Renal Osteodystrophy

- Renal osteodystrophy, also known as uremic osteopathy, is a constellation of musculoskeletal abnormalities that occur in patients with chronic renal failure, due to concurrent and superimposed
- Osteomalacia (adults) / rickets (children)
  - Secondary hyperparathyroidism: abnormal calcium and phosphate metabolism
  - Bone resorption
  - Osteosclerosis
  - Soft tissue and vascular calcifications
  - Brown tumors
- Aluminum intoxication, e.g. if the patient is on dialysis
- Chronic kidney disease-mineral bone disorder (CKD-MBD)
  - newer term for syndrome of abnormalities of calcium, phosphorus, vitamin D, and parathyroid hormone (PTH) with associated bone changes and extra skeletal calcification caused by CKD

Secondary hyperparathyroidism

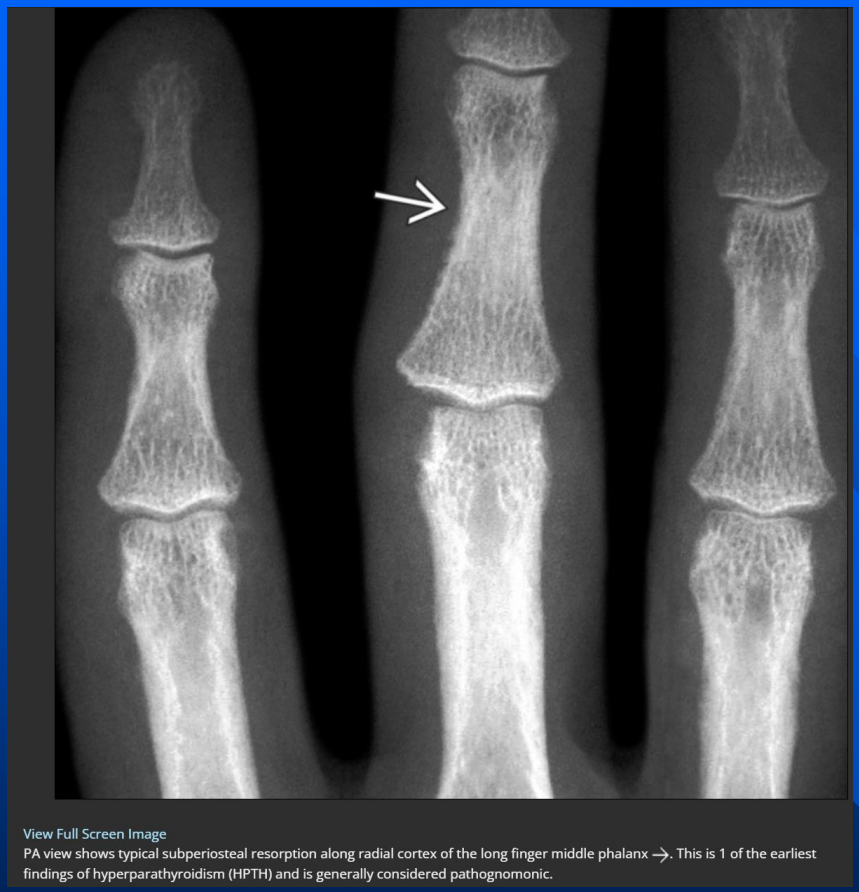
- Serum calcium concentration is the main determinant of parathyroid hormone (PTH) release.
- Defect in the activation of vitamin D in the kidneys due to chronic kidney disease (CKD) leads to hypocalcemia and hyperphosphatemia.
- This results in a compensatory increase in parathyroid gland cellularity and parathyroid hormone production and causing secondary hyperparathyroidism (SHP).

Imaging

- 2° HPTH manifests as bone resorption, brown tumors, and metastatic soft tissue and arterial calcification
- Osteomalacia: Looser zones (pseudofractures, Milkman fractures)
- Rickets: physis cupping, fraying, irregularity
- Generalized bone sclerosis, rugger jersey spine
- Amyloid deposition in bursae, tendons, tenosynovium, bones, joints, vertebral disc, articular cartilage, muscle
- Crystal deposition disease: gout, chondrocalcinosis, oxalosis, hydroxyapatite
- Osteonecrosis: usually from corticosteroids (kidney transplant)
- ↑ tendon and ligament laxity or tear
- Olecranon bursitis, osteomyelitis, septic arthritis

Dialysis-related conditions

- Olecranon bursitis, osteomyelitis, septic arthritis
- Amyloid deposition
  - Most common sites of deposition different from other causes of amyloidosis
    - Bursae, tendons, tenosynovium, bones, joints, vertebral disc, articular cartilage, muscle
  - Shoulder especially common site; creates shoulder pad sign
  - Wrist amyloid contributes to carpal tunnel syndrome
  - Subchondral cysts (hemodialysis cysts): carpus, especially scaphoid, lunate, capitate; MCP joints, hip, elbow
  - Sites of deposition in bone prone to fractures
  - Large joint erosive destructive amyloid arthropathy; most common shoulders and hips
  - Erosions in tight joints
  - Destructive spondyloarthropathy
    - Disc space narrowing, endplate sclerosis and fragmentation/irregularity, focal kyphosis
- Aluminum toxicity
- Radiographic changes identical to osteomalacia
- Presents as worsening of osteomalacia



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PA view shows typical subperiosteal resorption along radial cortex of the long finger middle phalanx →. This is 1 of the earliest findings of hyperparathyroidism (HPTH) and is generally considered pathognomonic.

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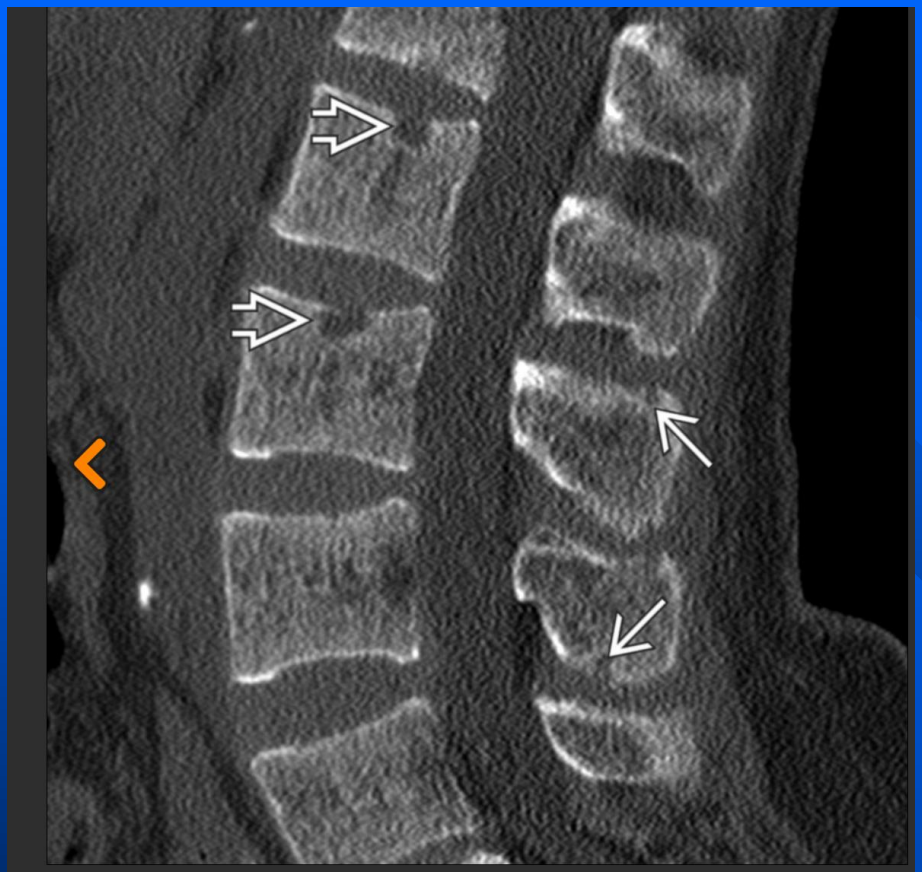
PA view shows several findings of renal osteodystrophy (ROD). Several fingers show acroosteolysis → with resorption of portions of distal tufts. However, there is also fluffy metastatic calcification ↗ about the sites of resorption. This is on a background of smudgy sclerosis from osteomalacia.



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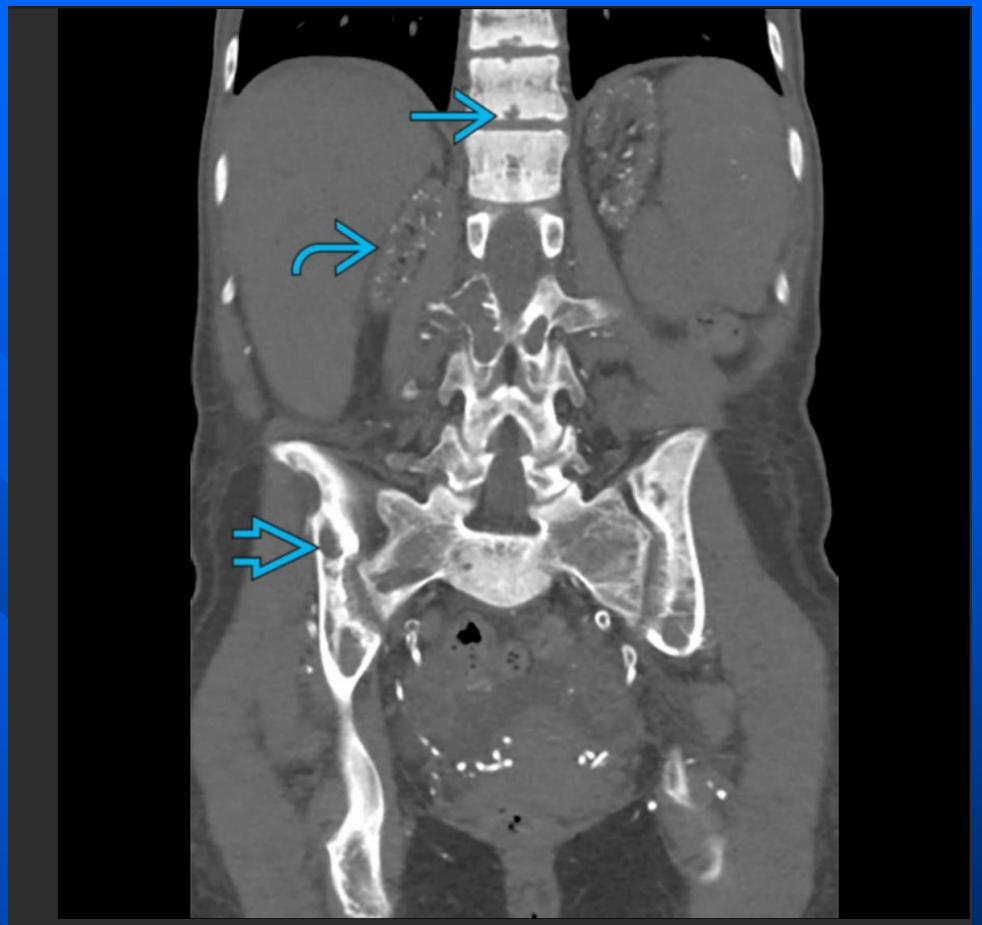
Sagittal bone CT shows coarsened and poorly defined trabeculae and multiple Schmorl nodes ⇨, all the result of osteomalacia. Several small foci of bone resorption → are the result of HPTH.



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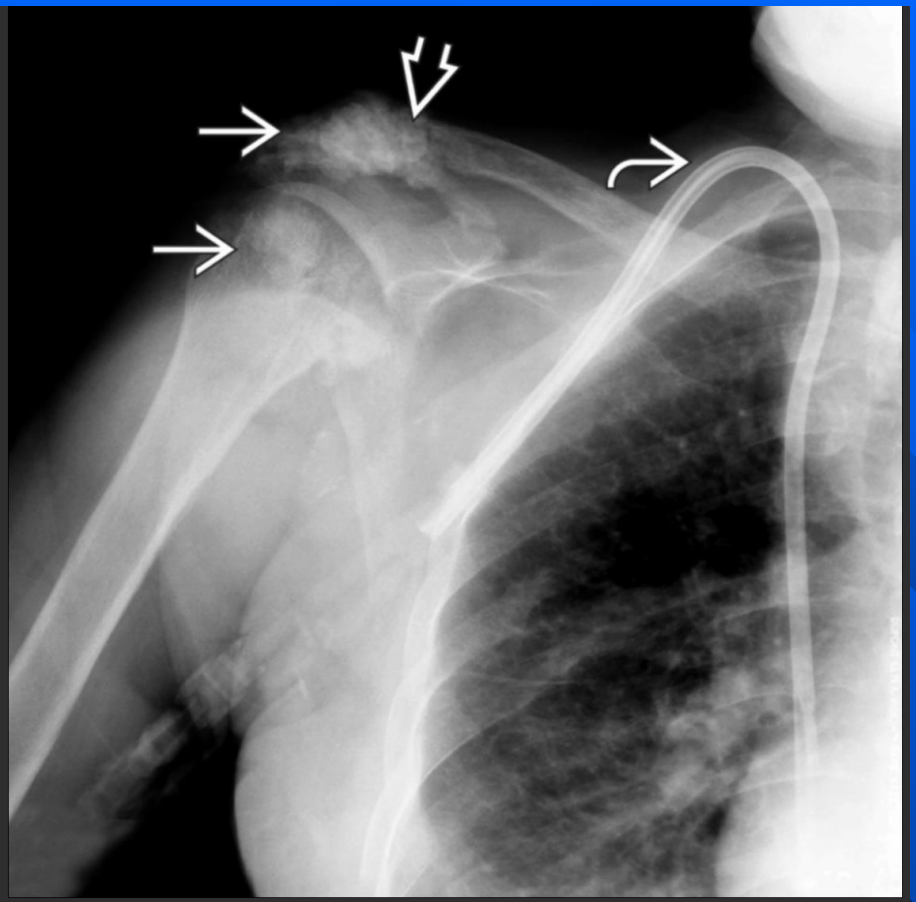
Coronal CT in a 24-year-old woman with severe ROD due to tertiary HPTH shows marked bone sclerosis and Schmorl nodes →, calcified, shrunken kidneys ↝, scattered soft tissue and vascular calcifications, and multiple lytic bone lesions ⇨.



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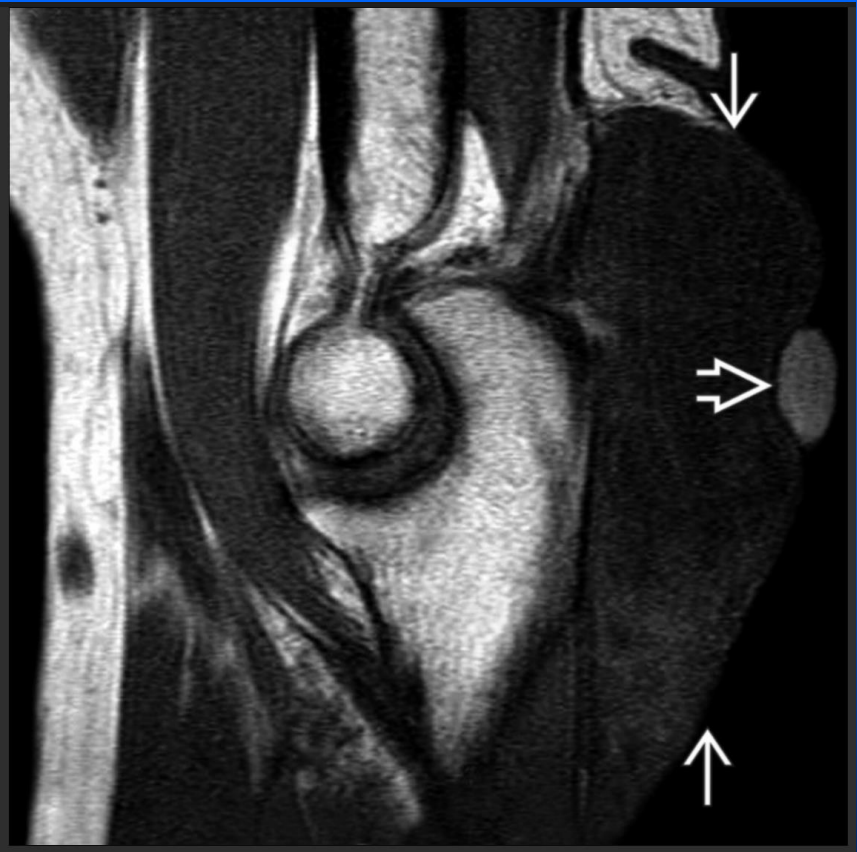
AP view shows globular, pasty calcium deposits around the shoulder →. The shoulder and hip are common sites for such tumoral-like calcinosis (metastatic calcification). The dialysis catheter ↗ provides a clue to the underlying etiology. Resorption of the clavicle is prominent but obscured by calcium ⇨.



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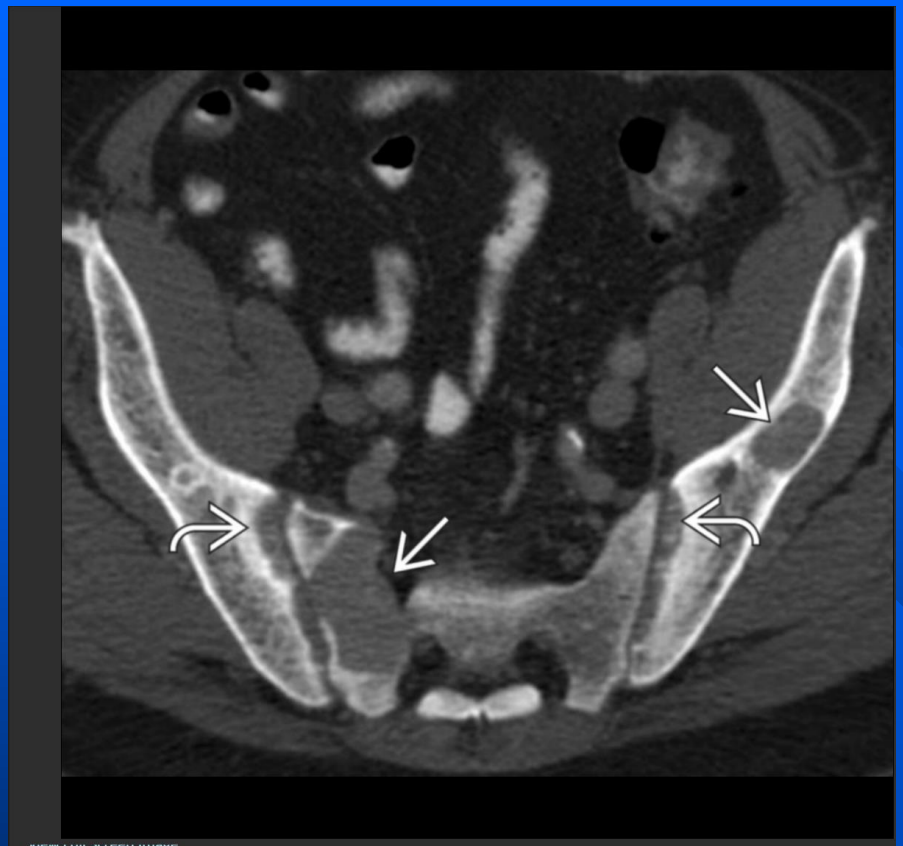
Sagittal T1 MR reveals a large complex fluid collection in the olecranon bursa →. In a dialysis patient, diagnostic possibilities include gout and "dialysis elbow," which is bursitis resulting from prolonged pressure on an immobilized elbow (marker ⇨ is present).



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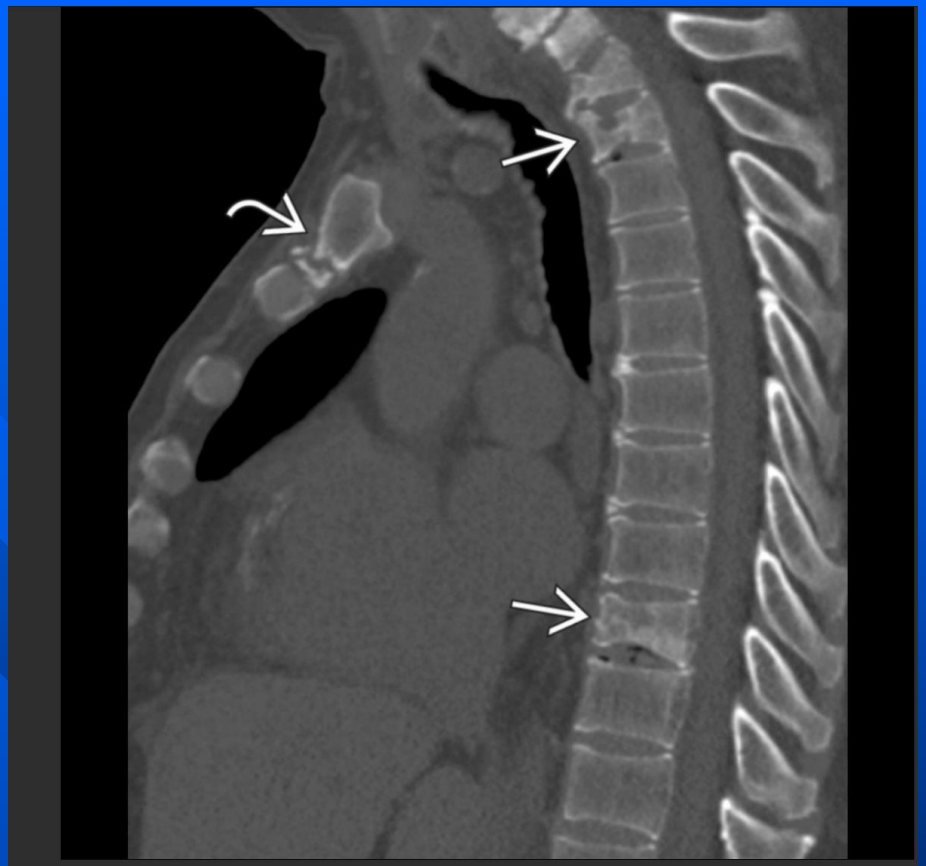
Axial bone CT reveals 2 lytic lesions with geographic nonsclerotic margins →. Similar lesions were present elsewhere, and the possibility of multiple myeloma was considered. Subchondral resorption at the SI joints ↗ is a clue to the underlying diagnosis of brown tumors in ESRD and secondary HPTH.



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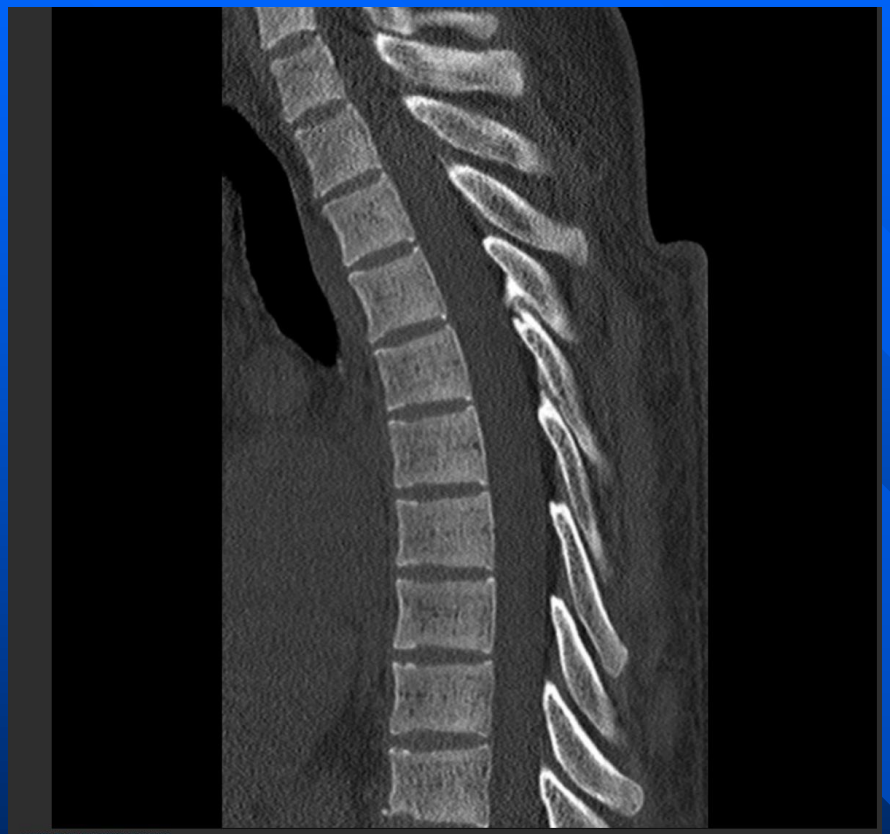
Sagittal CT in a 72-year-old man with worsening kyphosis shows vertebral body trabecular indistinctness and fractures → as well as a fracture of the osteomalacic manubrium ↗. This patient has ROD as an etiology of the fragility fractures.



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Sagittal CT of the thoracic spine in a 40-year-old woman with ESRD shows smudgy density within all the vertebral bodies. The trabeculae are so indistinct that they cannot be individually seen, though the overall density is not abnormal. Findings are typical of the osteomalacic component of ROD.

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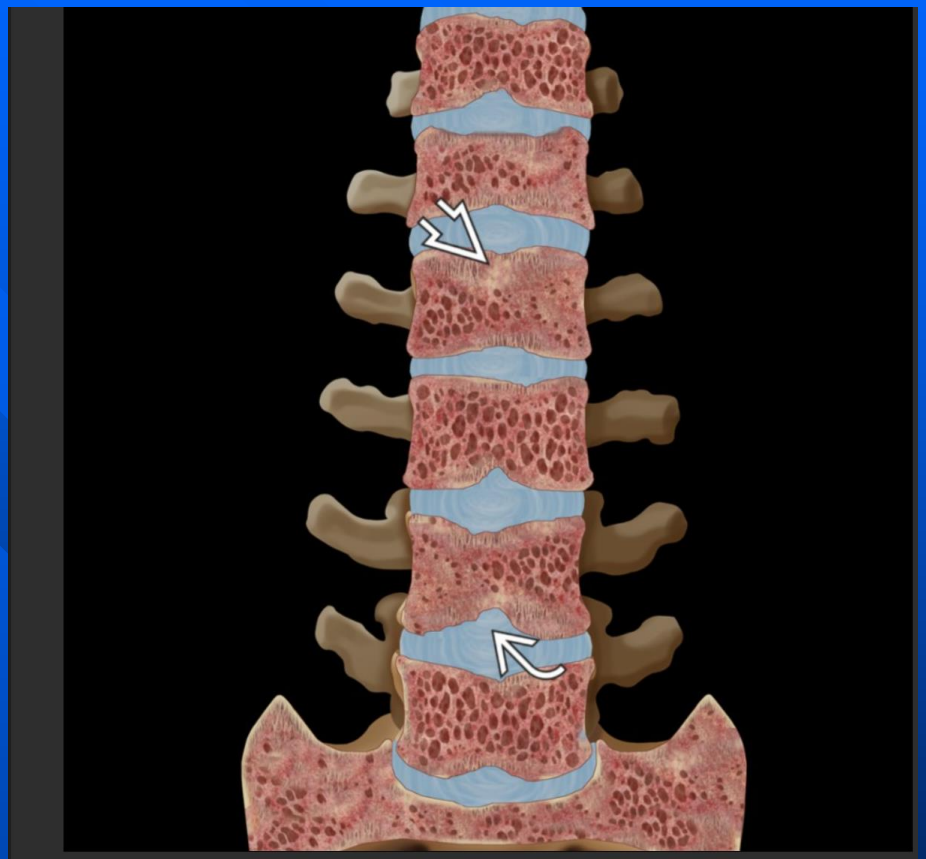

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Graphic depicts the transected spine in a patient with ROD. Note the loss of normal trabecular organization. There is also an ↑ in sclerosis, particularly at the endplates ⇨, but otherwise nonfocal, as well as some collapse ↷.