

# HIGH-YIELD MUSCULOSKELETAL SYSTEM NOTES

FOR USMLE STEP 1 AND STEP 2

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**Dear IMG**

High-Yield Notes for USMLE Step 1 & Step 2 CK

# STEP 1 - PATHOPHYSIOLOGY & BASIC SCIENCE

## COLLAGEN TYPES

- Type I = BONE + Skin + Tendon + Dentin + Fascia → OI + Ehlers-Danlos (vascular)
- Type II = CARTILAGE (2 wheels on biCycle)
- Type III = Reticulin = Skin + Blood vessels + Uterus → Ehlers-Danlos vascular type
- Type IV = Basement membranes → Goodpasture (anti-GBM = anti-Type IV)
- Type X = Growth plate (hypertrophic zone)

ARTHRTIS PATHOPHYSIOLOGY

Dear IMG

- OA = Mechanical wear → ↓ Proteoglycans → ↓ Type II collagen → Cartilage loss → Osteophytes
- RA = Autoimmune → CD4+ T cells → B cells → RF + Anti-CCP → Pannus formation → Bone erosions
- Pannus = Inflamed proliferating synovium → Contains osteoclasts → Destroys cartilage/bone
- Gout = Uric acid crystals → Neutrophils engulf → ↑ IL-1 + IL-8 → Acute inflammation
- CPPD = Calcium pyrophosphate crystals → Same neutrophil-driven mechanism

## CRYSTAL ARTHROPATHIES - STEP 1

- Gout: Monosodium urate → Needle-shaped → NEGATIVELY birefringent → Yellow parallel to light

- Uric acid = End product purine metabolism → Xanthine oxidase → Uric acid
- Lesch-Nyhan = HGPRT deficiency → ↑ Uric acid + Self-mutilation + Gout + Chorea
- Von Gierke (G6P deficiency) → ↑ Lactate → Competes with urate excretion → Gout
- CPPD: Calcium pyrophosphate → Rhomboid-shaped → POSITIVELY birefringent → Blue parallel to light
- CPPD associations: Hyperparathyroidism + Hemochromatosis + Hypomagnesemia + Hypothyroidism + Wilson disease
- Hydroxyapatite = Calcific tendinitis → Shoulder → Chalk-like aspirate

**CONNECTIVE TISSUE - STEP 1**

**PATHOLOGY**

- Marfan = FBN1 gene → ↓ Fibrillin-1 → ↑ TGF-β → Connective tissue weakness → AD
- Ehlers-Danlos = Collagen mutations → Type III most common (vascular) → AD
- Osteogenesis imperfecta = COL1A1/COL1A2 mutations → ↓ Type I collagen → AD (Type I) or AR (rare)
- Achondroplasia = FGFR3 gain-of-function → Inhibits chondrocyte proliferation → AD (80% new mutations)
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## **BONE DISORDERS - STEP 1 PATHOLOGY**

- Osteoporosis = ↓ Bone mass + Normal mineralization → ↓ Estrogen → ↑ Osteoclasts
- Osteomalacia = ↓ Mineralization (osteoid accumulates) → ↓ Vitamin D → ↓ Ca<sup>2+</sup>/PO<sub>4</sub>

- Paget =  $\uparrow$  Osteoclasts THEN  $\uparrow$  Osteoblasts  $\rightarrow$  Disorganized woven bone (mosaic pattern)
- Labs Paget:  $\uparrow\uparrow$  Alk Phos + Normal  $\text{Ca}^{2+}$  + Normal  $\text{PO}_4$
- AVN = Disrupted blood supply  $\rightarrow$  Ischemic necrosis  $\rightarrow$  Femoral head most common
- Osteitis fibrosa cystica = Hyperparathyroidism  $\rightarrow$  Brown tumors + Subperiosteal resorption
- Renal osteodystrophy = CKD  $\rightarrow$   $\downarrow$  Vit D +  $\uparrow$   $\text{PO}_4$   $\rightarrow$   $\downarrow$   $\text{Ca}^{2+}$   $\rightarrow$  2° hyperparathyroidism
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## BONE TUMORS - STEP 1 PATHOLOGY

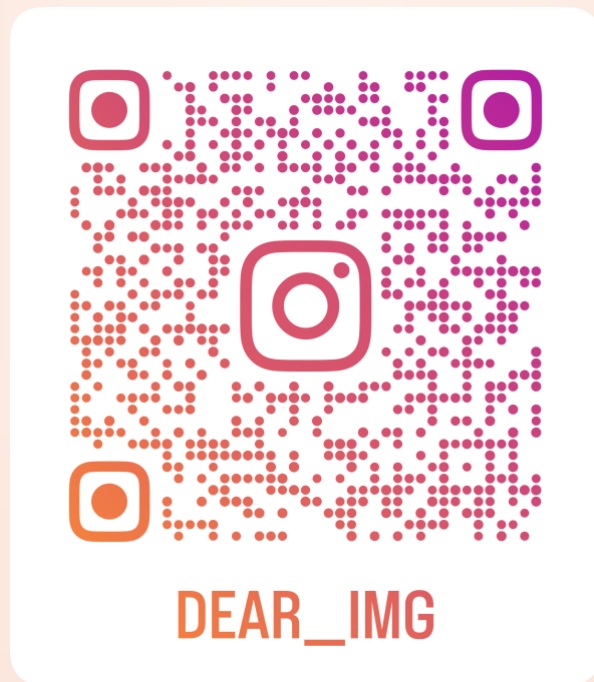
- Osteosarcoma = Malignant osteoid-producing  $\rightarrow$  Metaphysis long bones  $\rightarrow$  Codman triangle + Sunburst  $\rightarrow$  Rb gene + p53

- Ewing sarcoma = Undifferentiated round blue cells → Diaphysis → t(11;22) EWS-FLI1 → PAS+ → Onion skin
- Giant cell tumor = Osteoclast-like giant cells → Epiphysis + Metaphysis → Soap bubble → RANKL+
- Osteoid osteoma = Nidus of osteoid <2cm → Pain RELIEVED by aspirin → Reactive sclerosis around
- Osteoblastoma = Same as osteoid osteoma but >2cm → NOT relieved by aspirin → Vertebrae
- Osteochondroma = Cartilage cap on bony projection → Most common benign bone tumor
- Enchondroma = Benign cartilage in medullary cavity → Ollier disease (multiple) → Risk malignant transformation



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