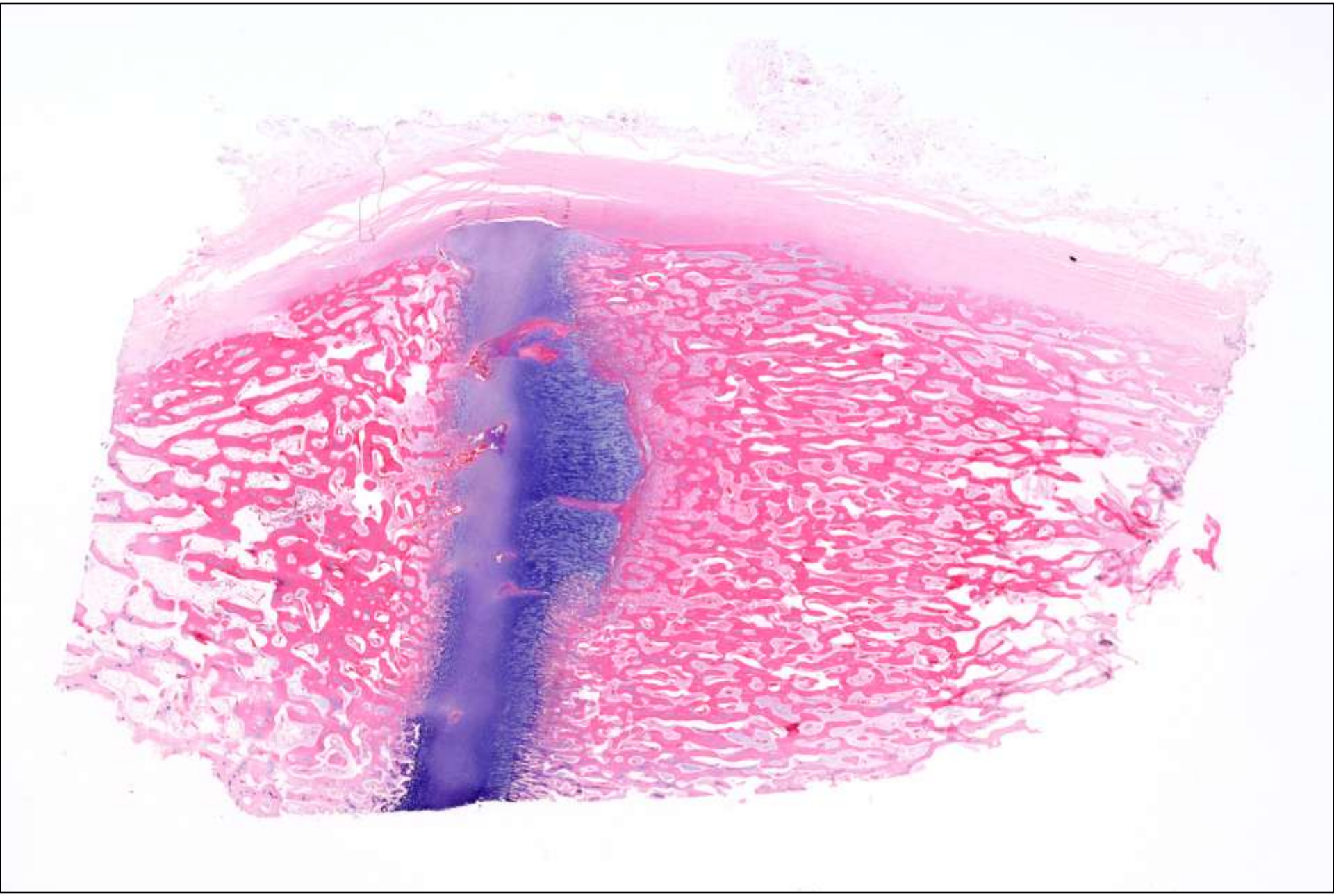
Retained Growth Cartilage: Osteomyelitis

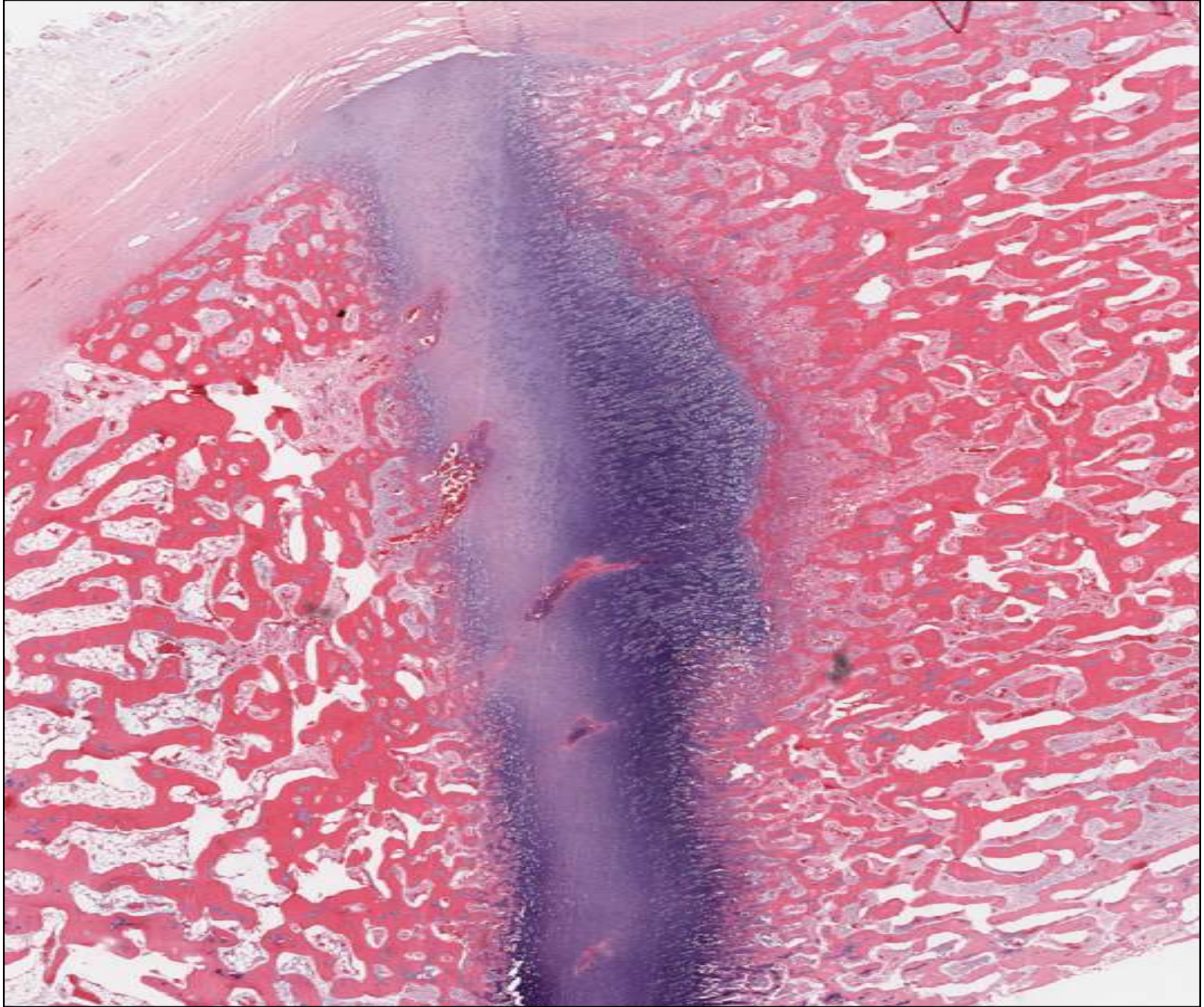
Physis

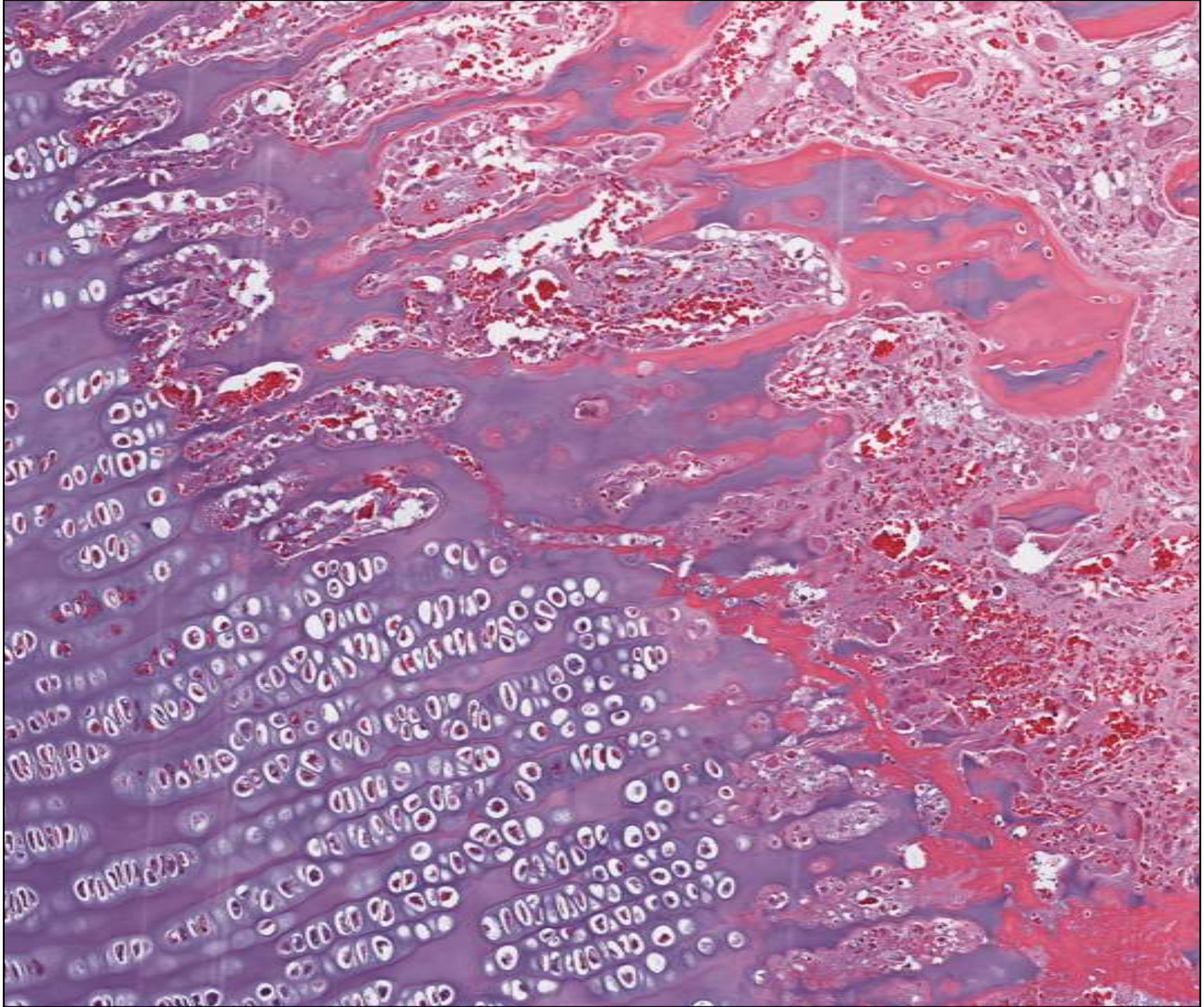
AE complex

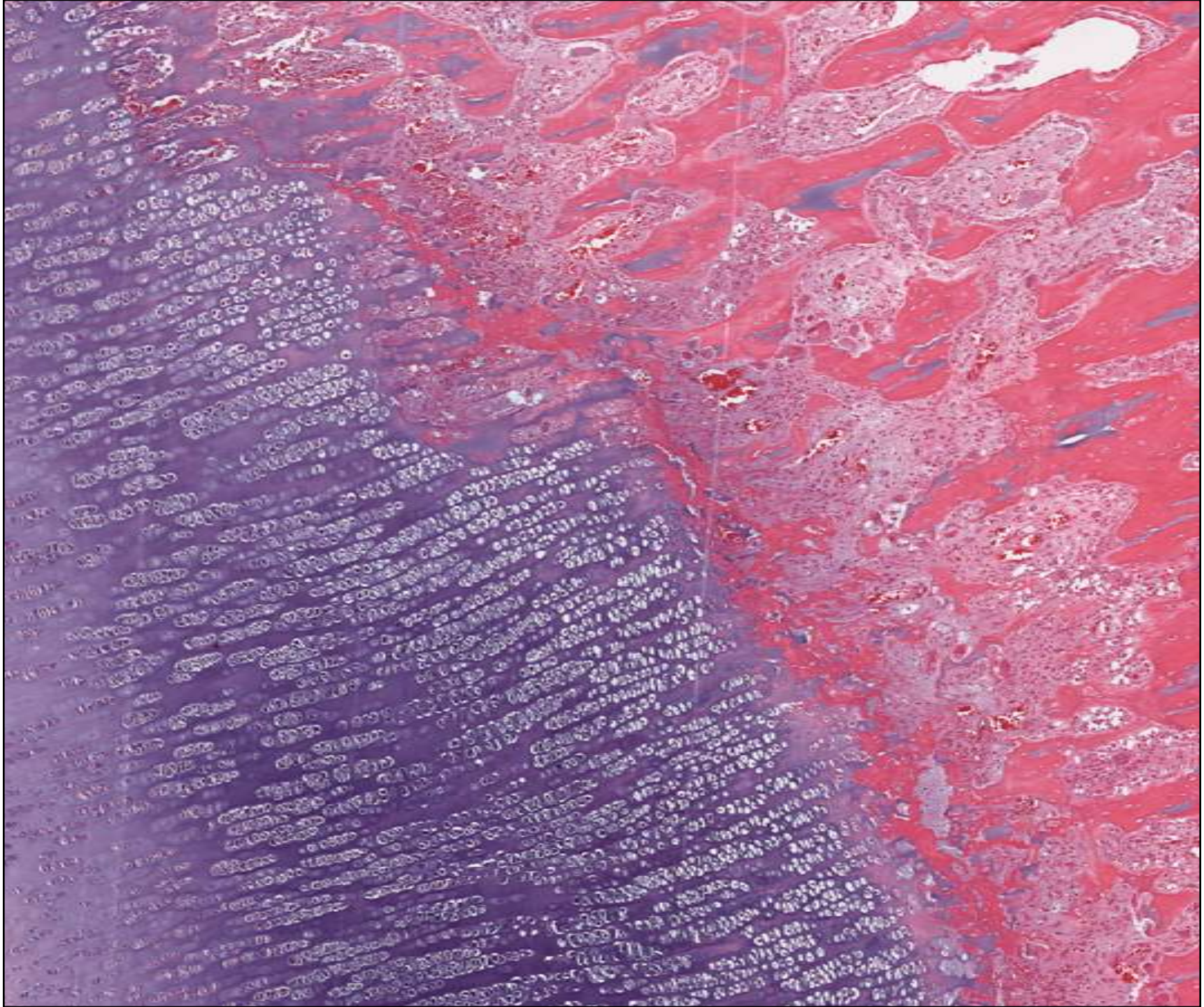


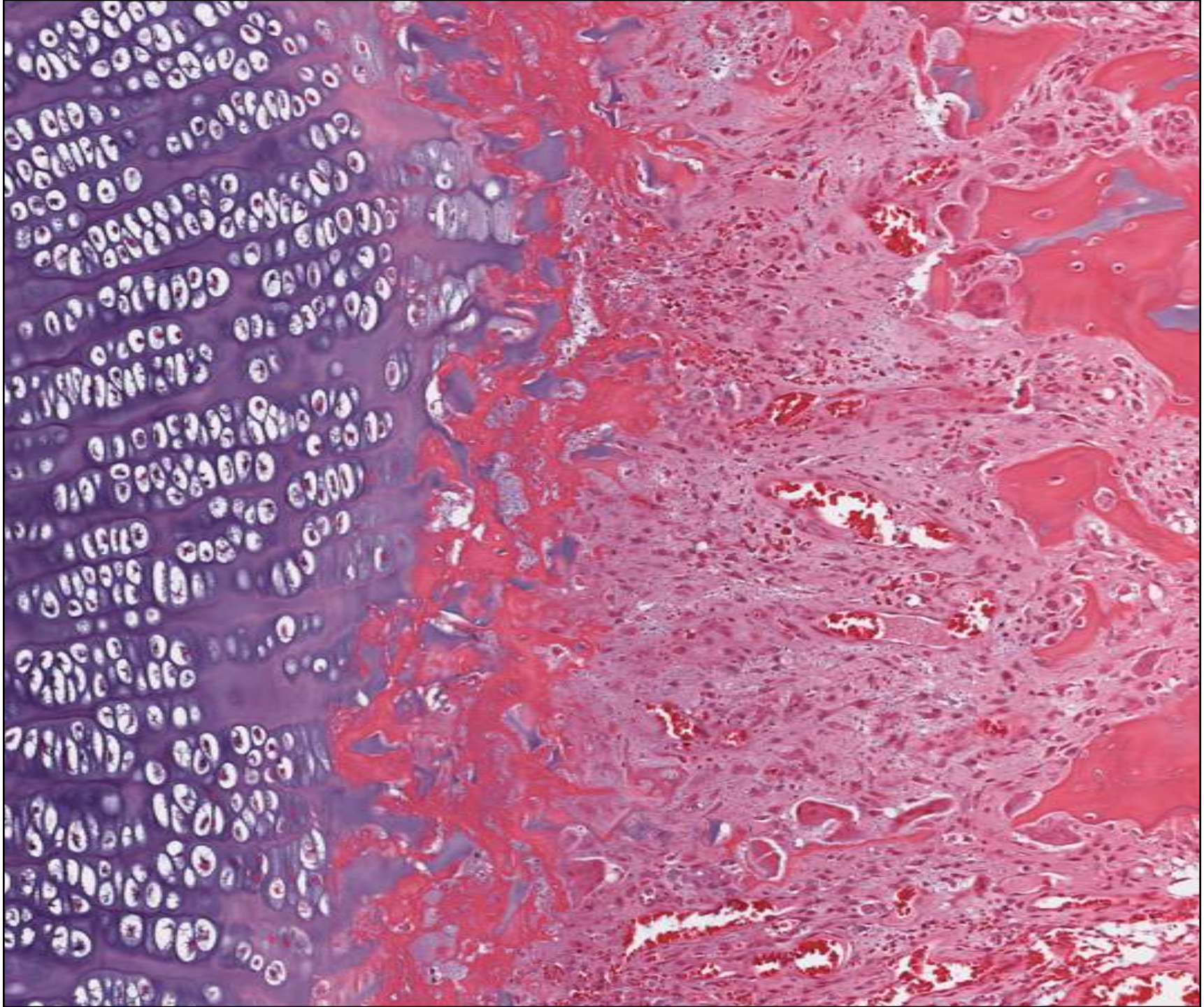
Retained Growth Cartilage: Traumatic Physitis

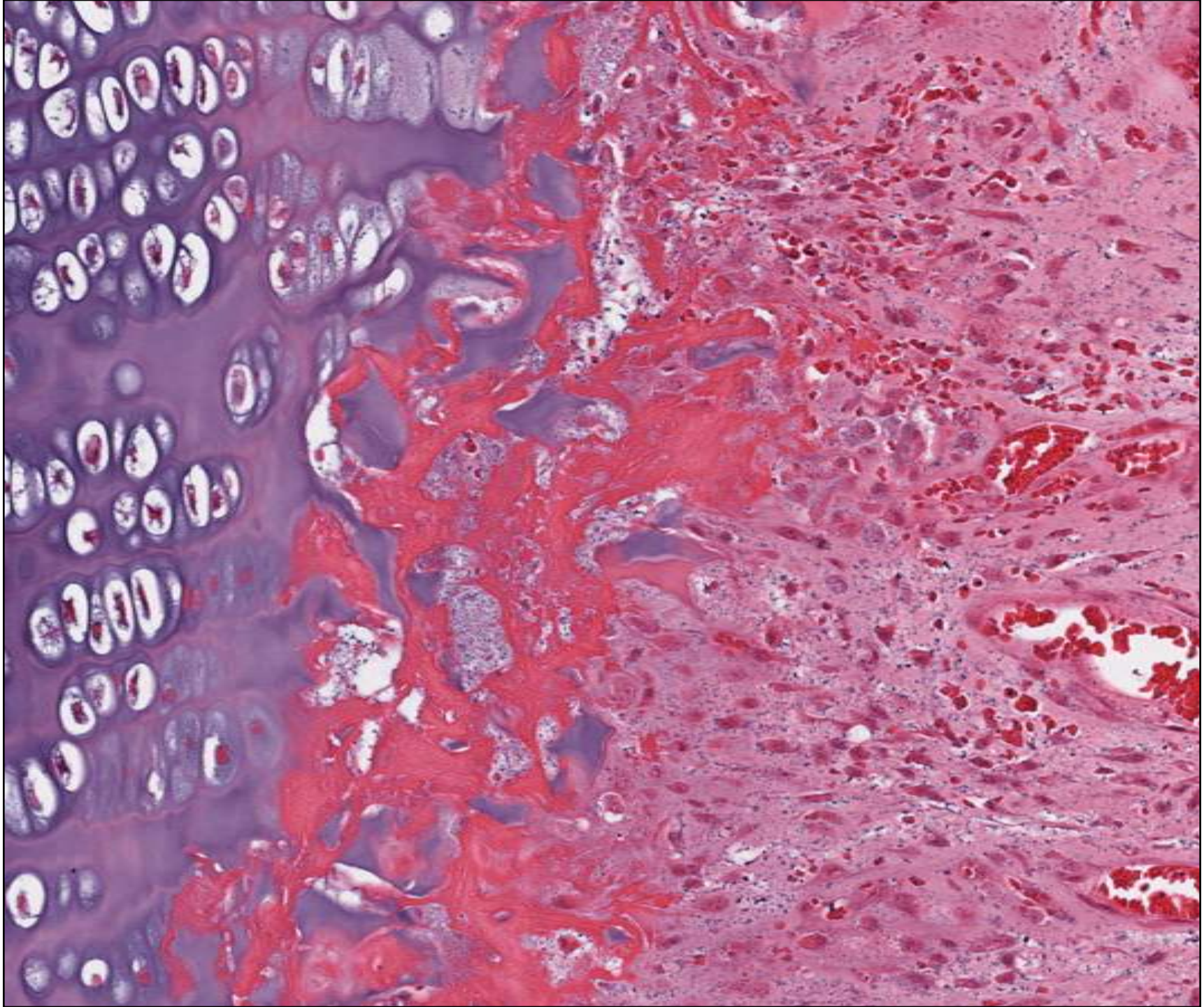


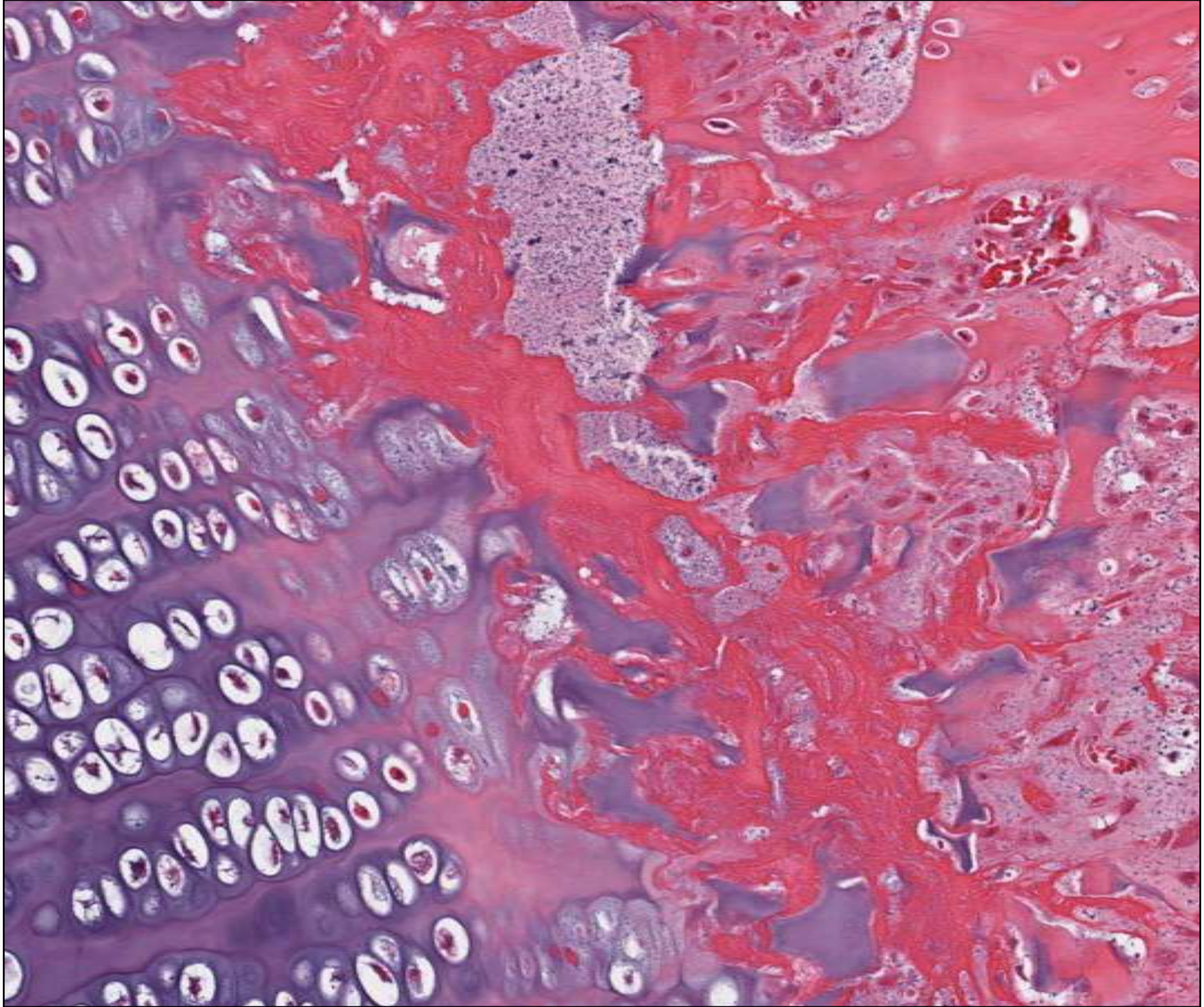












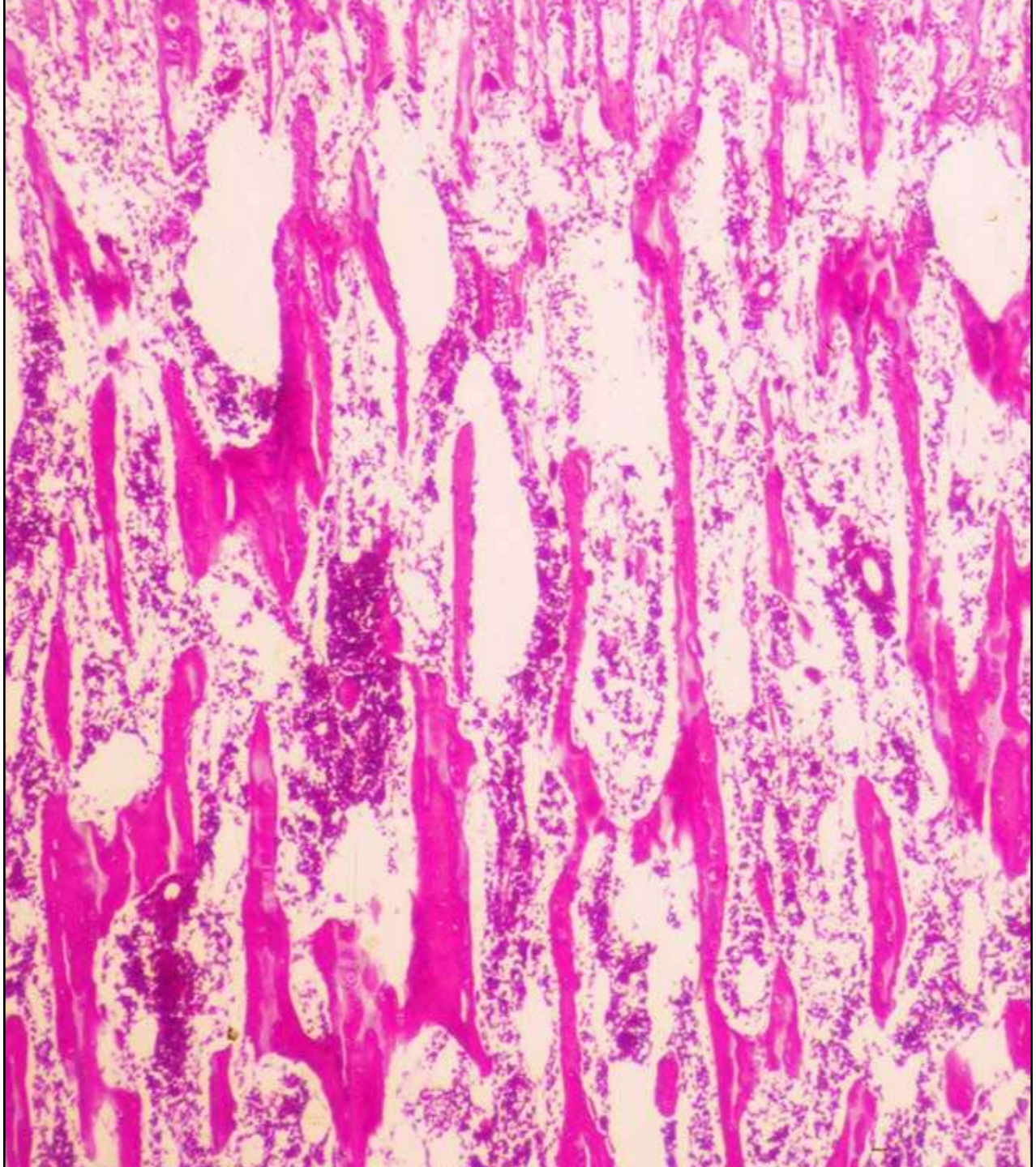
Abnormal Endochondral Ossifiction at the Trabecular Bone Level

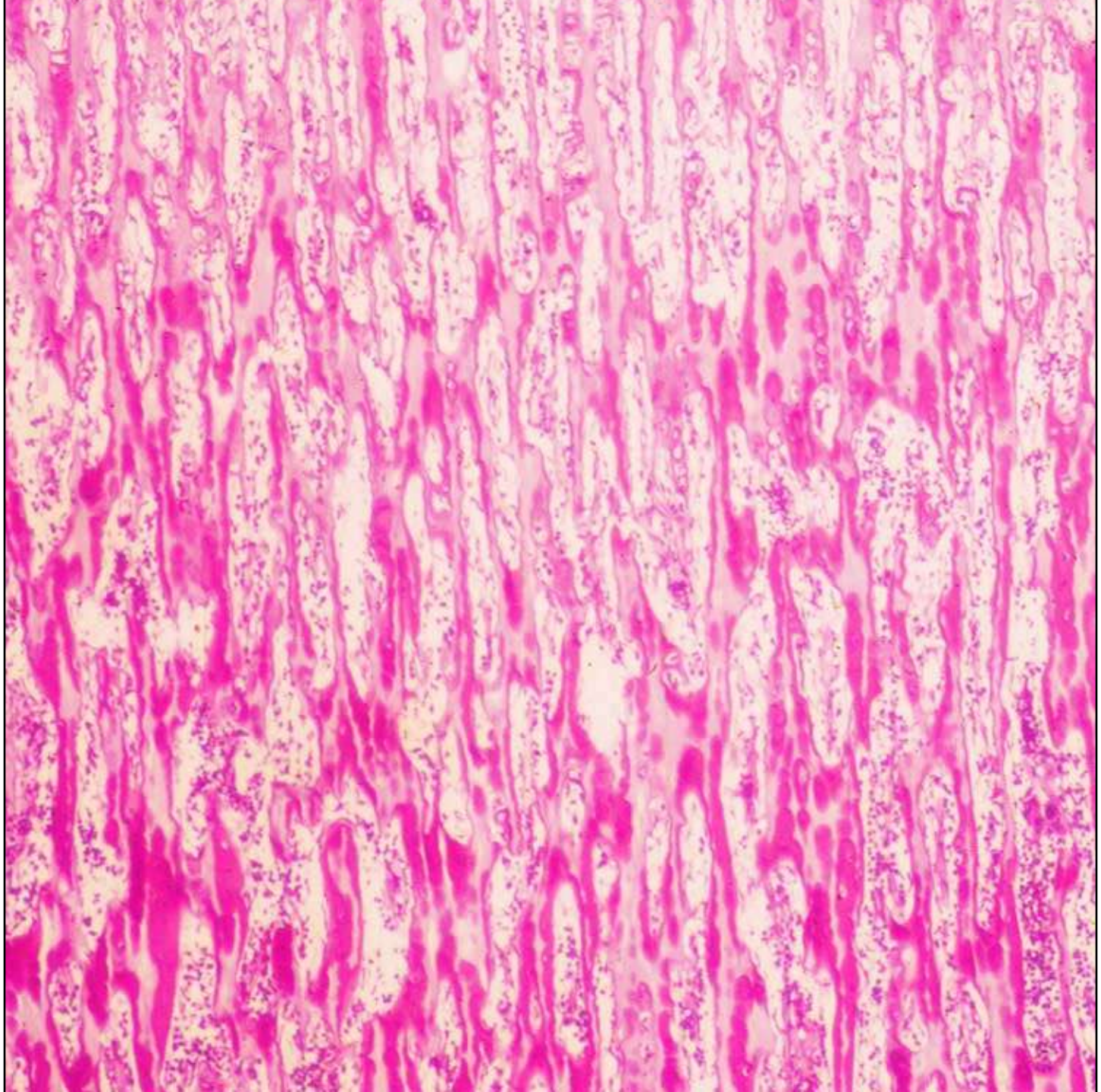
Growth Retardation Lattice

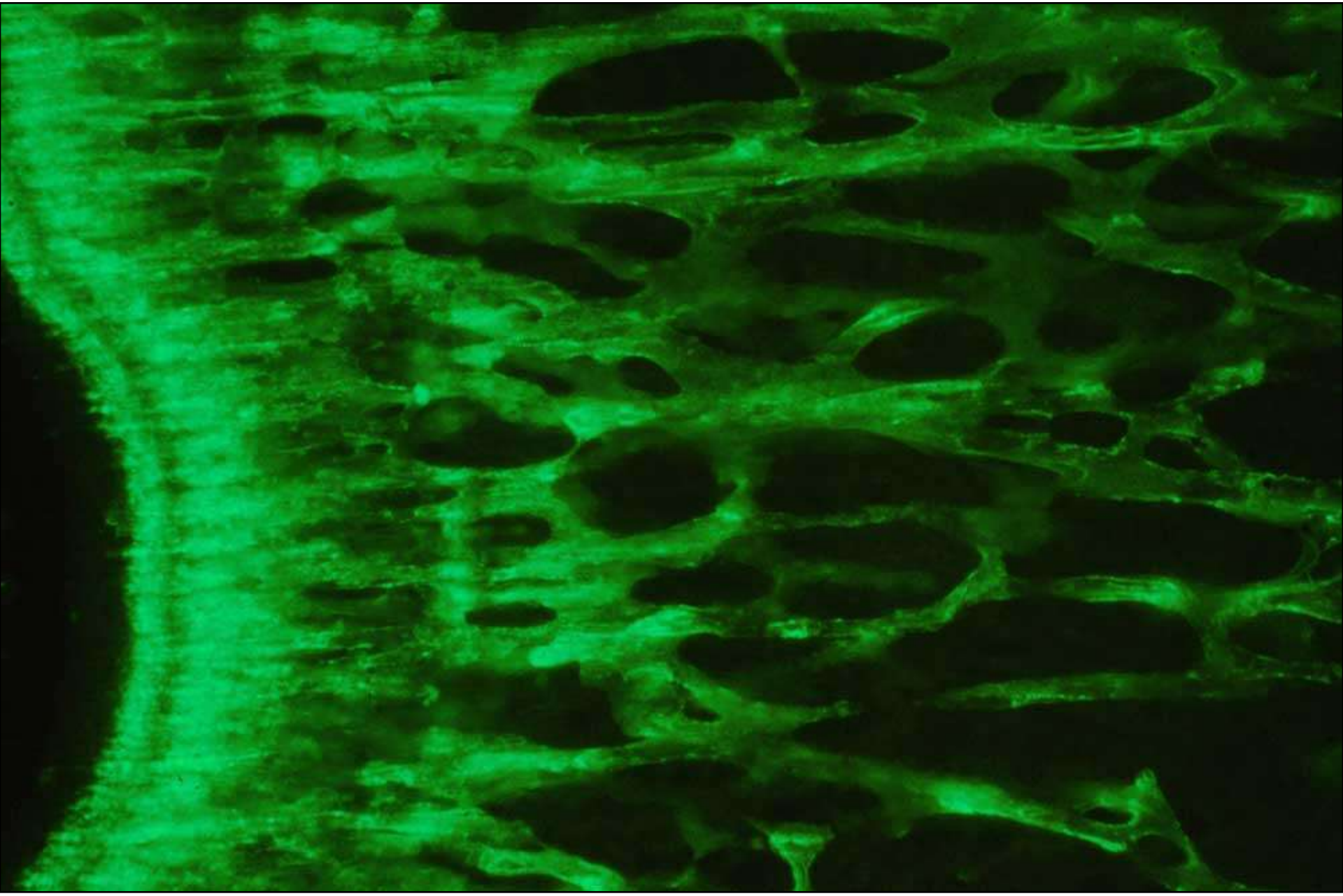
THIS IS REALLY AN ERROR IN MODELING AND NOT E/C OSSIFICATION

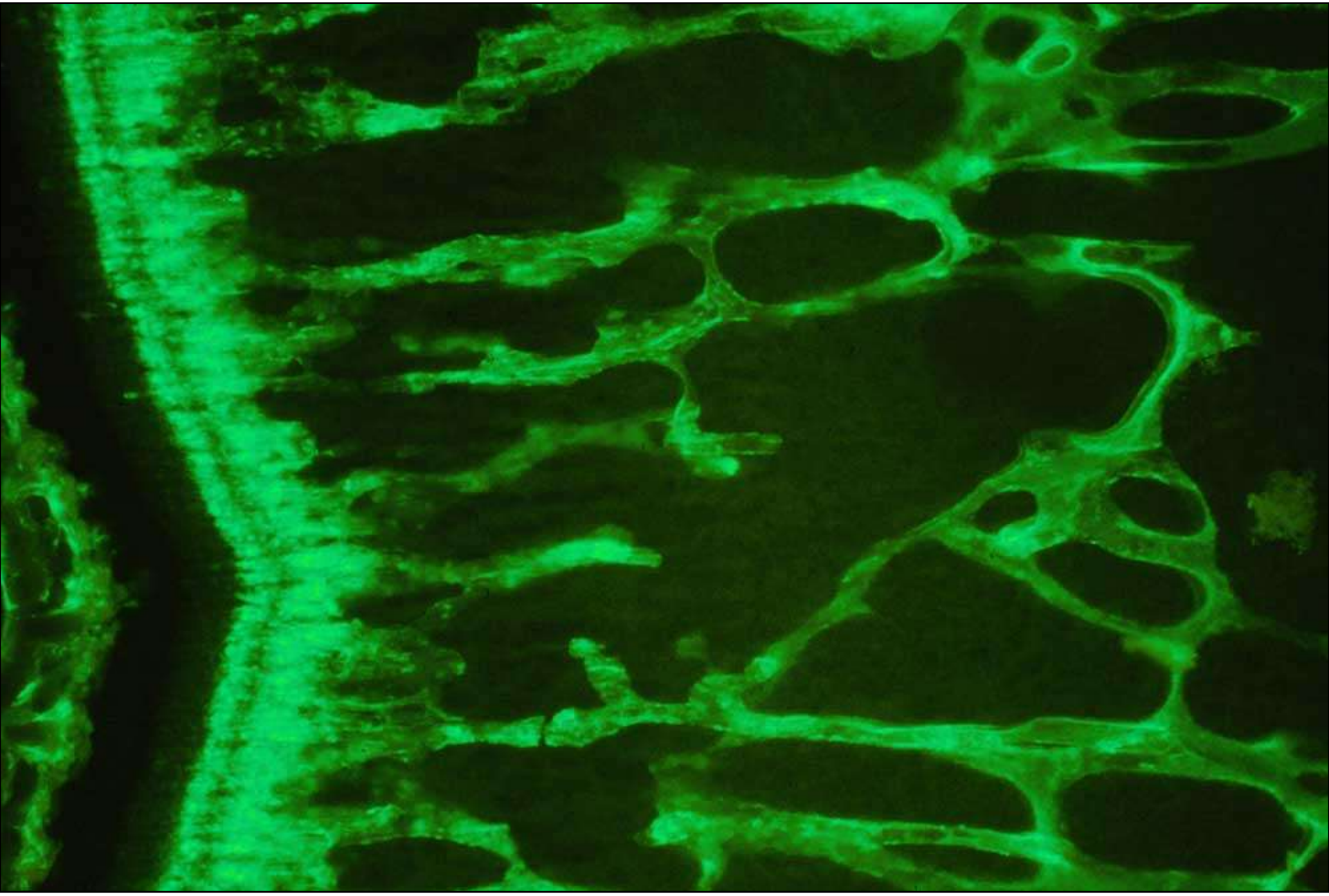
Growth Retardation Lattice

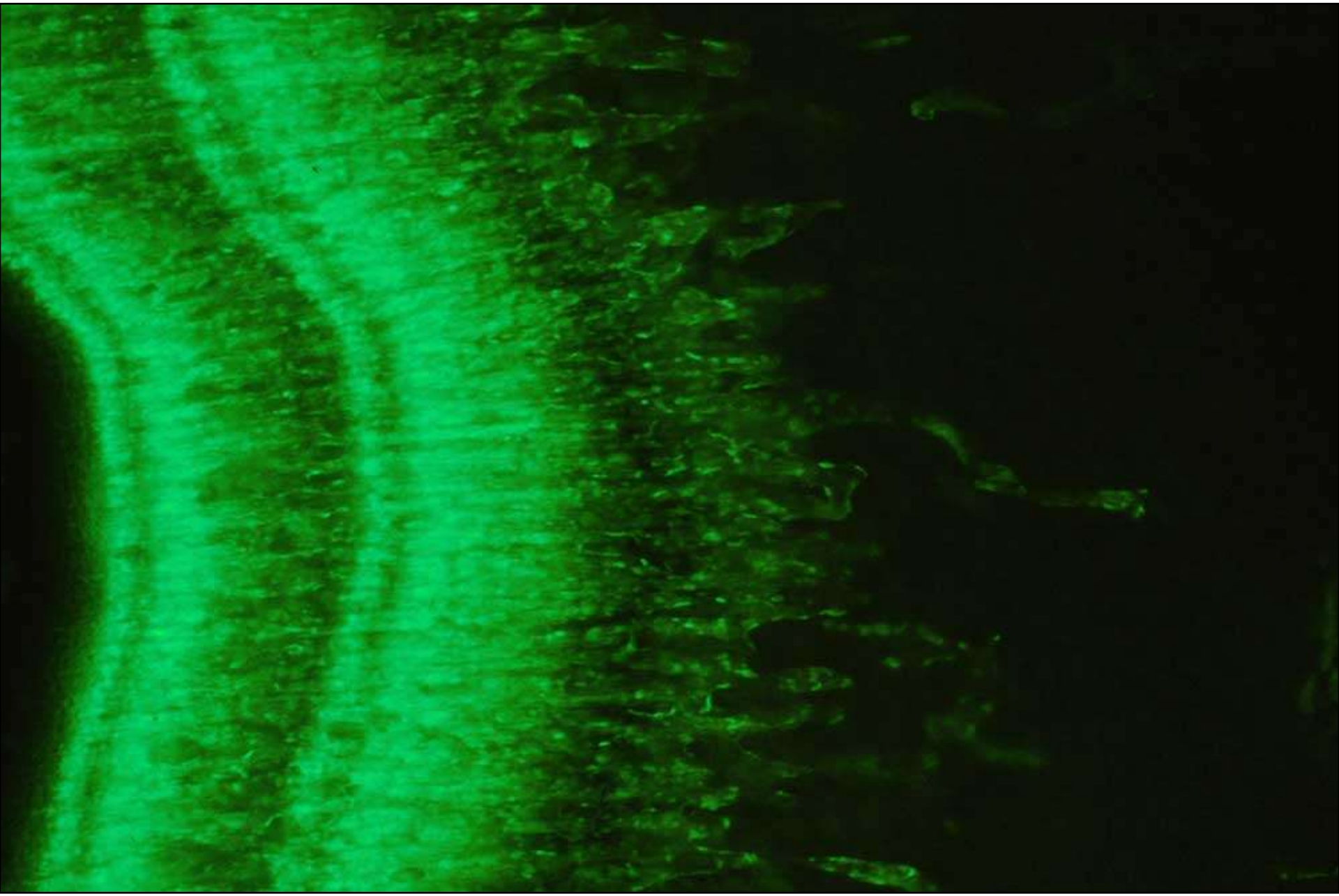
- Failure of osteoclastic modeling at a site of endochondral ossification
- Retention of un-modeled primary trabeculae







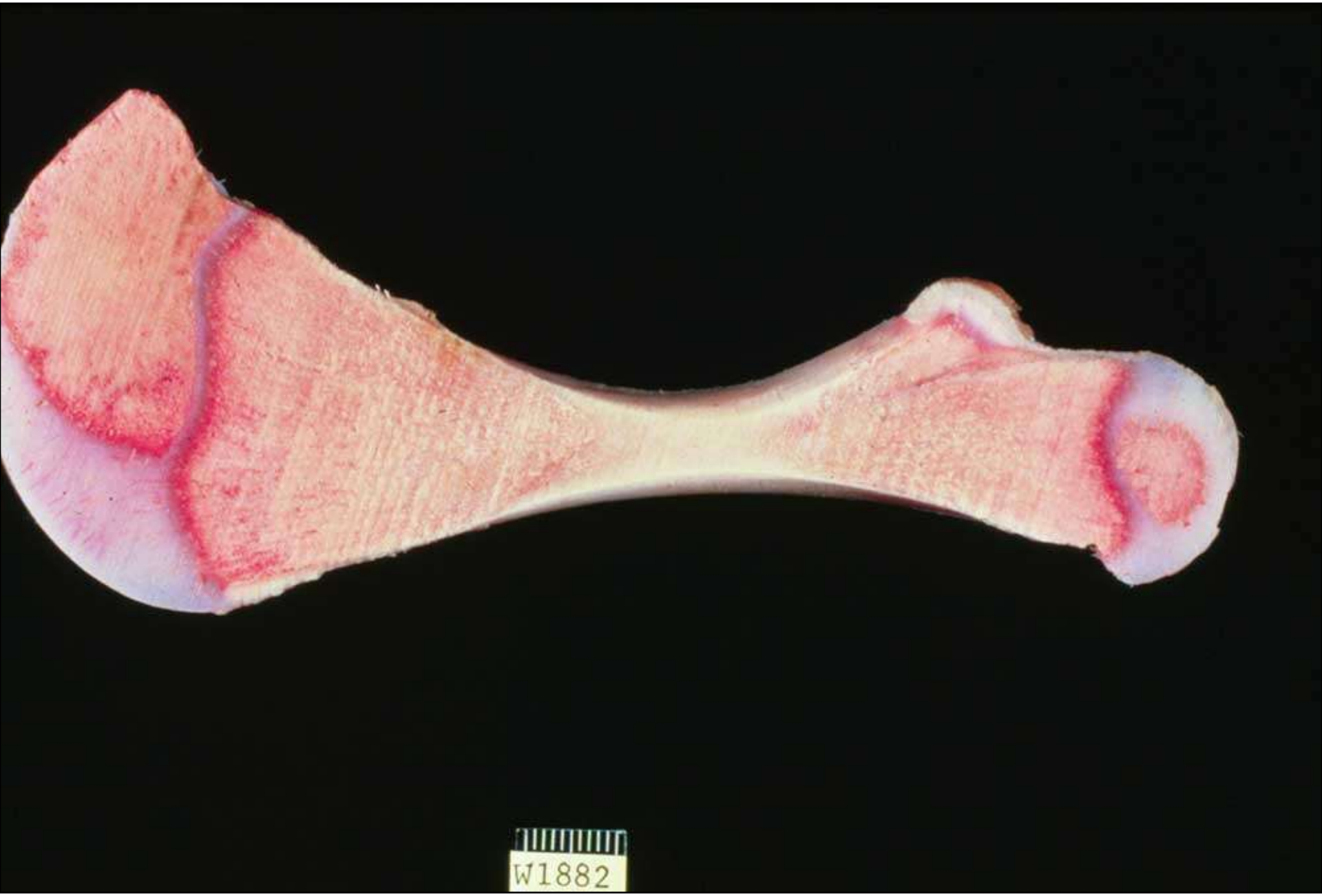




Abnormal Endochondral Ossifiction at the Trabecular Bone Level

Osteopetrosis

THIS IS REALLY AN ERROR IN MODELING
AND NOT E/C OSSIFICATION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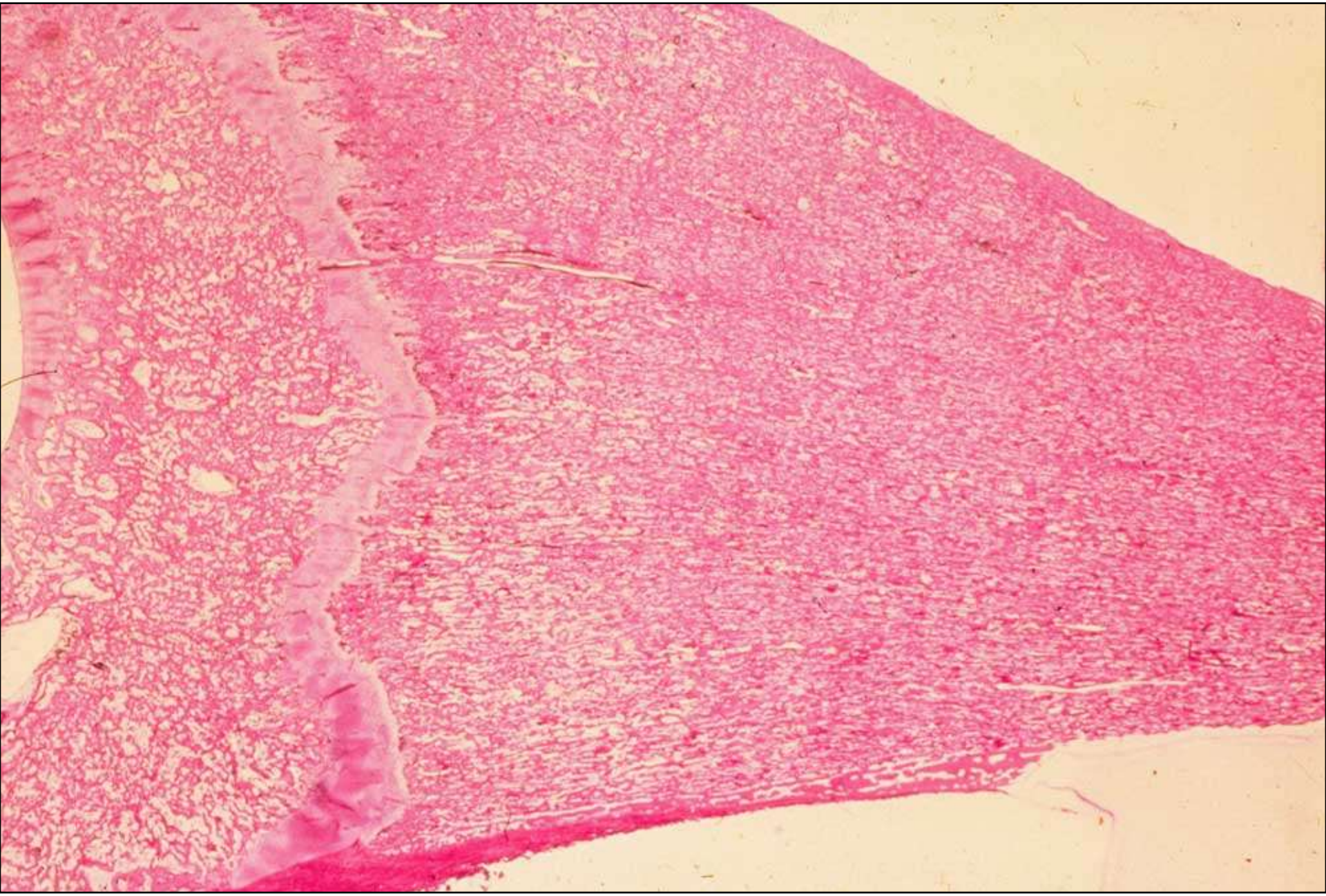
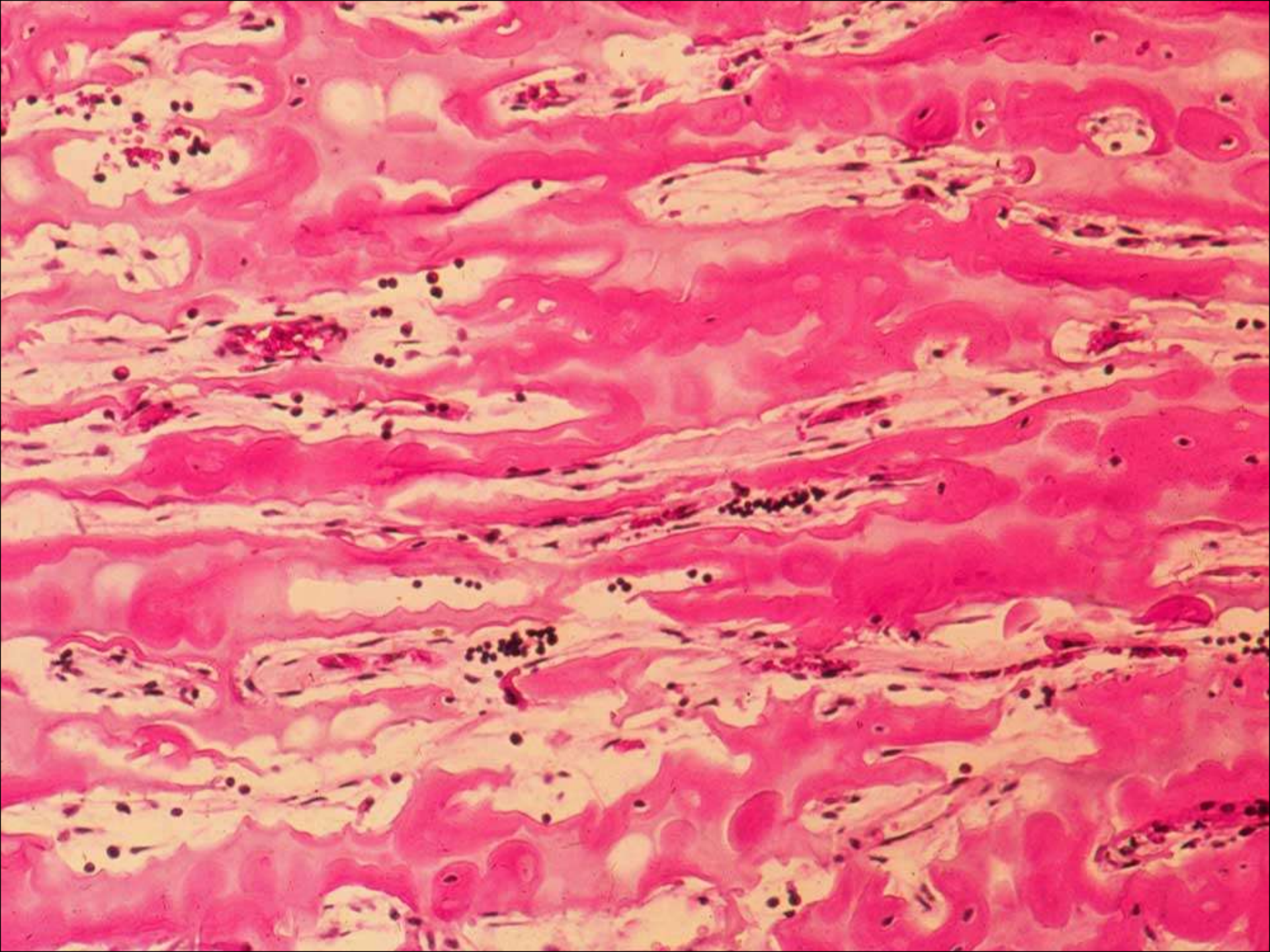




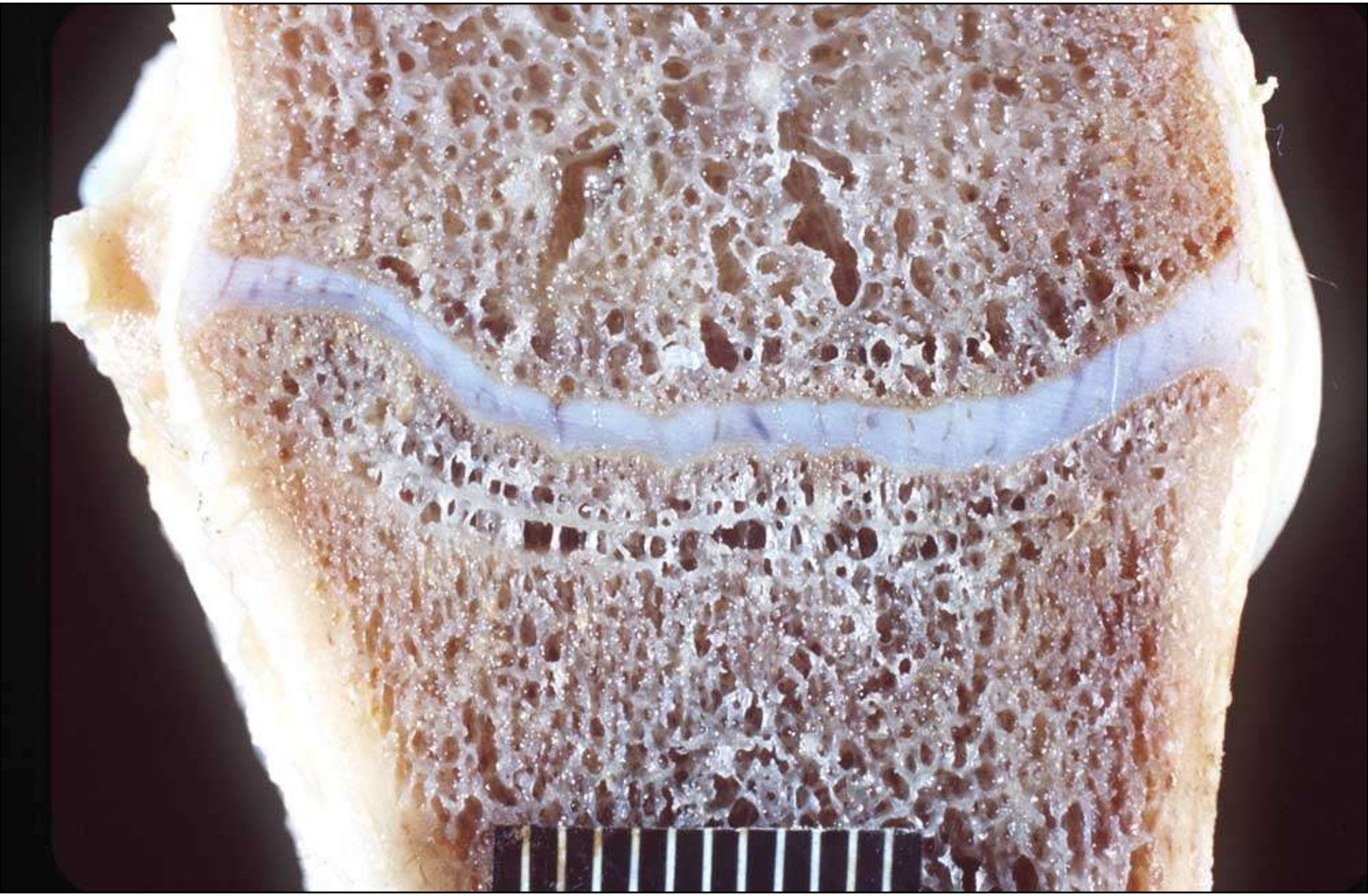
Abnormal Endochondral Ossifiction at the Trabecular Bone Level

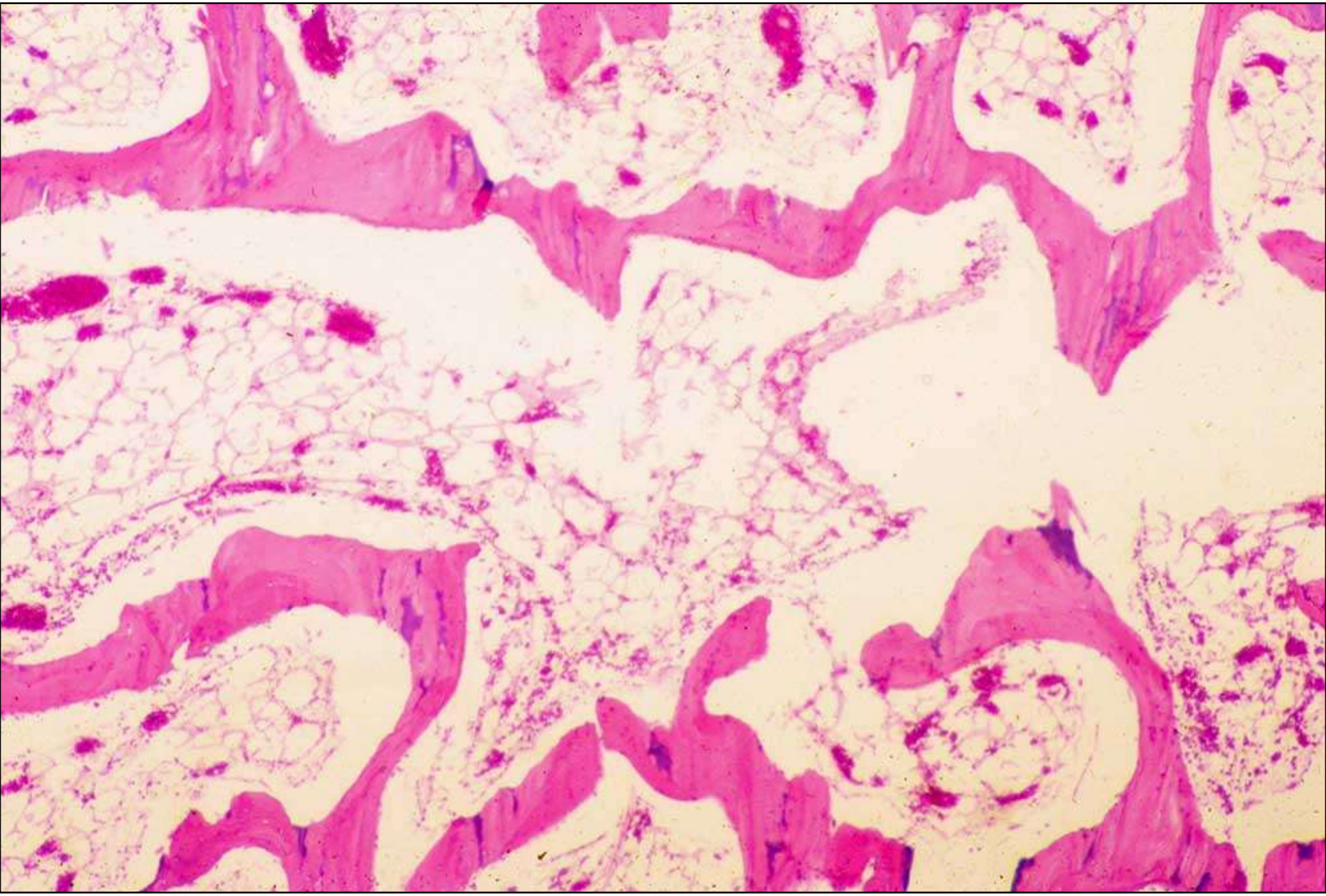
Growth Arrest Lines

THIS IS REALLY AN ERROR IN MODELING AND NOT E/C OSSIFICATION

Growth Arrest Line

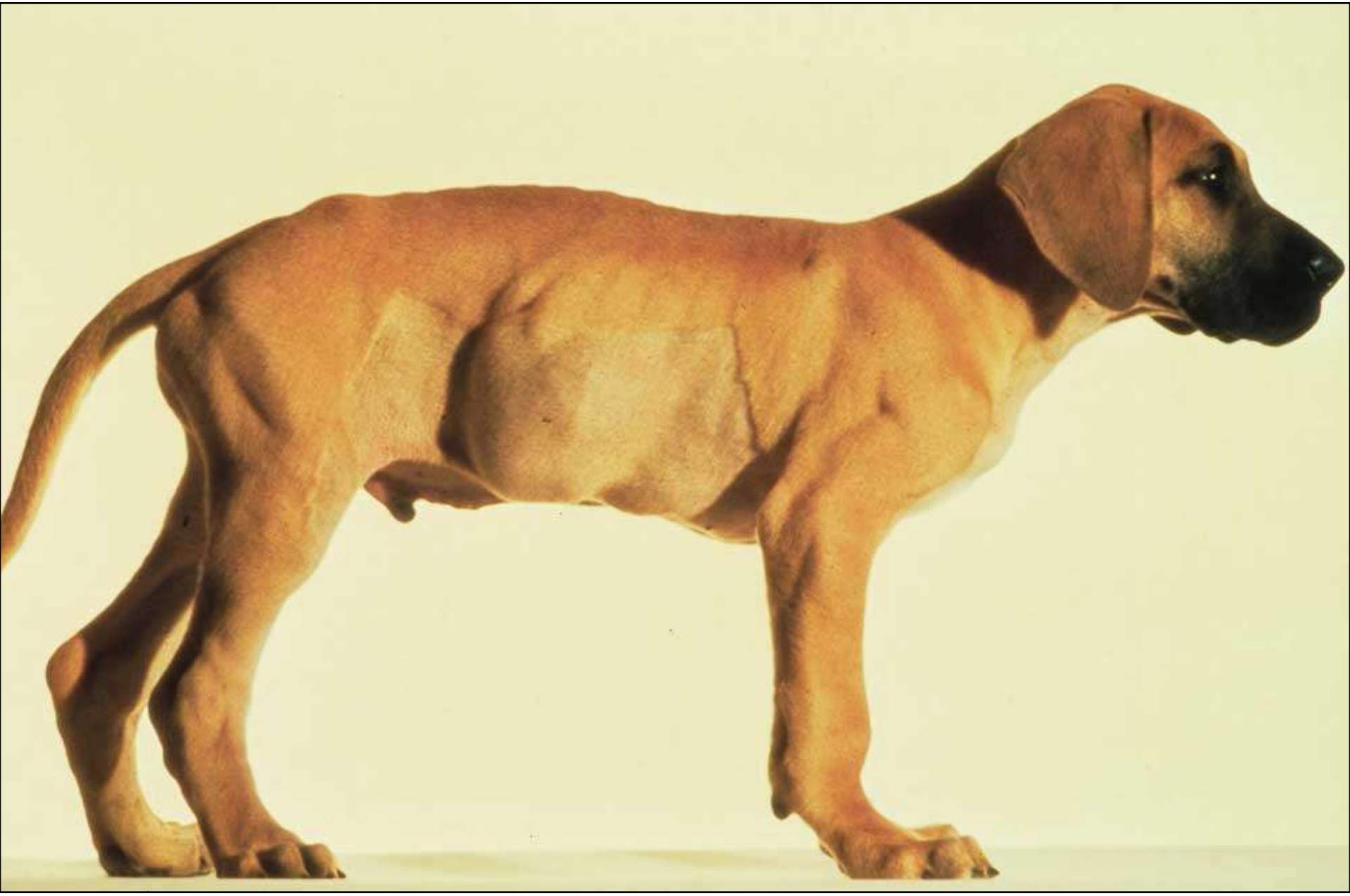
- Transverse trabeculation between trabeculae secondary to slowed longitudinal growth
- Mechanism = ???

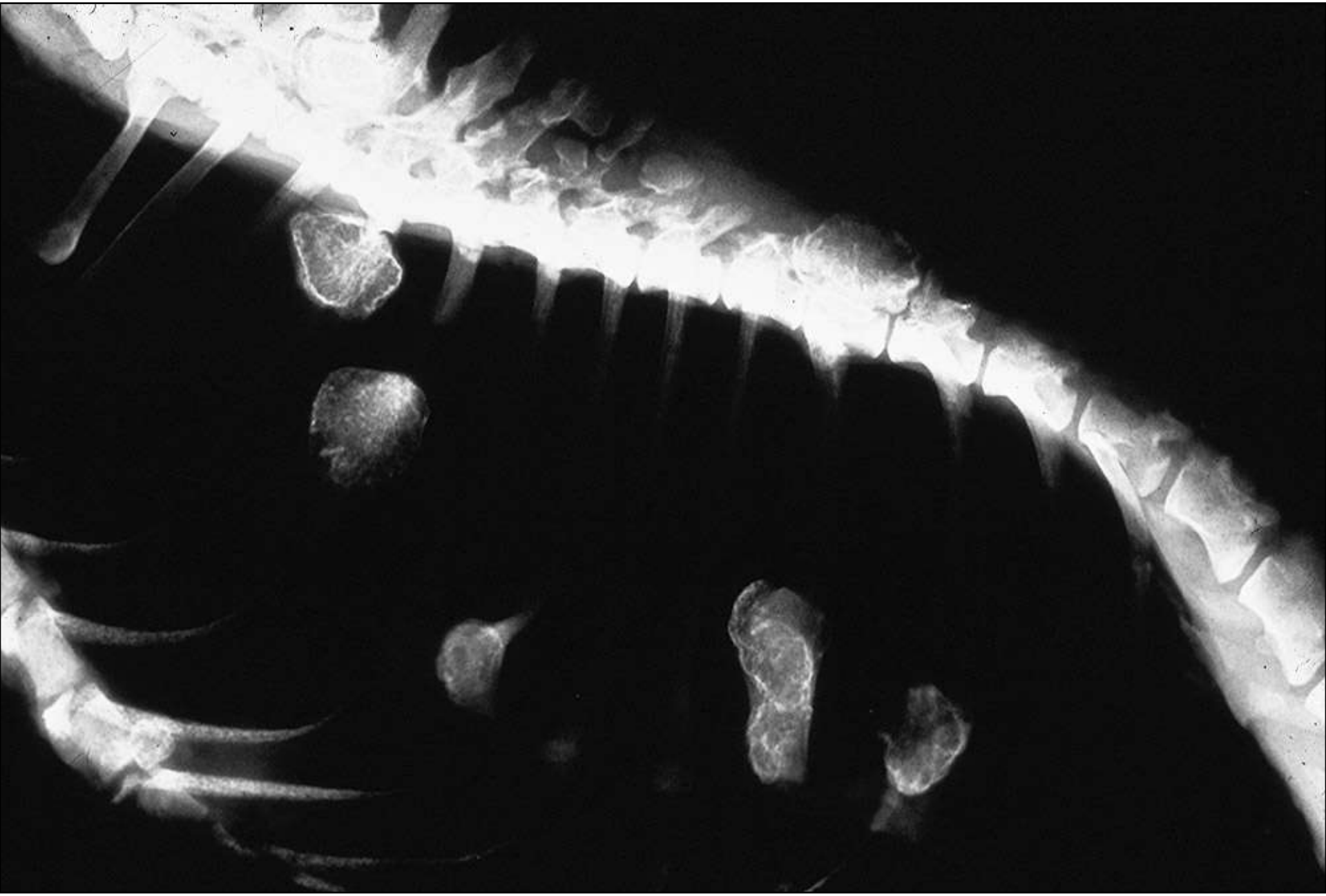


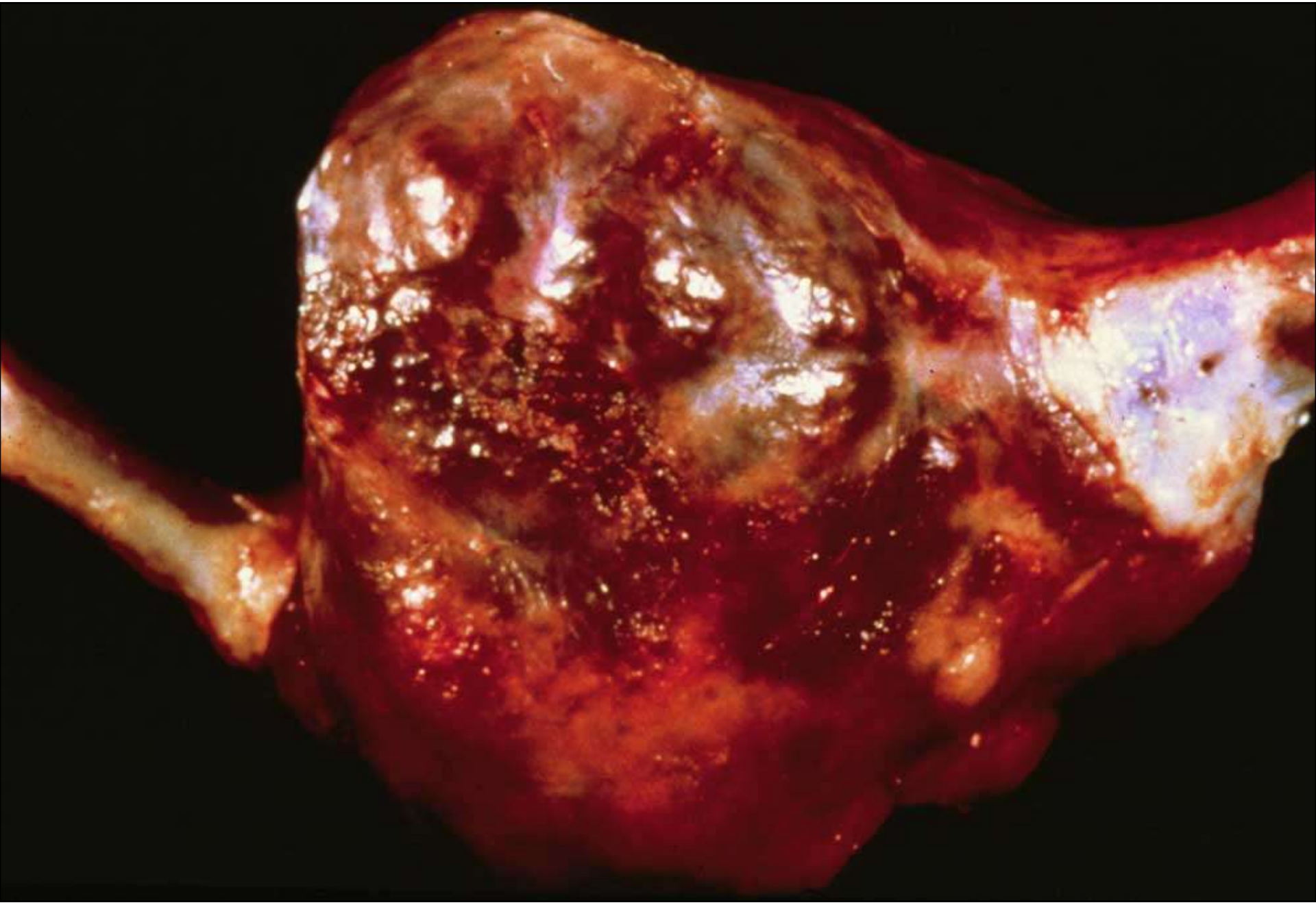


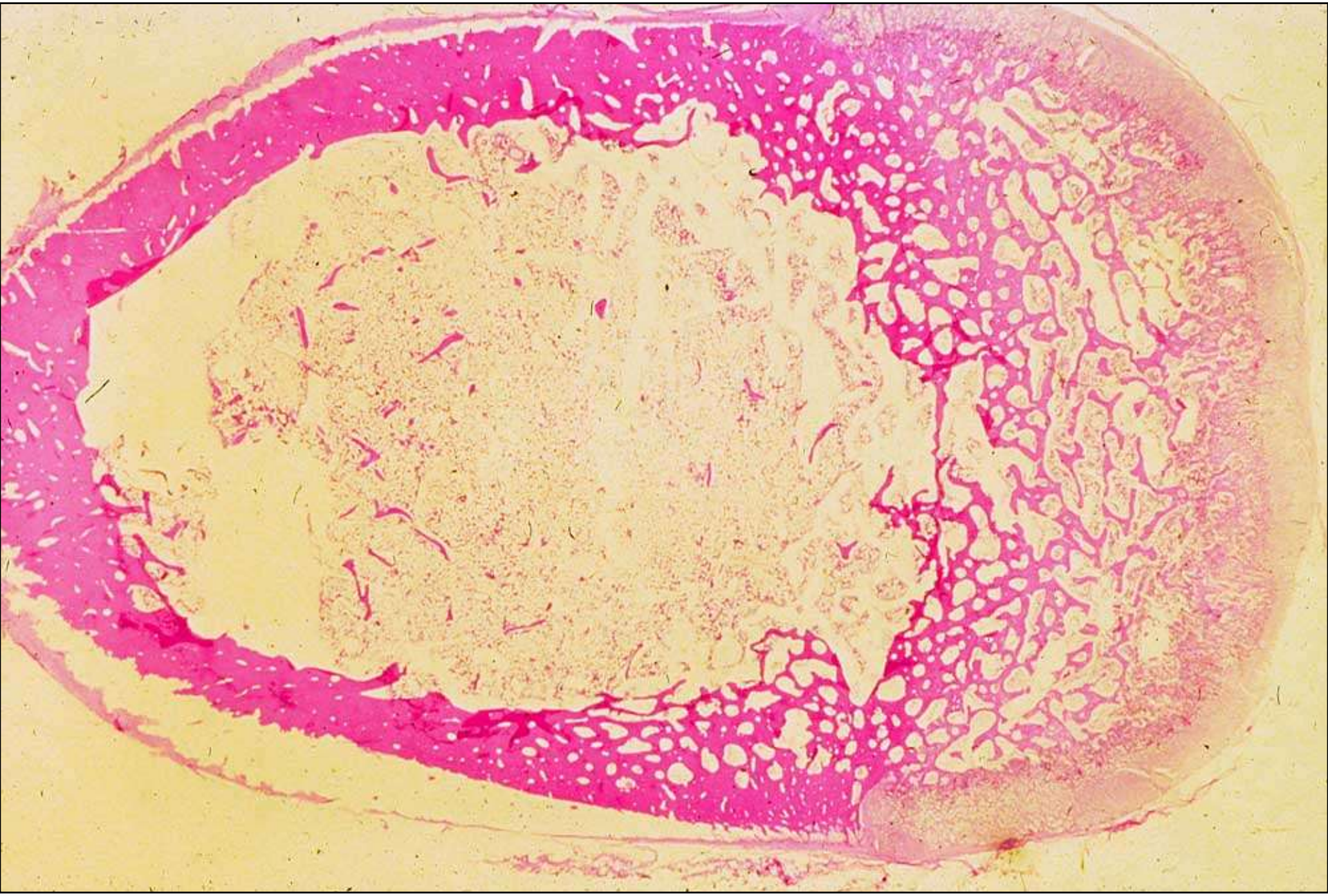
Ectopic Endochondral Bone Growth

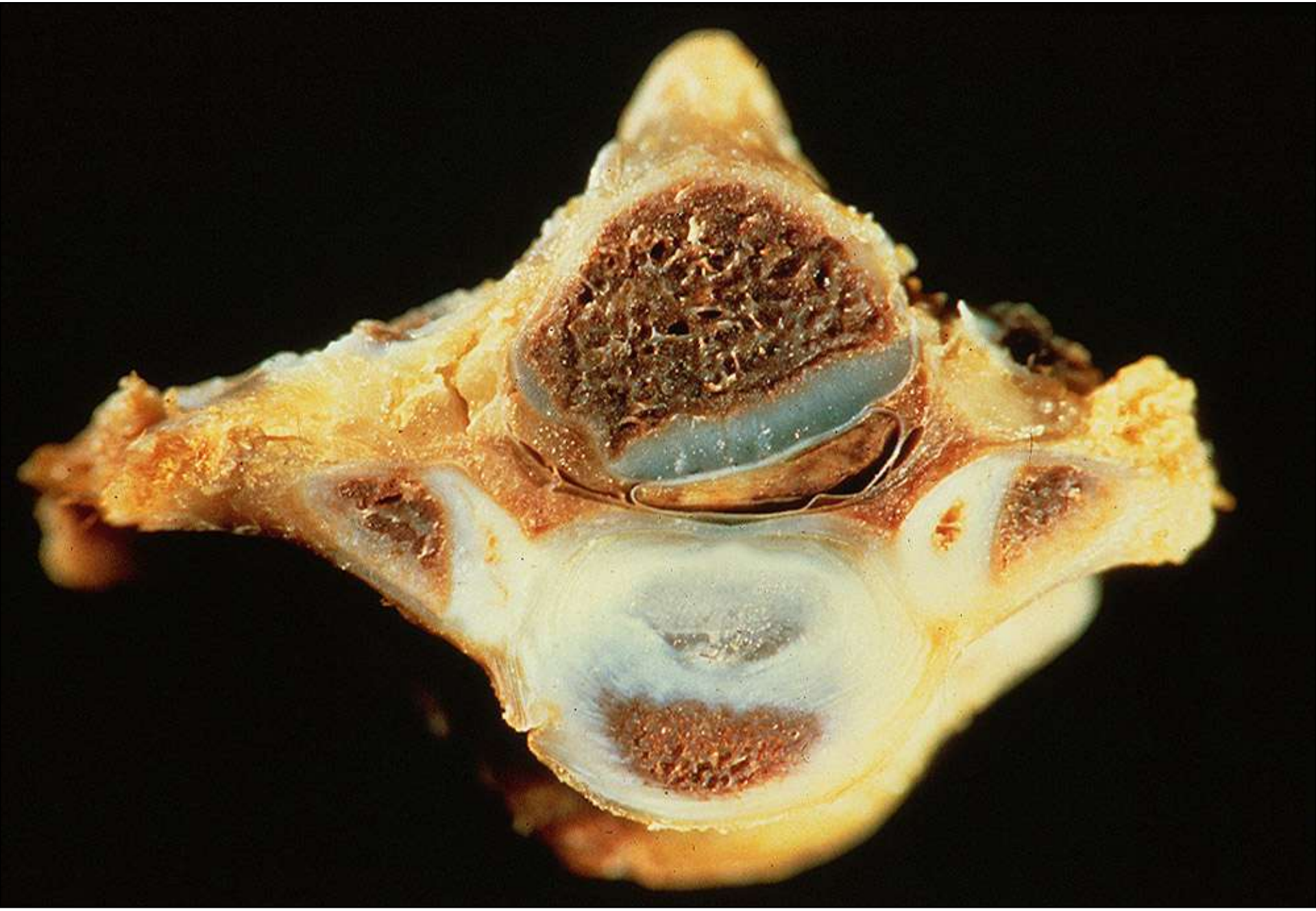
Osteochondromatosis











Abnormal Modeling

Modeling in response to structural damage and abnormal use (Wolff's Law)

Bone will model to accommodate mechanical use

- Formation with compression
- Resorption with tension
- Alignment of trabeculae along lines of stress

Detection of Altered Mechanical Use

- Streaming potentials in the canalicular system
- Piezoelectric forces derived from deformation of the collagen “crystal” lattice
- Stretch receptors on osteoblasts
- Compression/tension on nerves and blood vessels

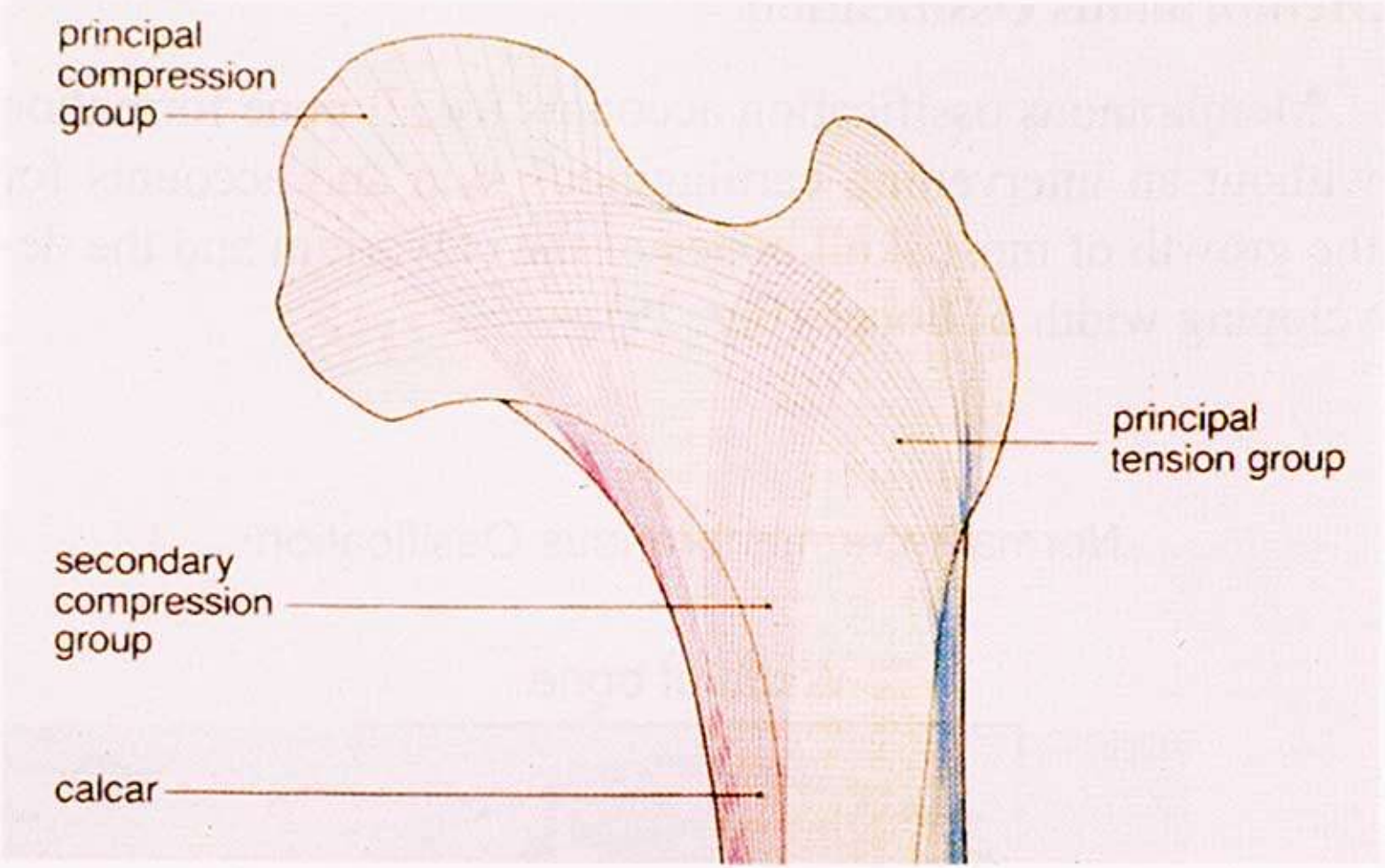
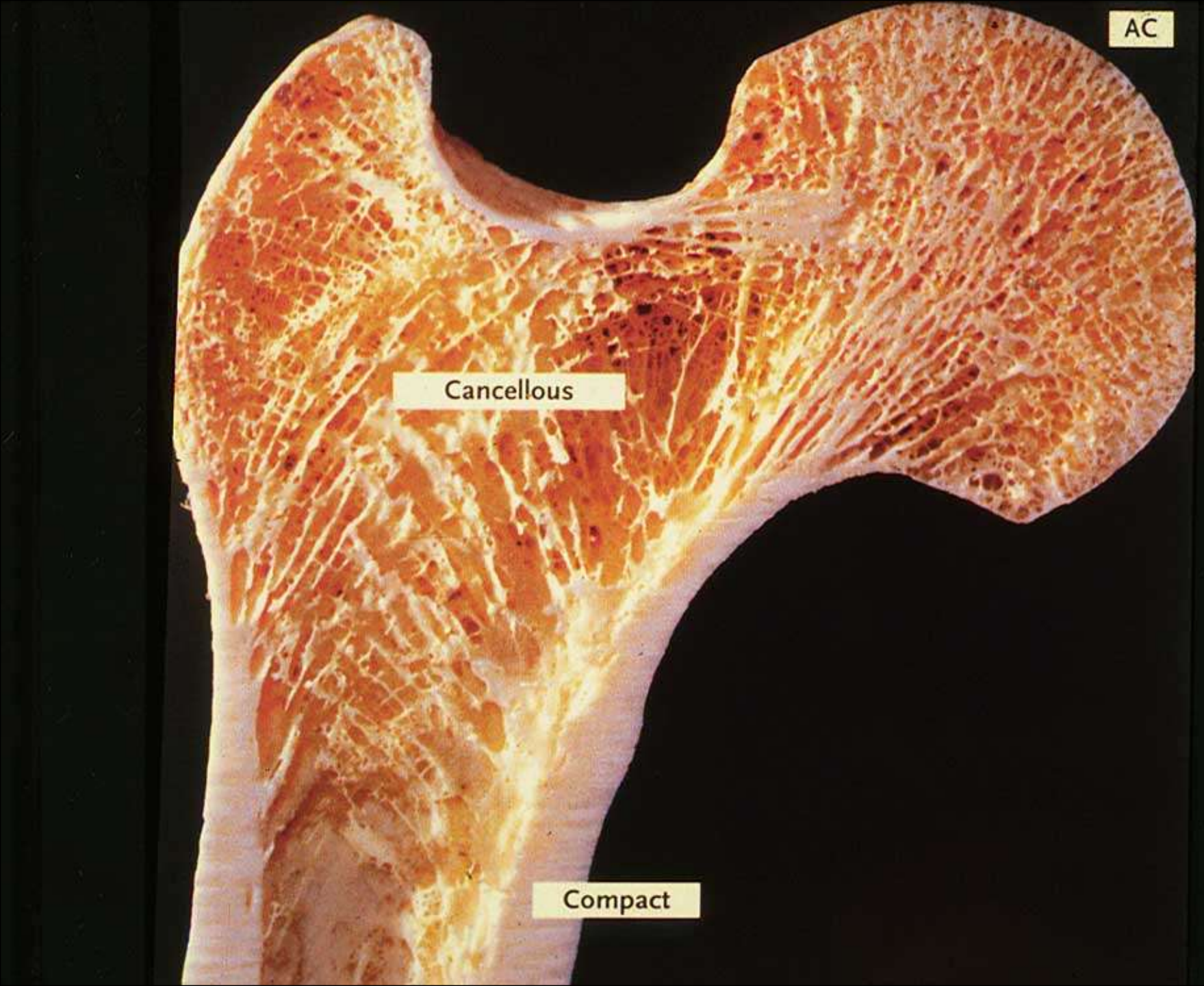


FIG. 31. Bone modeling: the trabecular structure of the proximal femur is a composition of arcades of cancellous bone that "model" or "shape" the internal architecture of bone along compressive and tensile stresses produced during weight bearing.


AC
Cancellous
Compact

Angular Limb Deformity

- Secondary to trauma or inflammation at the physis (physitis in horses)
- Many cases due to conformational abnormalities of complex cause/pathogenesis
- Bone can “drift” to a bended contour; flexible bending would require abnormal quality of the bone as in fibrous osteodystrophy

Abnormal Modeling

Angular Limb Deformity


R
OP

Change in Bone Mass due to Altered Remodeling

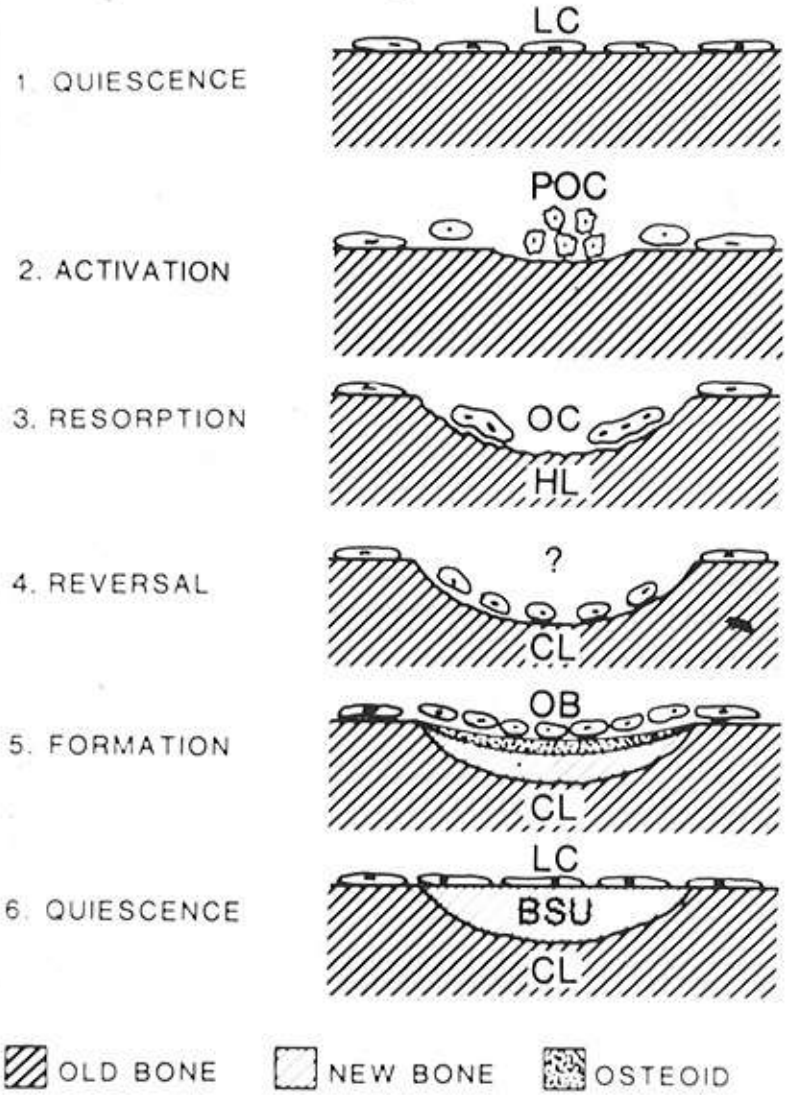


Fig. 1. The normal remodeling sequence in adult bone. Schematic representation of successive events on the endosteal surface. LC—lining cell. POC—preosteoclast (mononuclear). OC—osteoclast (multinucleated). HL—Howship's lacuna. CL—cement line. OB—osteoblast. BSU—bone structural unit. (Modified from Resident and Staff Physician (December 1981, 60–62) with permission.)