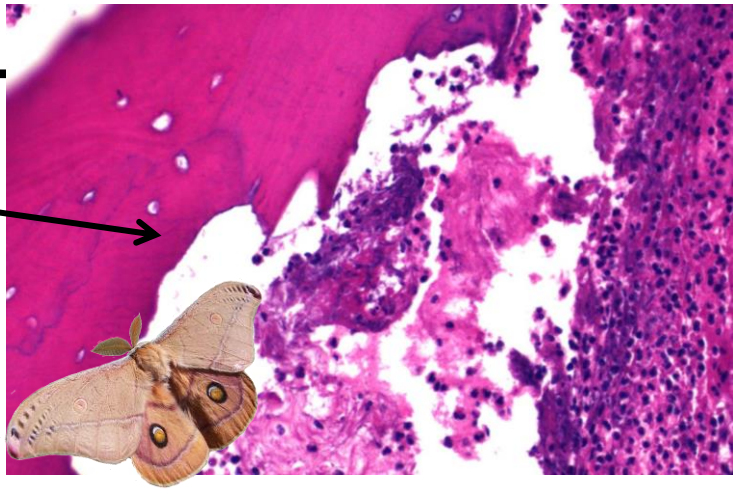
Non-Neoplastic Bone & Joint Lesions

Infectious

Acute Osteomyelitis



aka Suppurative or Pyogenic osteomyelitis

Acute **Inflammation** with **Bone Destruction**

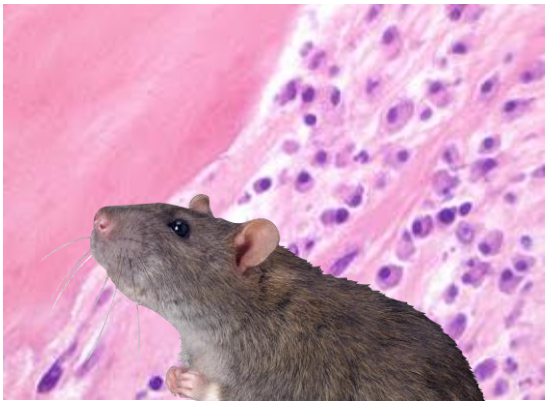
Necrotic bone with empty osteocyte lacunae.
May see brisk osteoclast activity.
Bone often appears "moth eaten" (irregular erosions) with lots of "rat bites."

Often caused by **bacteria** (usually *Staph*)

Can get from hematogenous spread ("primary," often in kids in metaphysis of long bones or adults in spine).

Can also be from direct inoculation, often from trauma or ulceration ("secondary," often adults)

Chronic Osteomyelitis



Chronic **Inflammation** with **Bone Destruction**

Marrow replaced by fibrosis with plasma cells and lymphocytes
Often bone remodeling with osteoclasts and osteoblasts
- Plasma cells are polytypic (mixture of kappa and lambda)!
- Similar irregular rat/moth-eaten appearance
- Often granulation tissue

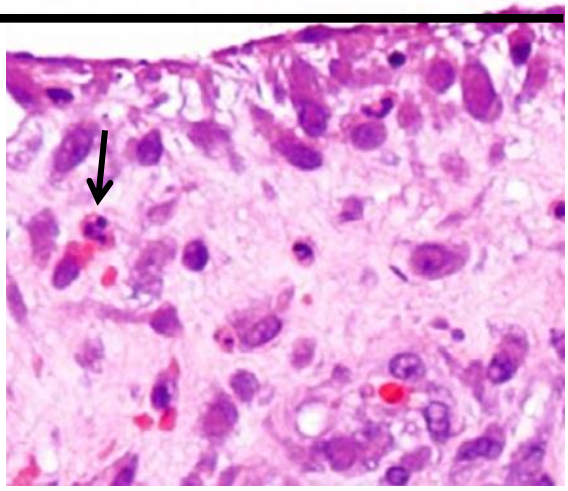
Necrotizing granulomas→ consider Tuberculosis ("Pott's disease" in spine),

Can have sinus tract to surface line by squamous epithelium→ can turn into squamous cell carcinoma.

Septic Arthritis

Neutrophilic inflammation of synovium with accumulation of pus in joint space. Often clinical/lab Dx.
Caused by bacteria, often *Staph* (esp. *S. epidermidis* with prosthetic joints).
Leads to rapid cartilage destruction→ acute medical emergency that needs rapid treatment.

Periprosthetic Joint Infection



Can cause prosthetic loosening, requiring revision arthroplasty
If there is concern for infection, will often send joint capsule for frozen section neutrophil count (cutoff often **>5 neutrophils/single HPF in 5 separate HPFs, excluding surface fibrin**).

Be SURE it is PMN—lymphocytes can be twisty and mimic PMNs. Treatment = prosthesis removal and subsequent reimplantation after eradiation.

Also evaluated for clinically based on physical exam, culture, ESR, CRP, and synovial fluid studies.

Degenerative/Reparative Changes

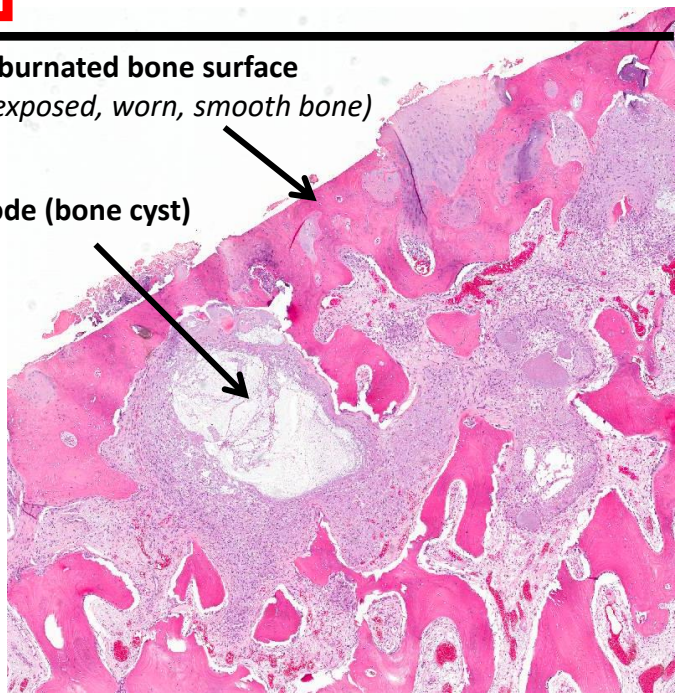
Degenerative Joint Disease

aka "DJD" or Osteoarthritis ("OA")

Non-inflammatory **loss joint cartilage**, subchondral **bone sclerosis**, periarticular bone cysts (Geodes), **osteophyte formation**, and synoviocyte hypertrophy/hyperplasia.

Common result of a variety of factors including **trauma**, **"wear and tear,"** metabolic diseases, avascular bone necrosis, and altered loading/anatomy.

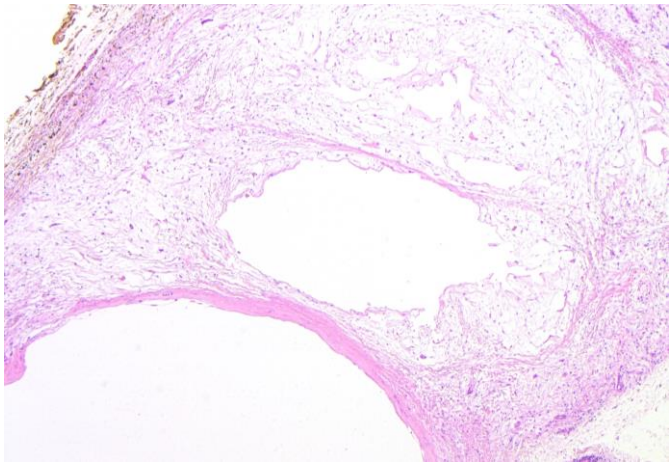
If treated surgically→ joint arthroplasty



Ganglion Cyst

Cysts composed of fibrous tissue without a lining.
Contain **myxoid/mucous material**.
Can be unilocular or multilocular.
Seems to arise from joint capsule.
Most often on **wrists** and hand/feet.
Most common in young adults.

Can surgically excise if bothersome.
Historically, could strike and rupture with a large heavy book (e.g., a Bible)→ "*Bible bump*"



Fracture Callus

Reparative changes seen at **a site of prior bone fracture**

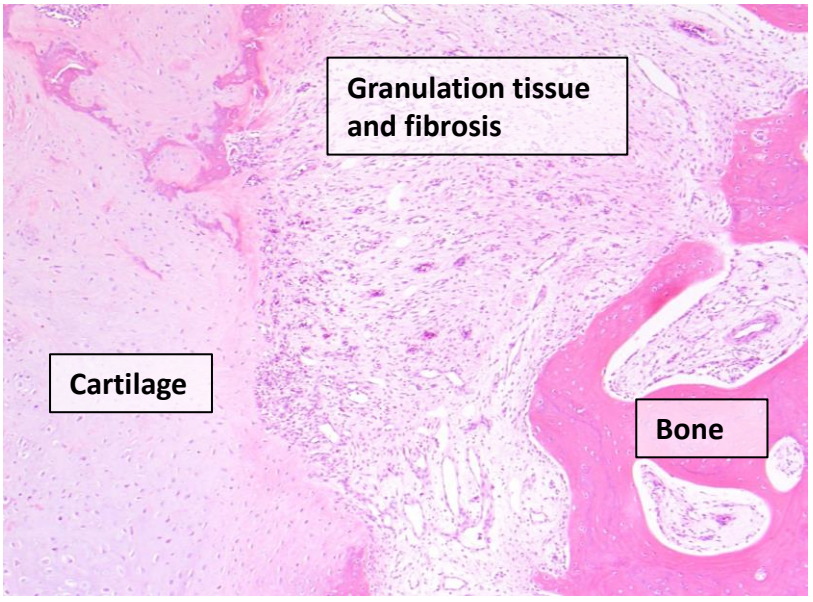
Immediately after fracture→ hemorrhage and hematoma→ gradually replaced by organization and granulation tissue

Woven bone, fibrosis, and cartilage with ossification

Prominent osteoblastic rimming and bone remodeling

Fracture can be seen on imaging.

Should *NOT* see: atypical mitoses, significant cytologic pleomorphism

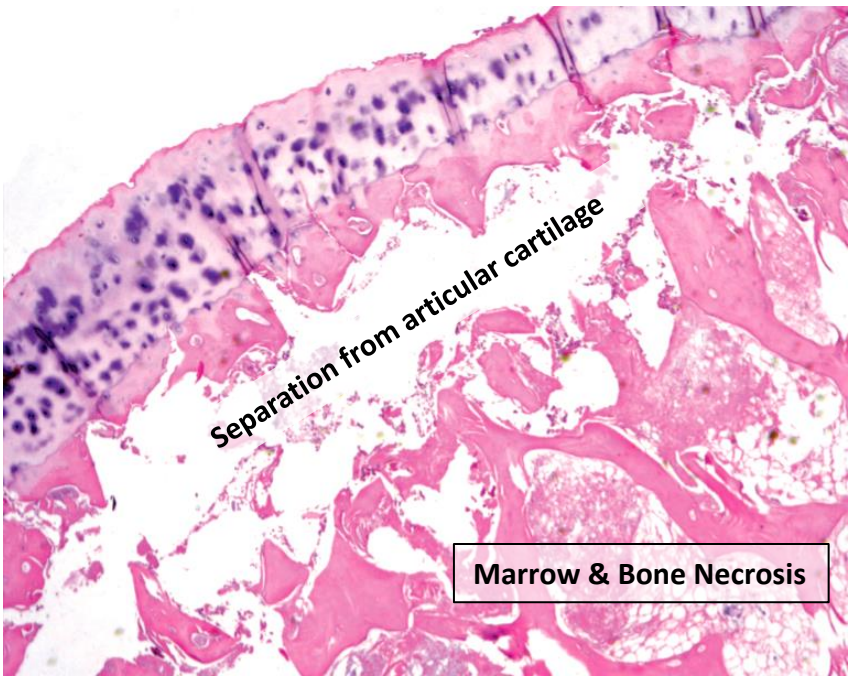


Avascular Necrosis

Geographic area of subchondral bone and marrow necrosis with partially separated articular cartilage surface ("crescent sign").

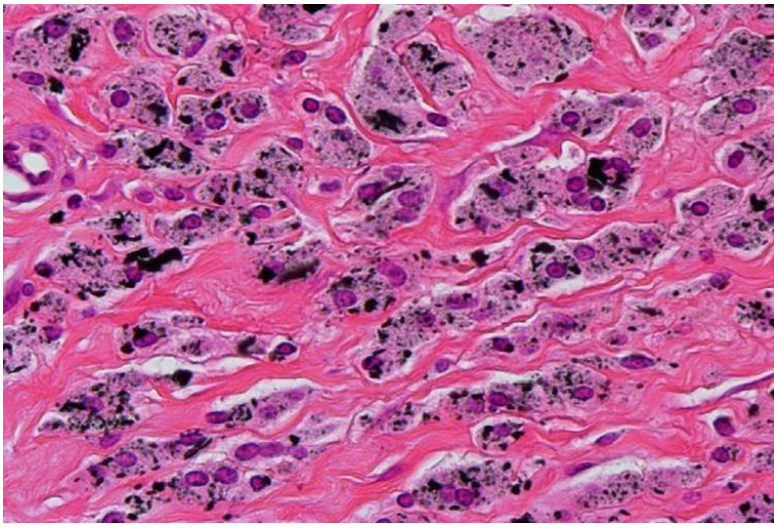
Risk factors: Trauma, Steroids, Alcohol, Chemotherapy, Collagen vascular disease, Pregnancy, etc…

→ Leads to DJD/OA→ requires joint replacement



Aseptic Joint Loosening

Foreign material wear particles (fragments of prosthetic that have broken off: metal, polyethylene glycol, cement, ceramic, etc..) are **ingested by macrophages**→ causes inflammation around joint → Osteolysis → Joint loosening



Abundant foamy histiocytes, Foreign body giant cells, and inorganic particles.

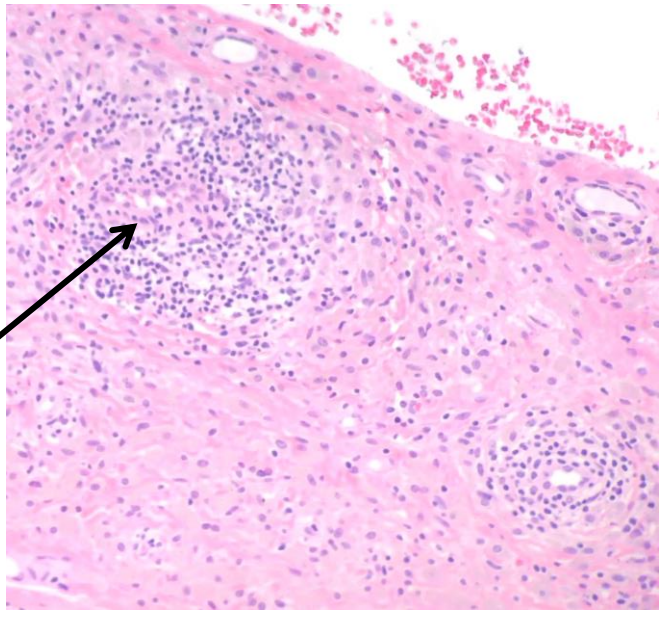
Wear particles from metal articular surfaces are small and appear black. Accumulate in macrophages and fibrous tissue→ "**Metallosis**"

Metal can even make its way to regional lymph nodes!

Aseptic Lymphocytic Vasculitis-associated Lesion (AVAL)

Seen with metal-on-metal articulations. Despite name, no true vasculitis.

Three defining features:
1) **Prominent lymphoid aggregates**, often near venules
2) *Absence* of obvious metal debris
3) **Necrosis of synovium**



Loose Bodies

Loose fragments of tissue found free within the joint space
Can result from trauma, DJD, or neoplasm.
Most common in knee→ cause locking and pain

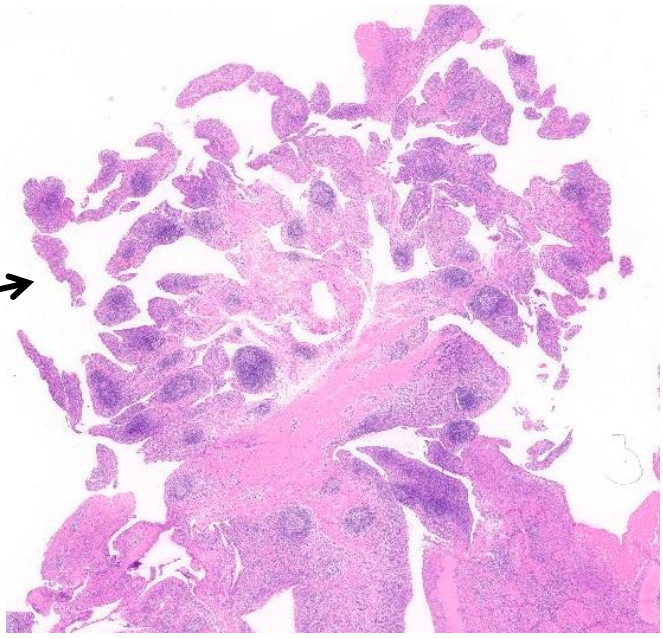
Fibrinous Loose bodies ("Rice Bodies")
Consist of laminated fibrin. Grossly resemble rice grains.

Osteochondral or Cartilaginous Loose bodies
Detached fragments of articular cartilage ± bone.
Result from trauma. Often solitary.

Synovial Chondromatosis
Locally aggressive *neoplasm*. Multiple hyaline cartilage nodules within synovium or loose in joint space. Chondrocytes cluster together in groups.
FN1-ACVR2A fusions.

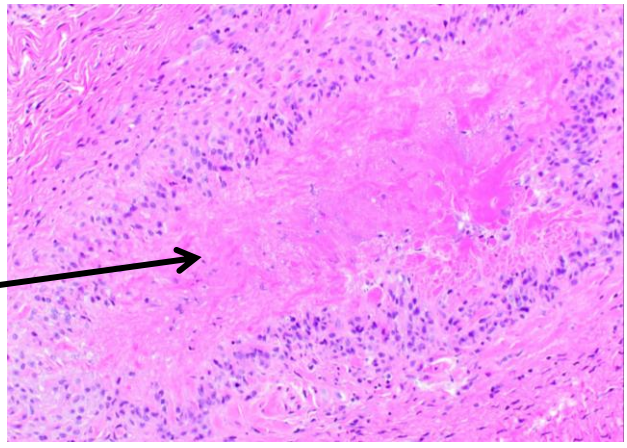
Autoimmune Diseases

Rheumatoid Arthritis



Most common primary inflammatory arthropathy.
Chronic, idiopathic erosive symmetric polyarthropathy.
Impacts all joints, but worst impacted are small joints of hands (MCP & PIP), feet, and C-spine.
Many extra-articular manifestations (e.g., Lung disease)
Serology: Positive Rheumatoid Factor (RF)

Chronic Synovitis:
Expands synovium with **chronic inflammation** (lymphocytes and plasma cells), often with lymphoid aggregates.
Often reactive/**hyperplastic synovium** with **surface fibrin/fibrinoid necrosis** and granulation tissue.
May erode nearby bone.
Sometimes occasional neutrophils.



Pannus
Synovium that erodes cartilage and other joint structures→ characteristic marginal erosions of bone on X-ray.

Rheumatoid nodule:
Necrotizing granulomas with central necrobiosis

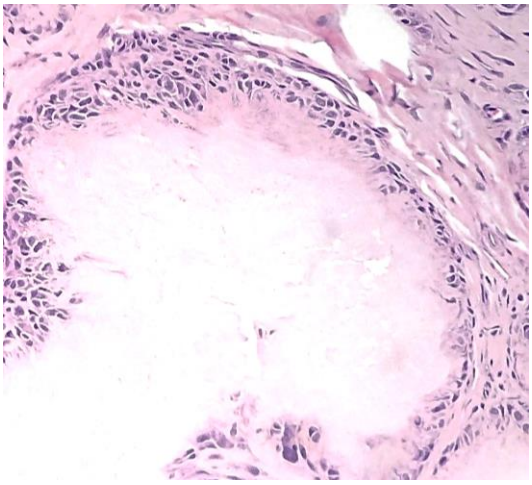
DDX for nodule: Granuloma annulare, infection, and epithelioid sarcoma (CK+, INI1 loss)

Crystalline Diseases

Modified from a presentation by Scott Kilpatrick, Cleveland Clinic, USCAP 2021

	Gout	Pseudogout	Tumoral calcinosis
Age	30-50 yrs (middle age)	>50 yrs (older)	10-40yrs (young)
Site	1st MTP	Knee	Shoulder, Hips
Crystal Shape	Needle	Rhomboid	Irregular gritty plates
Type	Uric acid	Calcium pyrophosphate	Calcium hydroxyapatite
Polarizable	+	+	-
Seen on H&E	-	+	+
Inflammatory reaction	+	-	+

Gout



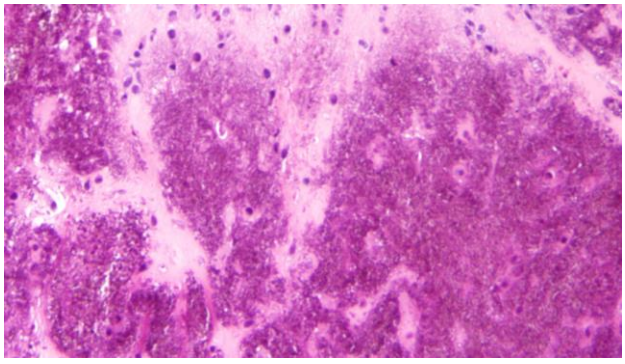
Uric acid metabolic disorder→ hyperuricemia→ deposit monosodium urate crystals in joint fluid and tissues

Classically middle-aged males
Most common joint: 1st MTP, but can get anywhere

Uric acid dissolves in water during staining process (so often not seen well on H&E slides), but can be seen on fresh touch preps or unstained slides→ "**needle-shaped**" yellow, negatively birefringent crystals. Joint fluid often neutrophil-rich.

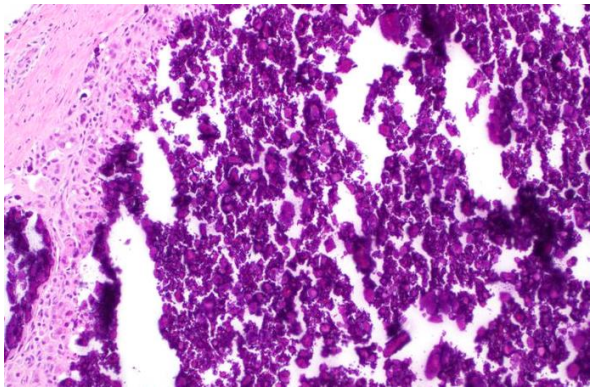
On H&E: See fluffy pink deposits with associated granulomatous inflammation and giant cells. Soft tissue deposits = "**Tophi**"

Pseudogout



Calcium Pyrophosphate Dihydrate (CPPD) deposits in cartilage and joint soft tissue.
Appear as **rhomboidal** purple positively birefringent crystals. On H&E: well-demarcated basophilic material with virtually no inflammatory response
Often associated with degenerative joint disease.
Often *incidental* finding in arthroplasty finding.

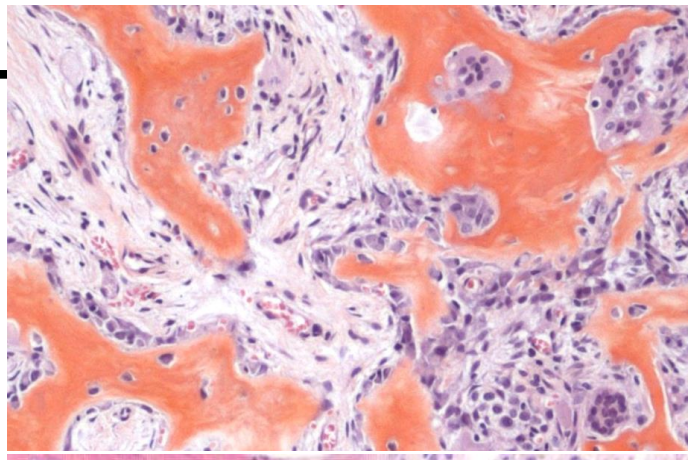
Tumoral Calcinosis

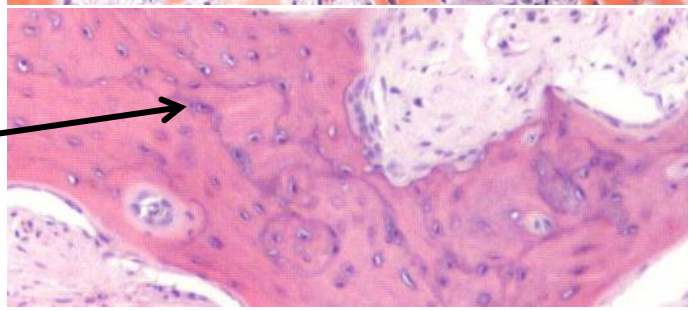


Calcium hydroxyapatite deposits
Common locations: shoulder, sites of pressure
Can be localized in relation to **trauma** or due to a **systemic disorder** (e.g., renal failure or hyperphosphatemia)
Lobules of apatite-type calcifications surrounded by chronic inflammation with a prominent foreign body giant cell reaction

Metabolic/Endocrine/Idiopathic

Paget Disease





Localized disorder of bone remodeling characterized by focal areas of increased turnover **with excess bone synthesis and resorption.**
Often localized to a single bone in elderly men.
Early → more resorptive; Late → more synthesis.

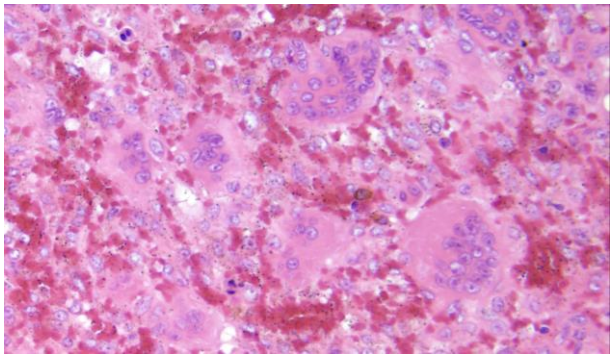
Unusually **large osteoclasts** with increased nuclei and prominent nucleoli.
Prominent osteoblastic rimming.
Paratrabecular marrow fibrosis.
Unusually thick and thin bone trabeculae

Numerous irregular reversal cement lines and bone scalloping. Mosaic pattern.

Etiology poorly understood

Increased risk of osteosarcoma

Brown Tumor of Hyperparathyroidism



Forms a **mass** lesion.
Most common in **Mandible** and **Maxilla**.

Hyperparathyroidism (often due to adenoma) → stimulates a proliferation of **osteoclasts** with fibrous tissue and hemorrhage (resembles many other giant cell-rich lesions, like reparative granuloma), so knowing PTH is key.
Treat with parathyroidectomy.

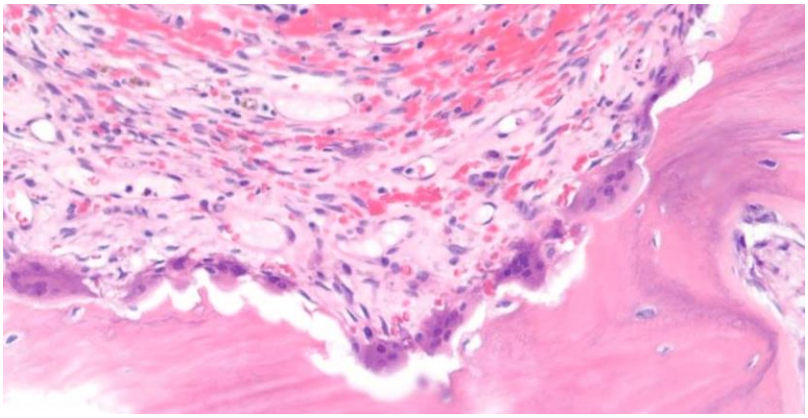
Also can see generalized bone changes with cortical bone loss → *osteitis fibrosa cystica*

Osteoporosis

Decrease in mass of mineralized bone → increased risk of fracture.

Frequent in postmenopausal women (due to estrogen loss) and with general aging. Can also be secondary to a variety of conditions (e.g., hyperparathyroidism, malnutrition) and medications (esp. Steroids).

Renal Osteodystrophy



Seen in setting of **chronic renal failure.**
Increased osteoclast activity → osteoporosis

With renal failure → hyperphosphatemia → secondary hyperparathyroidism → increased osteoclast activity

Also, Vit D deficiency → Hypocalcemia