CLÍNICA UNIVERSITÁRIA DE IMAGIOLOGIA

HOSPITAIS DA UNIVERSIDADE DE COIMBRA

PORTUGAL

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BENIGN LESIONS OF THE SPINE

- OSTEOID OSTEOMA
- OSTEOBLASTOMA
- GIANT CELL TUMOR
- ANEURYSMAL BONE CYST
- OSTEOCHONDROMA
- ENOSTOSIS
- HEMANGIOMA
- LANGERHANS CELL HISTIOCYTOSIS

OSTEOID OSTEOMA

- Involves the axial skeleton in 10 % of cases, with lombar spine most affected (60% cases)
- Clinical symptoms – painful scoliosis, focal or radicular pain (relieved by AINE), gait disturbance and muscle atrophy
- +++ 10-20 years; Male predominance (3:1)
- 75 % located in the posterior elements of the vertebra – pedicles, articular facets and laminae

OSTEOID OSTEOMA

- Pathologically the nidus of an osteoid osteoma is a small (< 2cm) round mass of pink to red tissue (vascularity of the lesion)
- Microscopically the nidus is composed of well organized, interconnected trabecular bone, with a background of vascularized fibrous connective tissue
- Frequently, nidus is surrounded by a variable degree of reactive cortical bone

OSTEOID OSTEOMA

- X-Ray
  - Round to oval, discrete radiolucent area (nidus)
  - Variable surrounding sclerosis
  - Central calcification may be present
  - Complex anatomy of spine often obscures the nidus so that only sclerosis or a dense pedicle is apparent on radiographs
  - Nidus localized to the concave portion at the apex of scoliosis (if present)

OSTEOID OSTEOMA

- Bone scintigraphy
  - Marked increased uptake by the nidus
  - Occasionally, a more distinctive double-intensity scintigraphic pattern is apparent: central high degree of uptake (nidus) surrounded by a less intense zone of tracer accumulation (osseous reaction)

OSTEOID OSTEOMA

- CT
  - Optimal modality for detecting osteoid osteoma
  - Particularly useful for identifying the nidus
  - Nidus – well-defined, low-attenuation lesion <2cm, with or without central calcification, surrounded by a variable degree of sclerosis

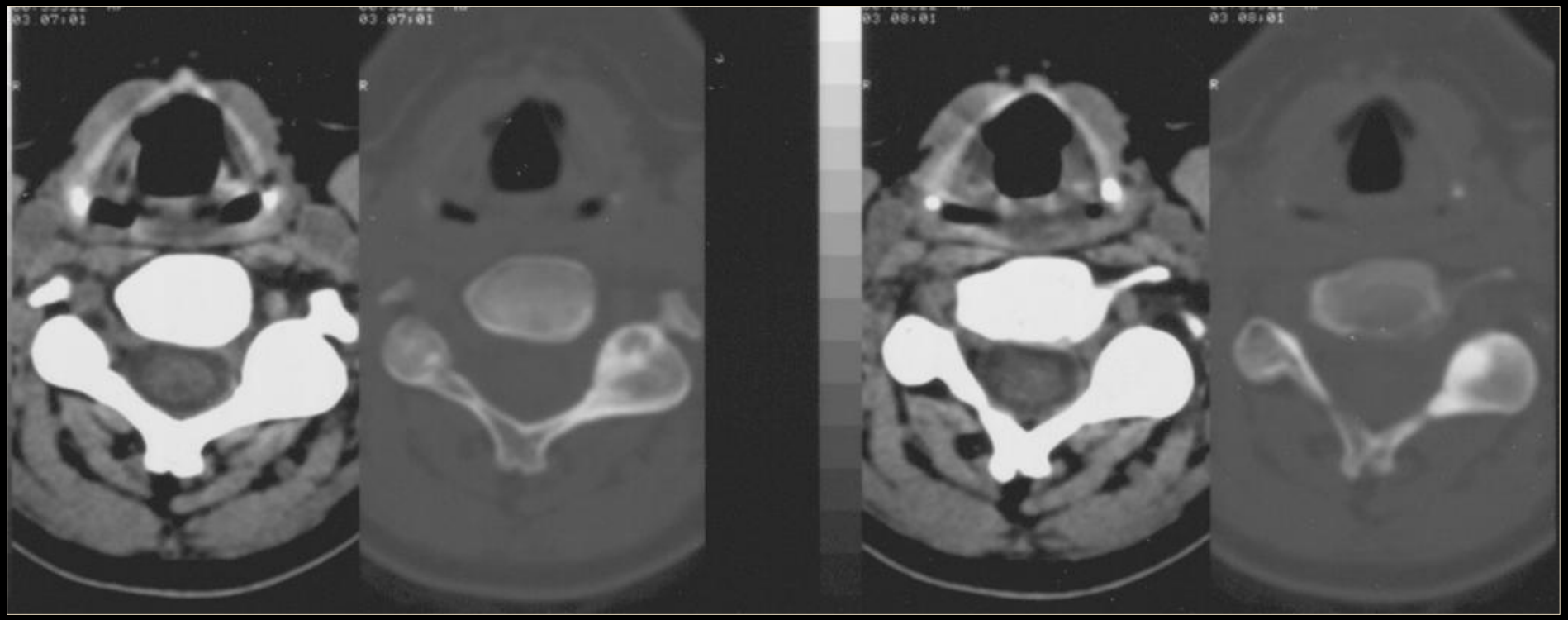
OSTEOID OSTEOMA

- RM
  - Nidus is generally low to intermediate signal intensity on T1 and intermediate to high signal intensity on T2
  - Areas of calcification always have low signal
  - RM can be misleading because the nidus may become obscured by signal changes due to associated surrounding sclerosis, marrow edema and soft-tissue inflammation

OSTEOID OSTEOMA

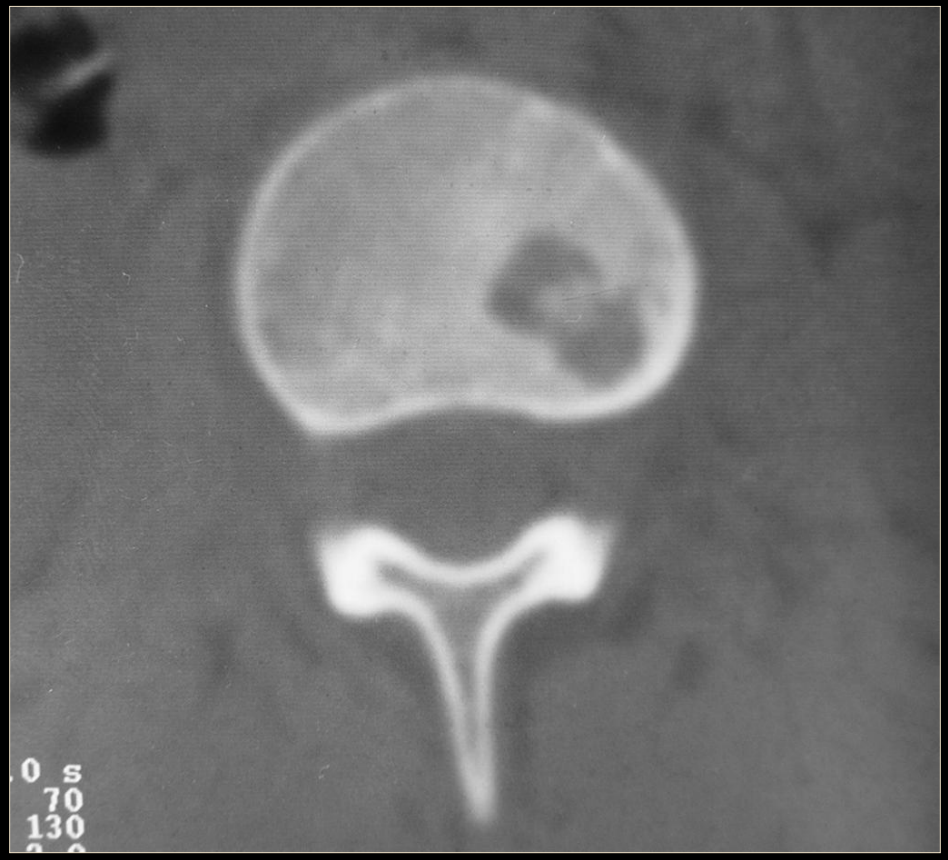
- TREATMENT
  - Complete resection of the nidus
  - Intraoperative scintigraphy, tetracycline labeling and CT-guided needle placement may be used for nidus localization
  - New methods of treatment include percutaneous CT-guided removal and percutaneous ablation with a radio-frequency electrode, laser or alcohol

Osteoid osteoma of left articular facet of C4



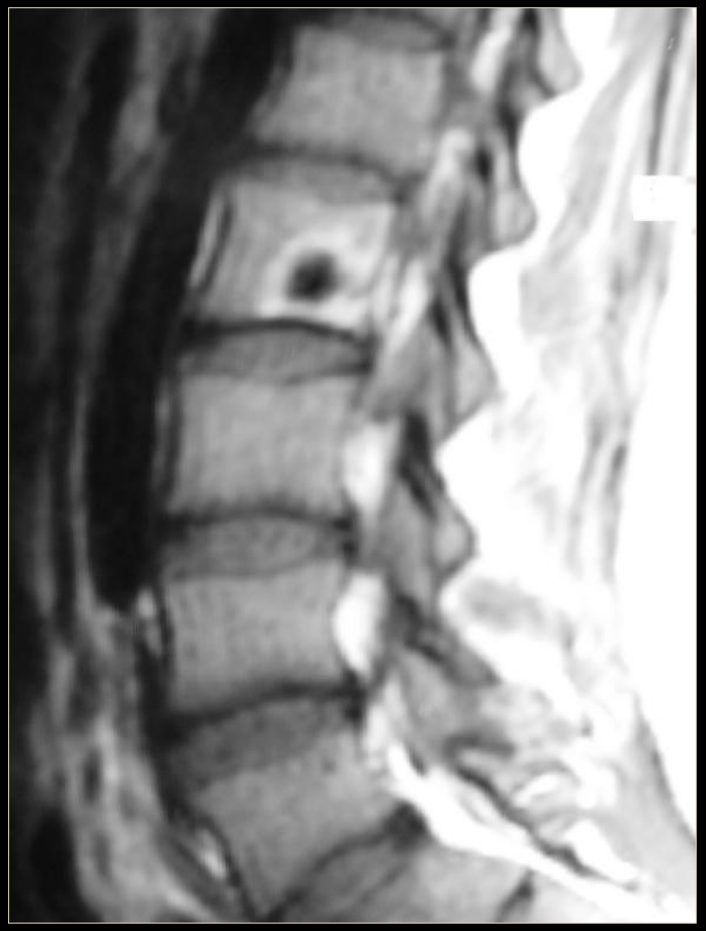
CT – We can see the nidus (left articular facet of C4), a well defined and low attenuation lesion, surrounded by area of sclerosis.

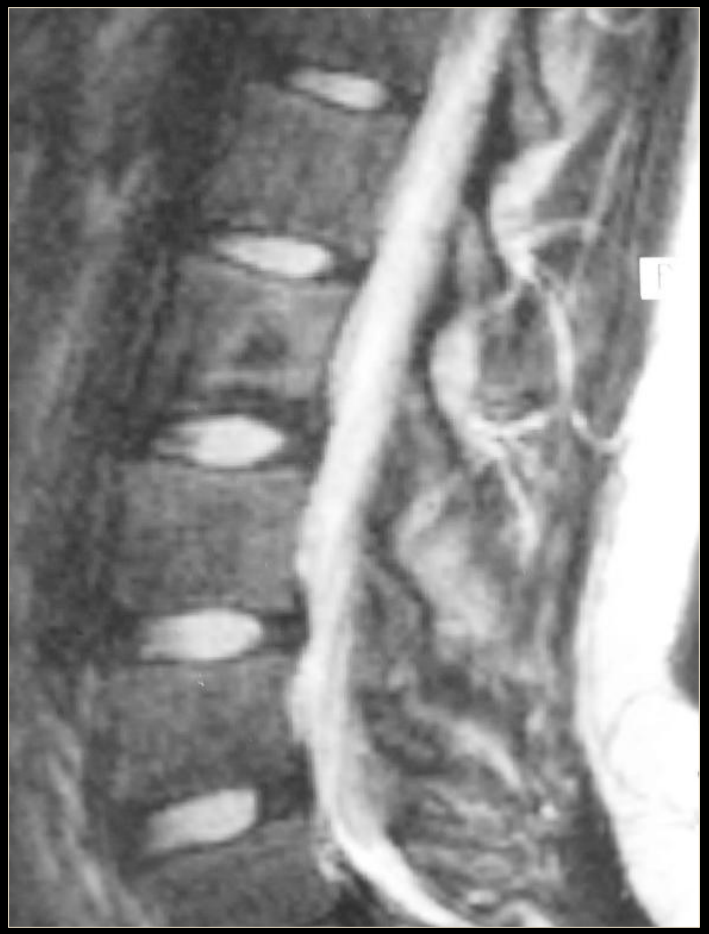
Osteoid osteoma of vertebral body of L2



CT – Hipodense nidus with central calcification and little reactive sclerosis.

Osteoid osteoma





MR (T1 and T2) – Low signal intensity on T1 and T2 images, due to the presence of mineralized osteoid matrix.

OSTEOBLASTOMA

- Osteoblastoma and osteoid osteoma (OO) are similar but distinct lesions – clinical, imaging and pathologic characteristics usually allow differentiation
- +++ Young adults – 90% cases diagnosed in the 2nd and 3rd decades of life
- Male predominance (2:1)
- Dull localized pain (opposed to the intense night pain caused by OO)
- Unlike OO, neurologic symptoms are common – paresthesias, paraparesis and paraplegia

OSTEOBLASTOMA

- Spine accounts for 30-40 % of all osteoblastomas and most frequently envolves the posterior vertebral elements (55% of cases)
- Hstologic examination may reveal features very similar to those of osteoid osteoma, but the microscopic pattern is not as well organized and is typical > 1,5-2 cm
- 10% with aneurysmal bone cyst component

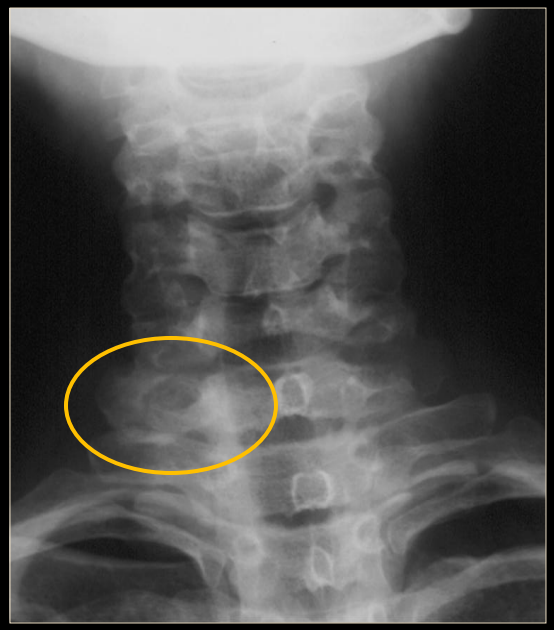
OSTEOBLASTOMA

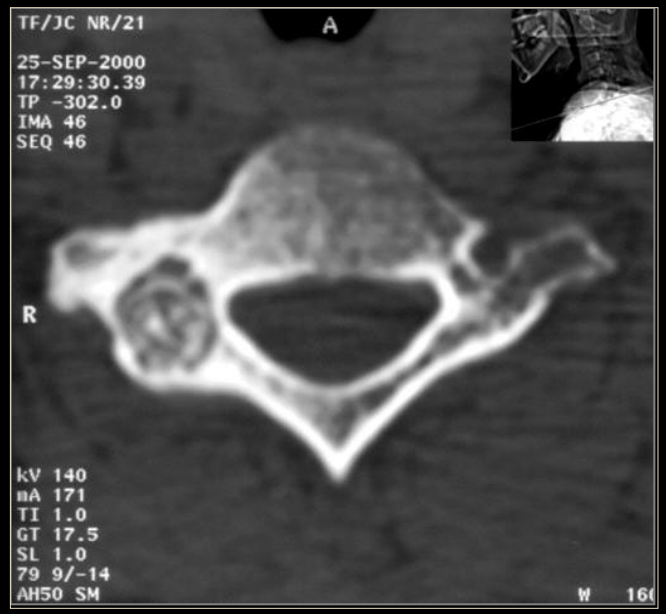
- Three radiographic patterns:
  - Central radiolucent area (with or without calcification) and surrounding sclerosis, similar to osteoid osteoma but > 1,5cm
  - Expansile lesion with multiple small calcifications and a peripheral sclerotic rim – most common appearance of spinal osteoblastomas
  - Agressive appearance consisting of osseous expansion, bone destruction, infiltration of surrounding soft tissue and intermixed matrix calcification

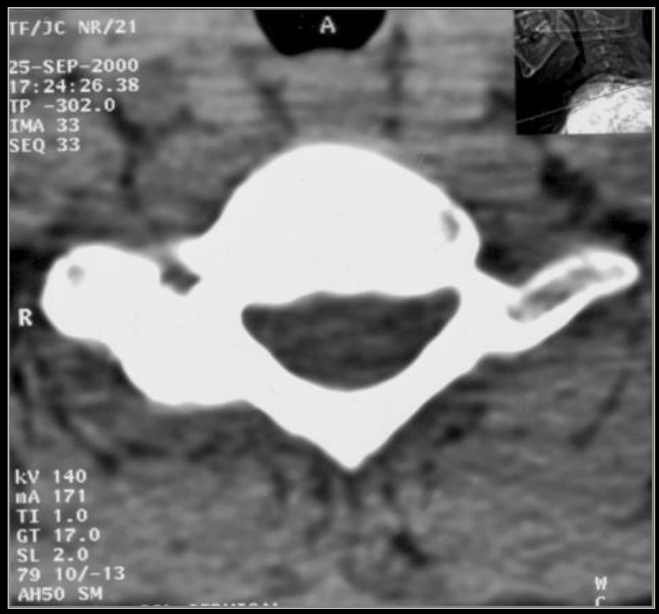
OSTEOBLASTOMA

- Marked radionuclide uptake at bone scintigraphy
- CT – areas of mineralization (50%), expansile bone remodeling and sclerosis or a thin osseous shell about its margins
- MR generally nonspecific, but optimally depicts the effects of the tumor on the spinal canal and surrounding soft tissues and extensive peritumoral edema has been reported
- Treatment of spinal osteoblastoma is surgical resection – recurrence rate of 10%

Osteoblastoma of right neural arch of C7



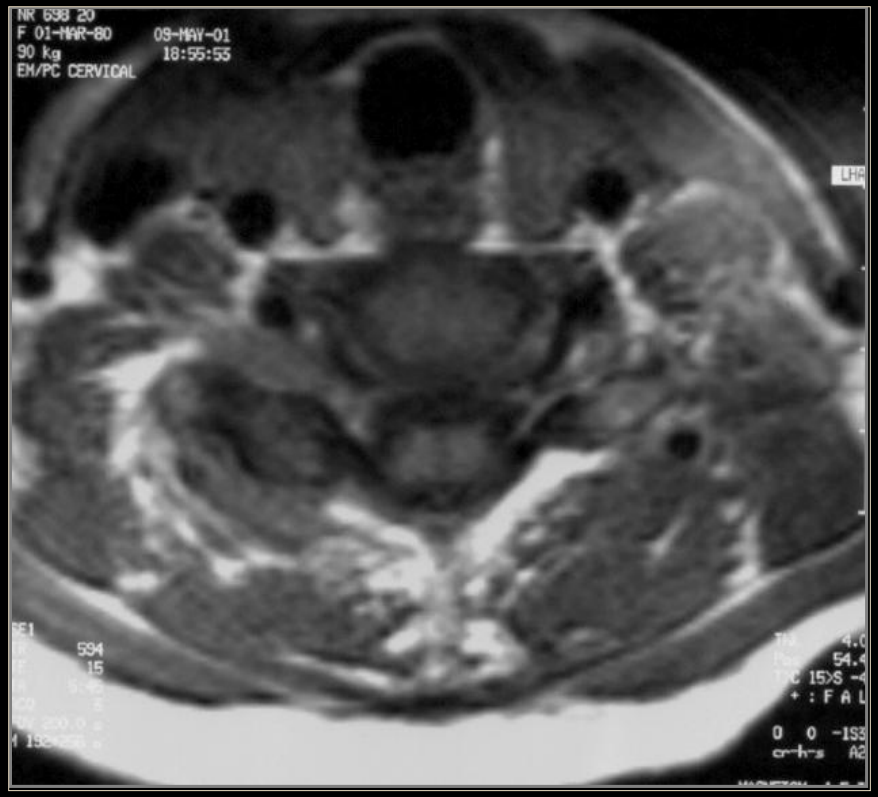




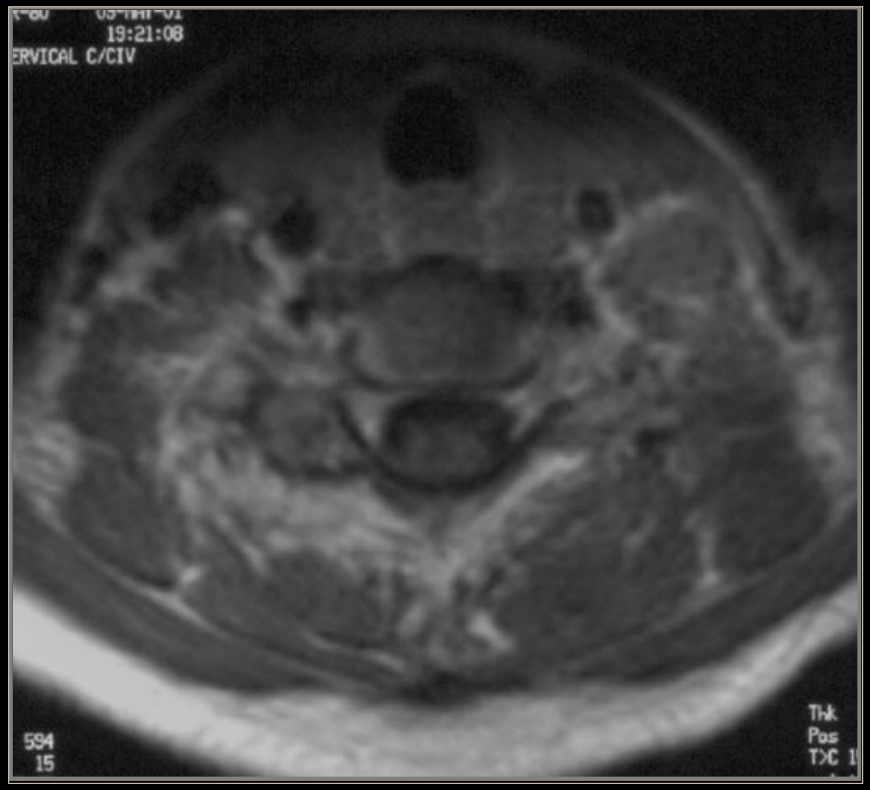
Cervical X-Ray – Thickening and increased density of the right lateral component of C7, with a faintly seen central lytic area.

CT – Low attenuation lesion with 2cm, with calcifications, cortical thinning, but no rupture.

Osteoblastoma of right neural arch of C7



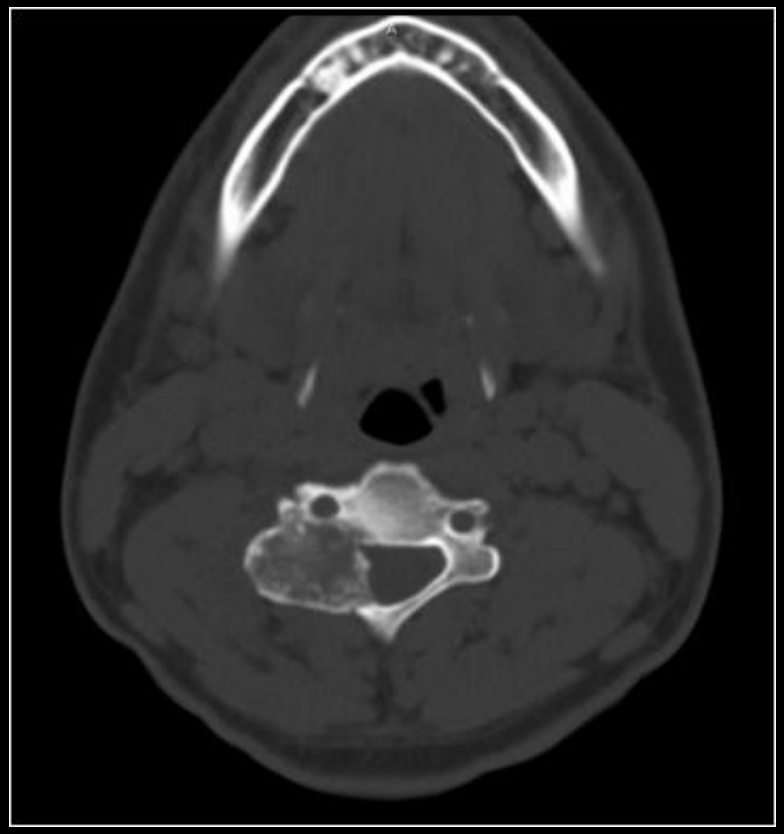
T1

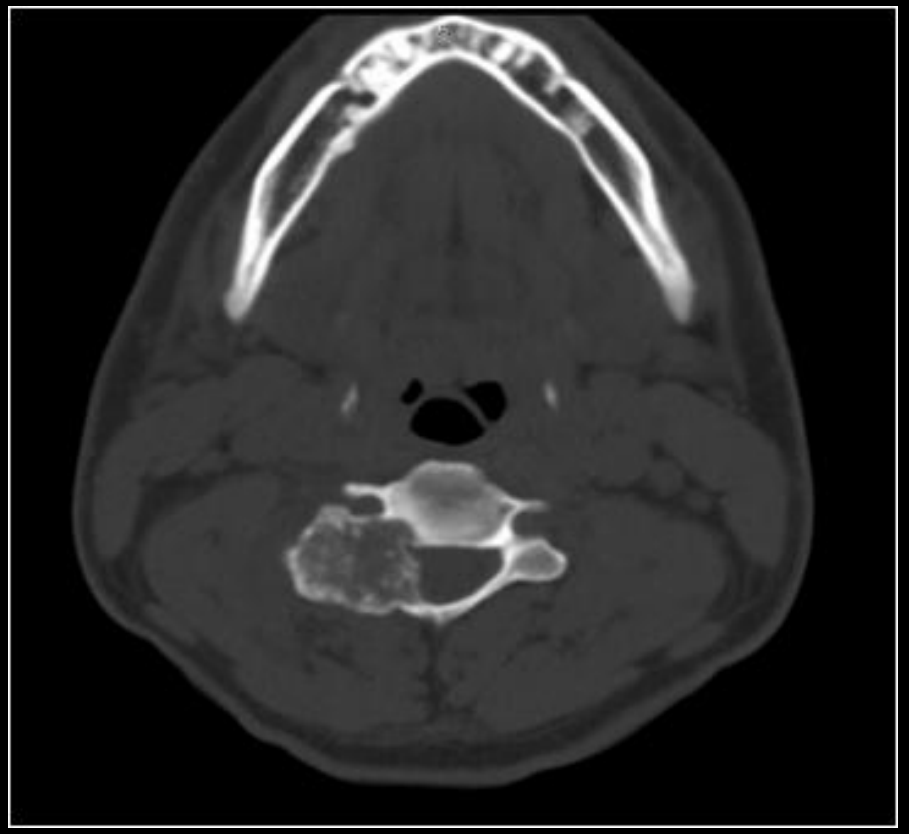


T1 after gadolinium

MR – The lesion has the same signal as the adjacent bone and there is a low signal halo in relation with sclerosis. After gadolinium there is some enhancement of the lesion and surrounding soft tissues, suggestive of peritumoral edema.

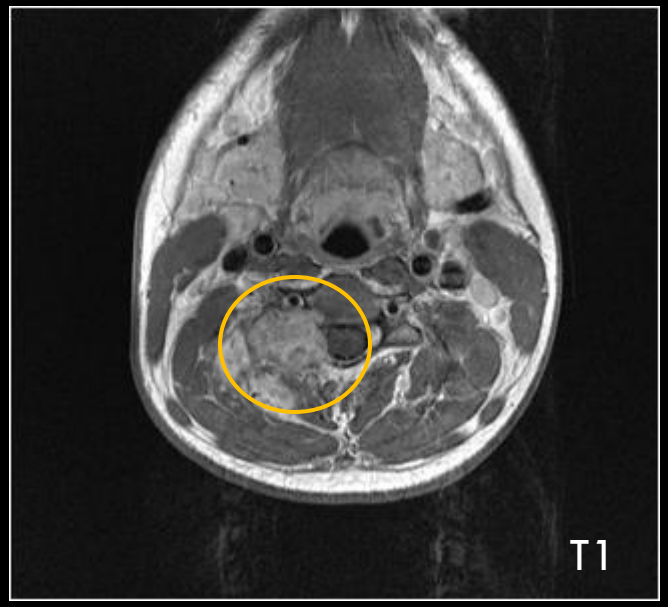
Osteoblastoma of C4

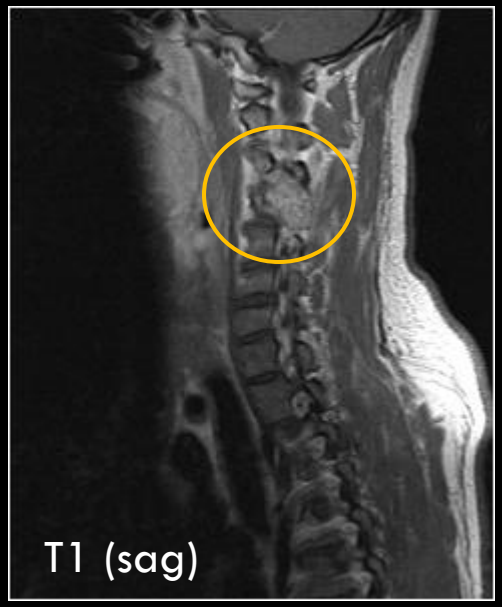


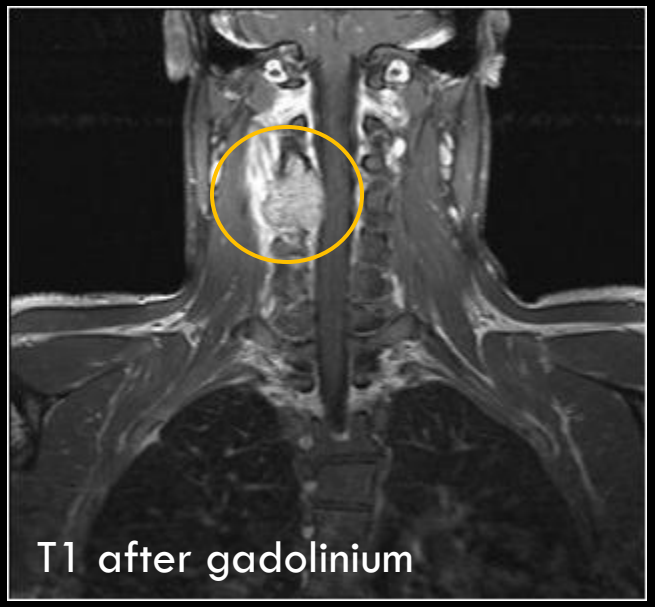


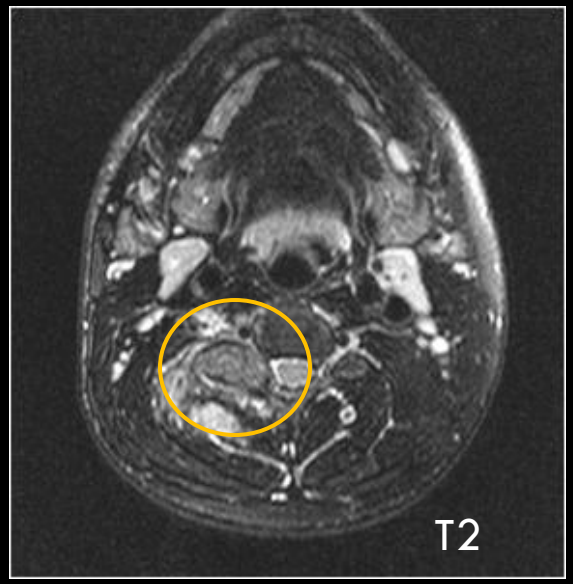
CT - Expansil lesion of C4 with calcified osteoid matrix in an amorphous pattern ("cloud-like") and little cortical thickening.

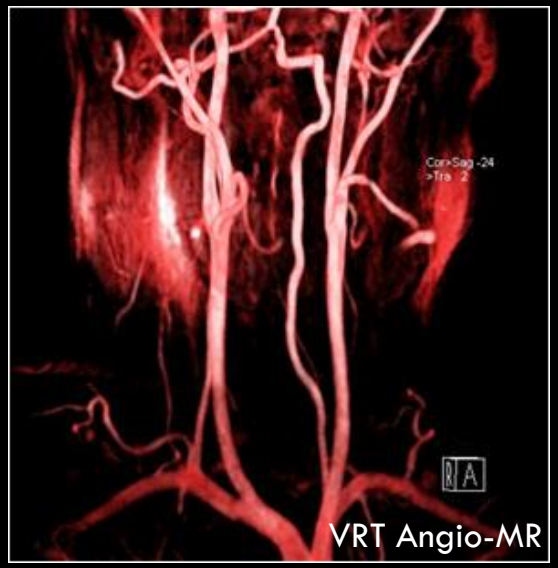
Osteoblastoma of C4











The lesion shows high signal and is centered at right lamina and pedicle of C4, extending into the vertebral foramen and adjacent soft tissue. There is marked enhancement pós-gadolinium. VRT angio-MR shows normal vertebral circulation.

GIANT CELL TUMOR

- 7 % of all cases of GCT – fourth most common location of GCT
- +++ Sacrum (90%)
- +++ Women, 2nd and 4th decade
- Symptoms: pain (often with radicular distribution), weakness and sensory deficits

GIANT CELL TUMOR

- Pathology
  - Composed of abundant osteoclastic giant cells intermixed throughout a spindle cell stroma
  - Cystic areas and regions of previous hemorrhage with hemosiderin
  - Prominent areas of fibrous tissues that are high in collagen content are frequent
  - Majority benign (90%)

GIANT CELL TUMOR

- Expansile lesion, with bone lysis seen on radiographs
- No evidence of mineralized matrix
- Sacrum – frequently large with destruction of the sacral foraminal lines (nonspecific), sometimes with extension across the sacroiliac joint
- Spine – usually affects the vertebral body (as opposed to most other spinal tumors), but extension into the posterior elements, paraspinal soft tissues, adjacent intervertebral disk and vertebrae are not uncommon
- Remember that GCT of long bones do not share this invasive feature and rarely extend across articular cartilage

GIANT CELL TUMOR

- Bone scintigraphy
  - Diffusely increased uptake of radionuclide
  - Sacral GCT, commonly demonstrates de “donut” sign of central photopenia and increased peripheral activity
- CT and MR are important methods for delineating the extent of spinal GCT

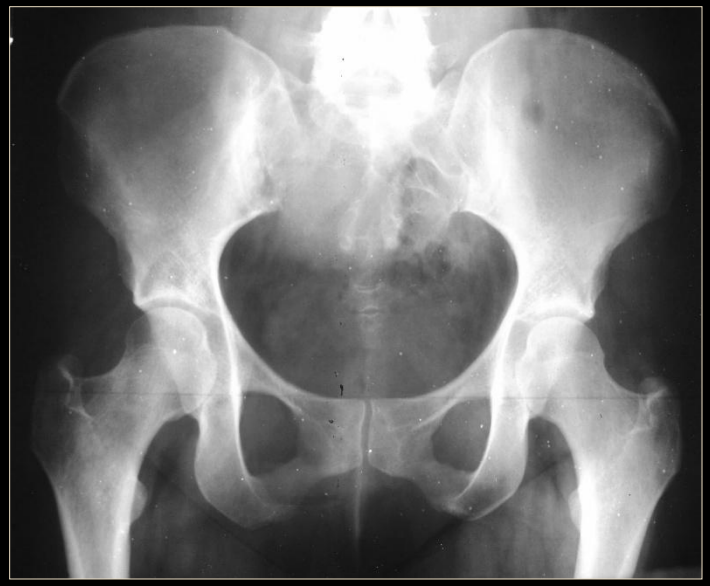
GIANT CELL TUMOR

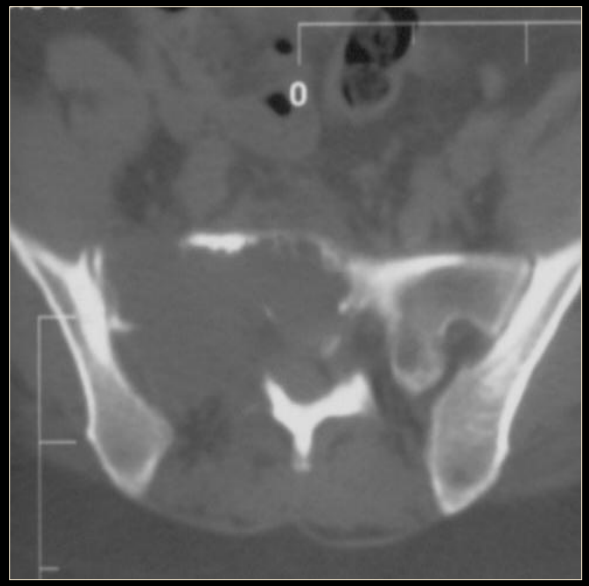
- CT
  - Tumor has soft-tissue attenuation with well-defined margins that may show a thin rim of sclerosis
  - Areas of hemorrhage or necrosis may create heterogeneity (foci of low attenuation)
- MR
  - Heterogeneous signal intensity
  - Low/intermediate signal on T1
  - Low/intermediate signal on T2 in 62-96% - very helpful in differential diagnosis
  - Hemorrhage (high signal on T1 and T2) and focal cystic areas (low signal on T1 and high signal on T2) may be present

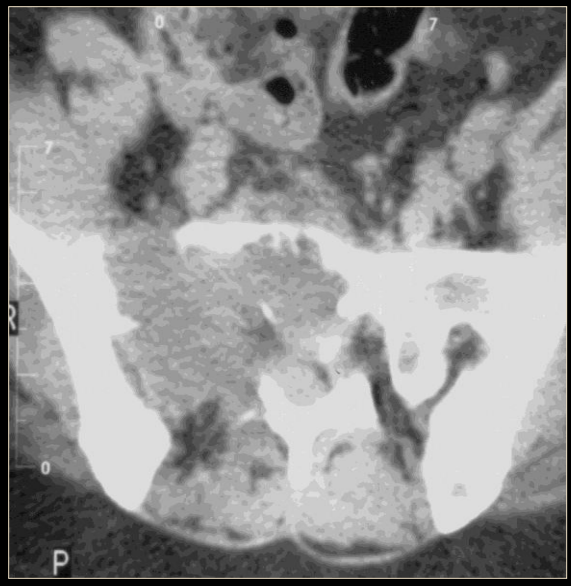
GIANT CELL TUMOR

- Imaging has a vital role to play in presurgical evaluation
- Sacral lesions that spare the majority of the S-1 segment and the sacroiliac joint are amenable to complete excision
- The majority of spine GCT are treated with a combination of partial curettage and RT
- Unlike other benign tumors of the spine, the Px is not as favorable – lesions are often locally aggressive with recurrence rate of 50%

Giant cell tumor of sacrum

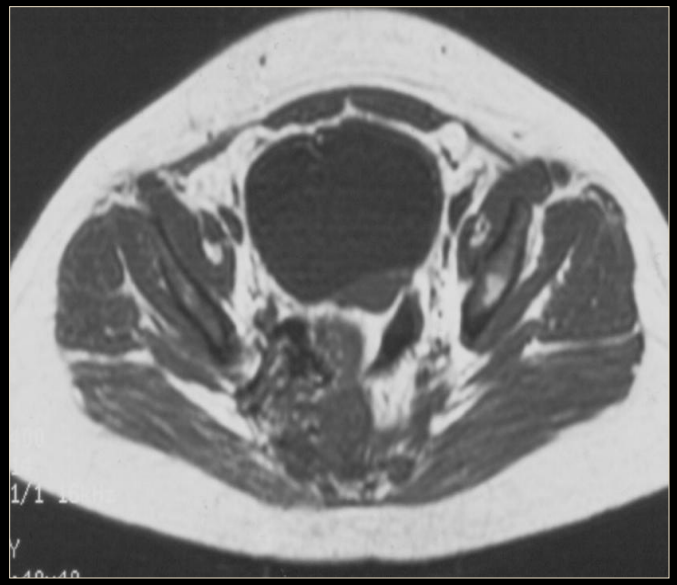


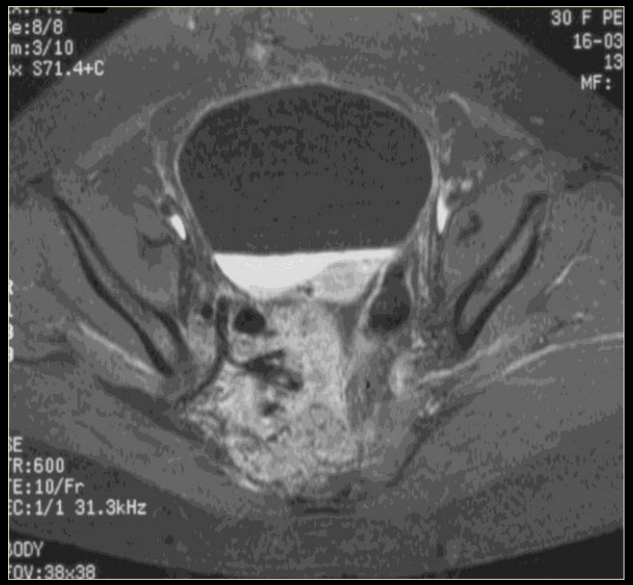


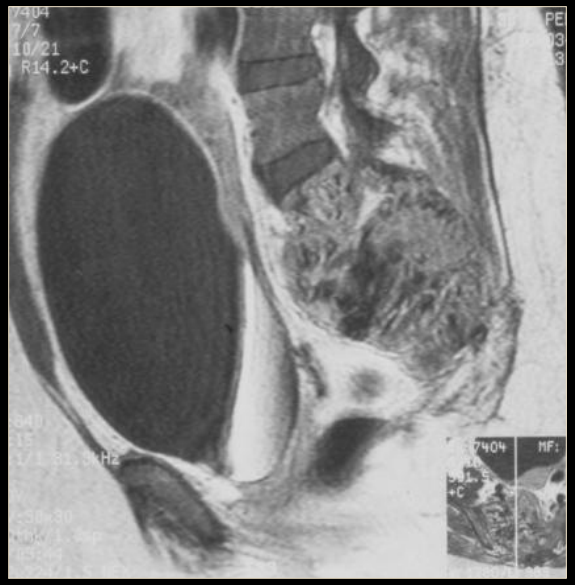


Pelvis X-Ray and CT – Lytic and expansile lesion of sacrum. There is cortical rupture and associated soft tissue mass.

Giant cell tumor of sacrum

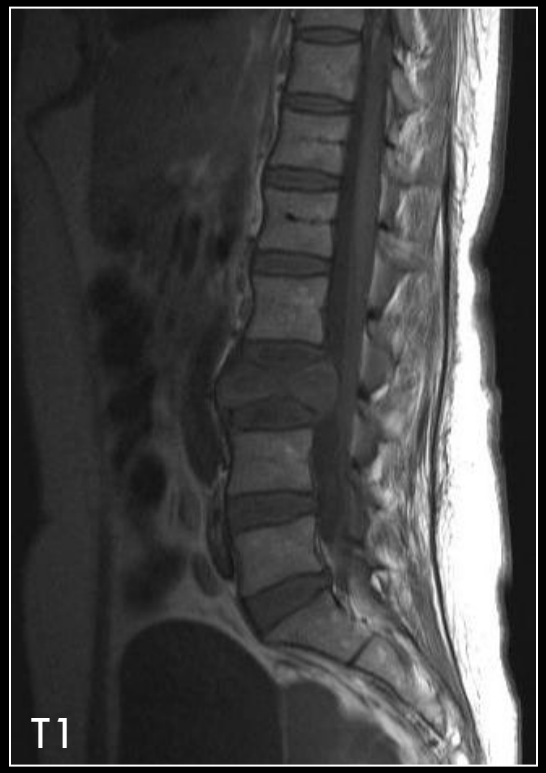


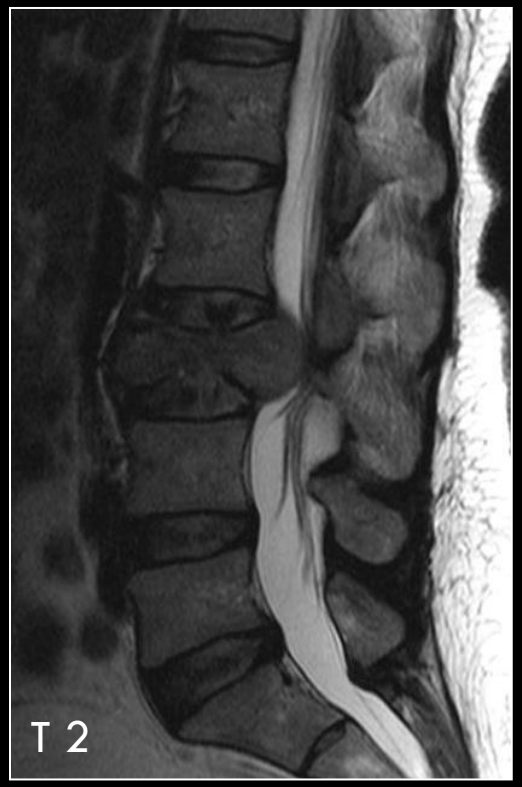


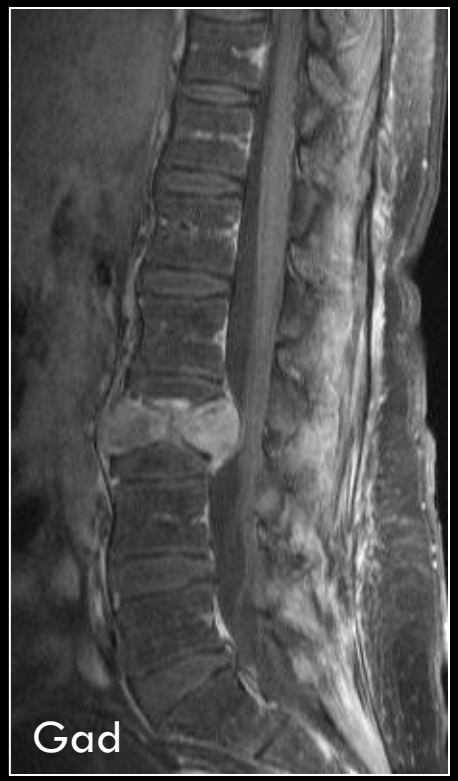


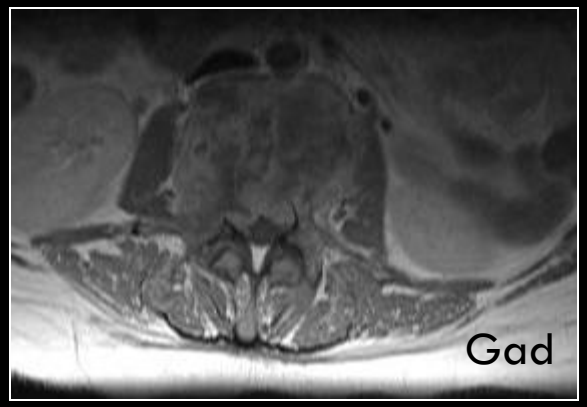
MR T1 and T1 after gadolinium (with and without FS) – Volumous mass arising from sacrum, with low signal on T1 and heterogeneous enhancement after gadolinium administration.

Giant cell tumor of L3









MRI - This GCT of L3 affects mainly the vertebral body, pedicles and laminas with sparing of the spinous process. There is compression of the dural sac and there is extension to the right intervertebral foramen of L2-L3 and L3-L4. The lesion has low signal on T1; intermediate sign on T2 and heterogeneous enhancement after gadolinium on T1.

ANEURYSMAL BONE CYST

- Young patients – 80% < 20 years
- Mild female predominance
- Spine involved in 12-30% of cases, most commonly the thoracic spine
- Patients complain of back pain and neurologic symptoms resulting from encroachment on the spinal canal

ANEURYSMAL BONE CYST

- Pathology
  - Multiloculated blood-filled spaces – "blood-filled sponge"
  - Majority of ABC (65-99%) are considered primary lesions (no underlying neoplasm is found) – secondary to trauma?
  - Can be a secondary phenomenon produced by an underlying neoplasm – GCT, osteoblastoma, condroblastoma and osteosarcoma
  - Solid components are usually in septations interposed between the blood filled spaces and are composed of fibrous tissue, reactive bone and giant cells
  - Solid variants (5% cases) have propensity to involve the spine

ANEURYSMAL BONE CYST

- Radiographs show marked expansile remodeling of bone centered in the posterior elements, although extension into the vertebral body is frequently seen
- A thin, outer periosteal rim and septations may be apparent
- May also extend into adjacent vertebral bodies, intervertebral disks, posterior ribs and paravertebral soft tissues – similar to GCT
- Bone scintigraphy frequently demonstrates peripheral increased uptake of radionuclide – nonspecific pattern ("donut sign") also frequently seen with GCT

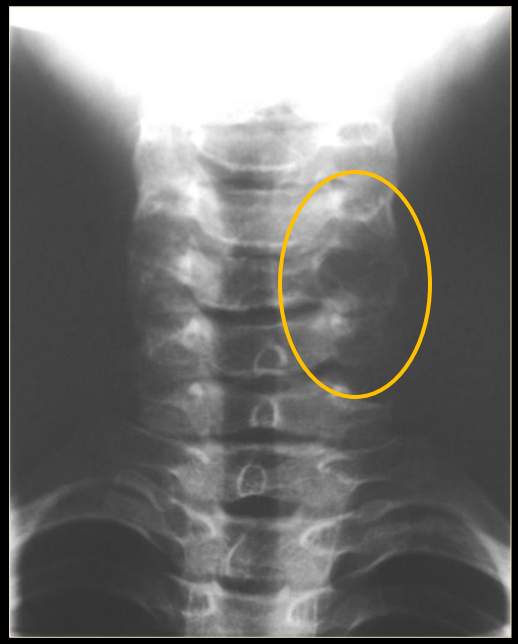
ANEURYSMAL BONE CYST

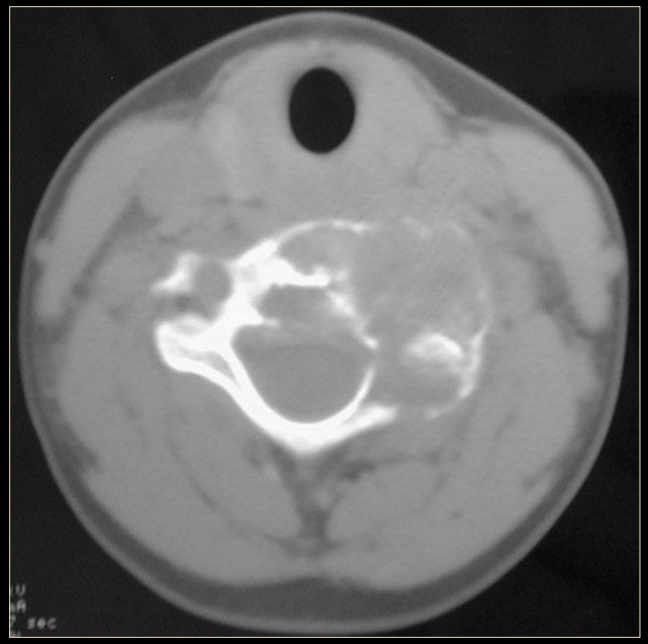
- CT and MR appearance sugests the cystic nature of lesion and often show fluid-fluid levels indicative of hemorrhage with sedimentation (MR is the most sensitive)
- Fluid-fluid levels are suggestive but are not pathognomonic
- Often present a soft-tissue attenuation or low signal intensity rim on TC and MR (all pulse sequences), that corresponds to an intact, thickened periosteal membrane

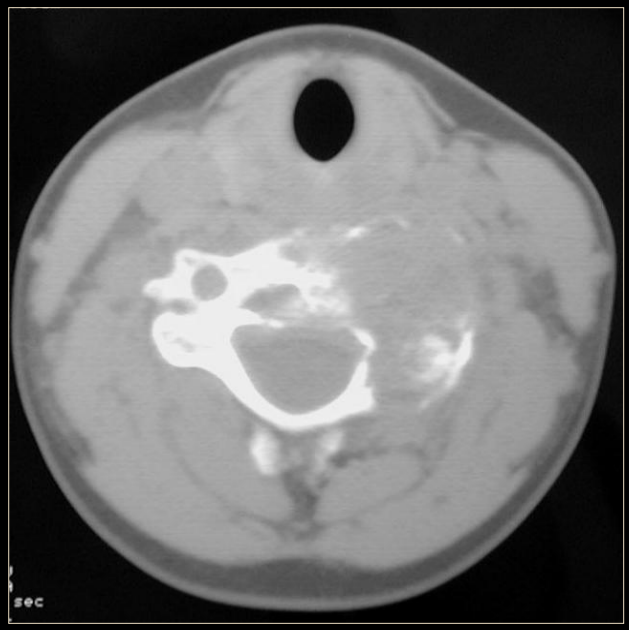
ANEURYSMAL BONE CYST

- Treatment of spinal lesions is often more problematic than that of appendicular lesions because complete ressection may not be possible without excessive morbidity
- Additional modes of treatment include embolotherapy and RT

Aneurysmal Bone Cyst of cervical spine

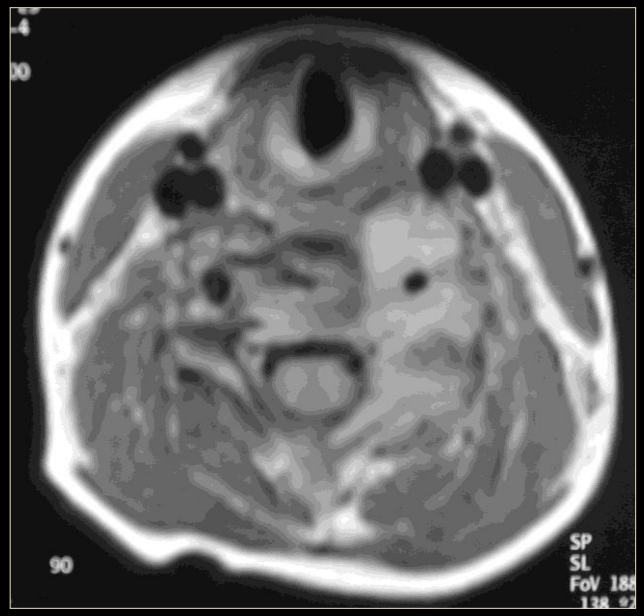




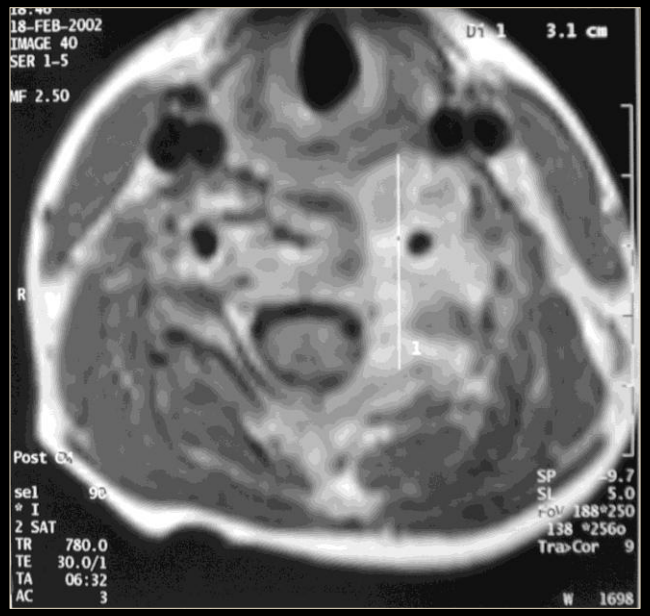


X-Ray and CT – Lytic and expansile lesion of the left neural arch and vertebral body of C4, with “ballooned”bony contour. There is marked cortical thinning, but there is no cortical rupture, no periosteal reaction and no soft tissue masses.

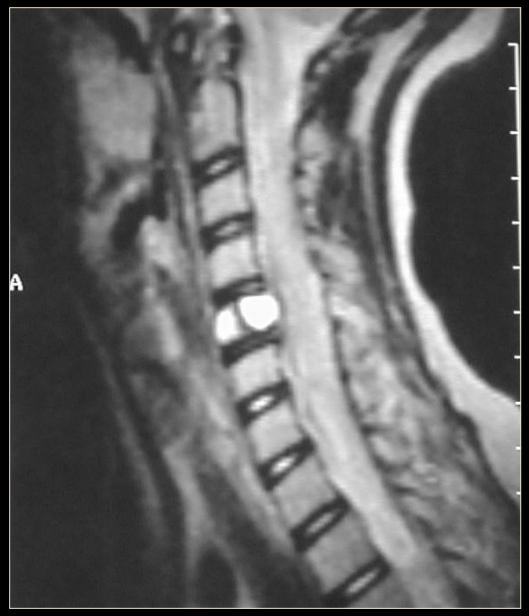
Aneurysmal Bone Cyst of cervical spine



T1



T1 after gadolinium



T2

MR – Intermediate sign on T1, marked high sign on T2. There is peripheral and internal septa enhancement after intravenous administration of gadolinium.

OSTEOCHONDROMA

- Spinal osteochondromas are uncommon – 1-4% of solitary exostoses and 4% of all solitary spinal tumors
- Only 7-9% of patients with hereditary multiple exostoses have a spinal lesion
- Male predominance
- Myelopathy present in 34% of patients
- Palpable mass if the lesion extends posteriorly
- Dysphagia, hoarseness and vascular complications if lesion protrude anteriorly

OSTEOCHONDROMA

- +++ Cervical spine and most commonly arise from the posterior elements
- Osteochondromas are composed of normal bone (cortex and marrow space) with a cartilage cap from which growth occurs
- The pathologic and radiologic hallmarks of osteochondroma is continuity of the lesion with the marrow and cortex of the underlying bone

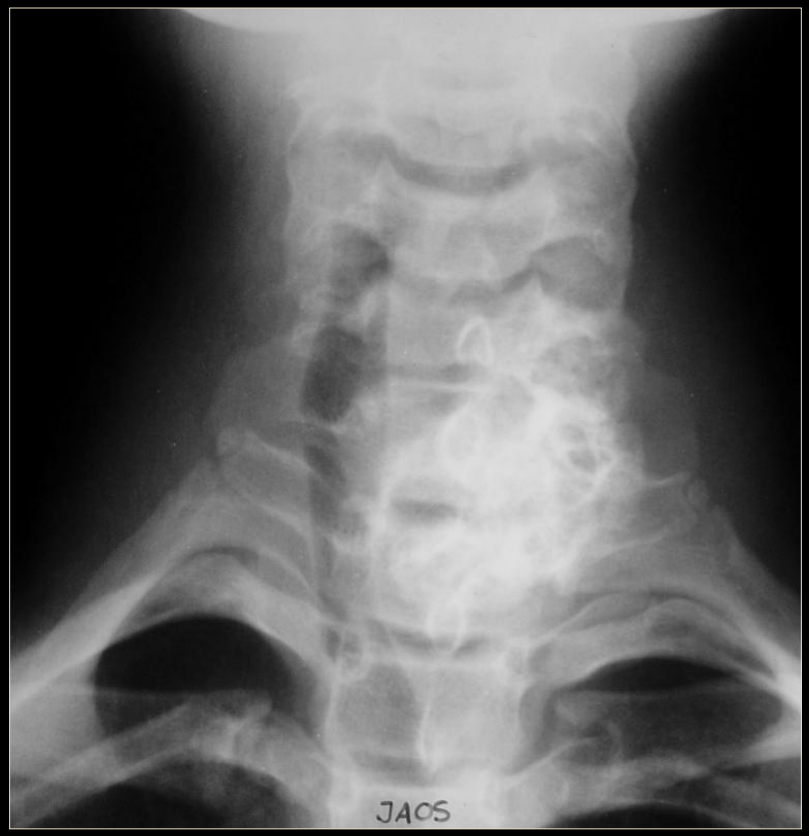
OSTEOCHONDROMA

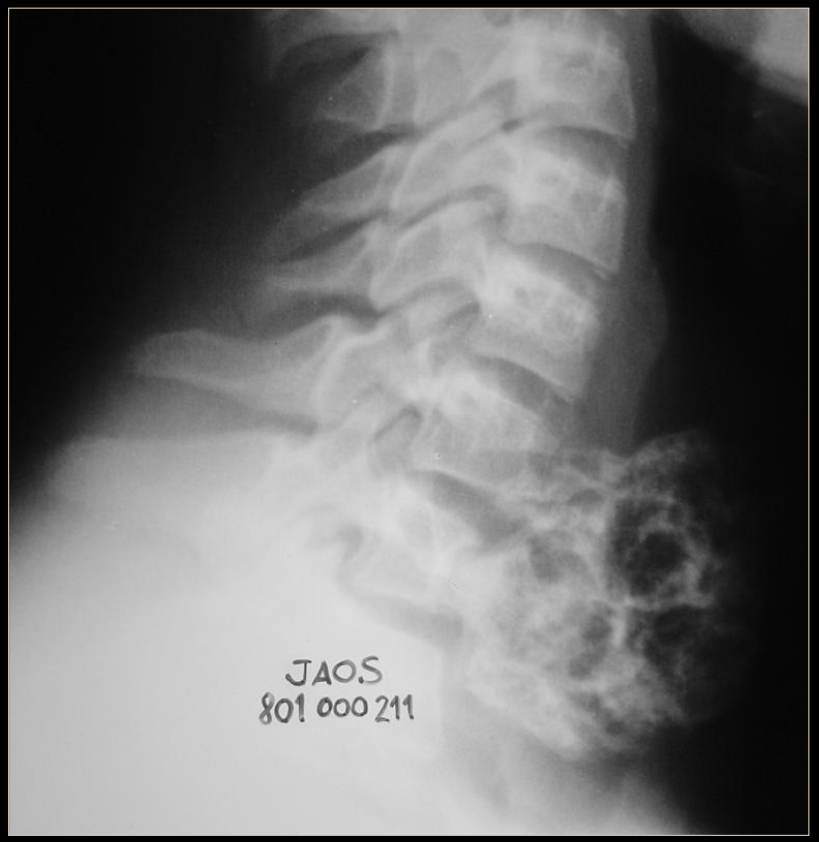
- The diagnosis of spinal osteochondroma can be definitively made from radiographic findings in only a minority of cases (20%), usually in large lesions protruding posteriorly
- Thin-sectoin CT is the radiologic examination of choice for detecting the osseous characteristics of the exostosis and the pathognomonic marrow and cortical continuity of the lesion to the underlying bone

OSTEOCHONDROMA

- MR reveals yellow marrow centrally (high signal on T1 and intermediate signal on T2) with a low signal cortex
- The hyaline cartilage cap is often small and thin
- Spinal osteochondromas with marked thickening (> 1cm) of the cartilage cap should be viewed with suspicion of malignant transformation to chondrossarcoma
- Surgical excision of osteochondroma is usually curative

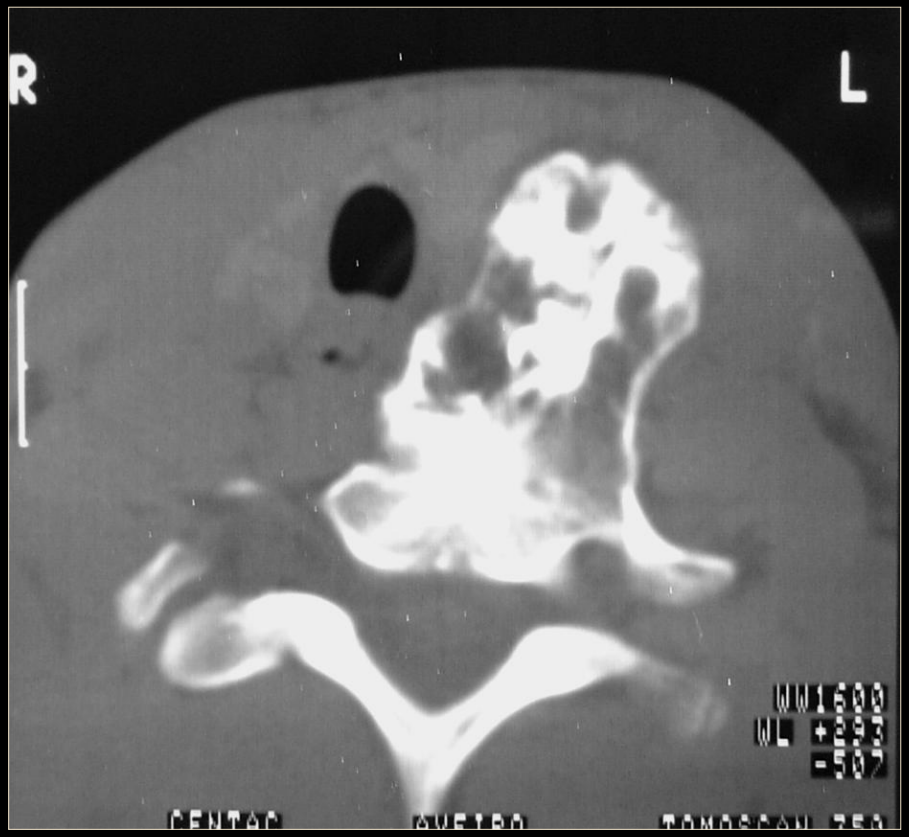
Osteochondroma of cervical spine

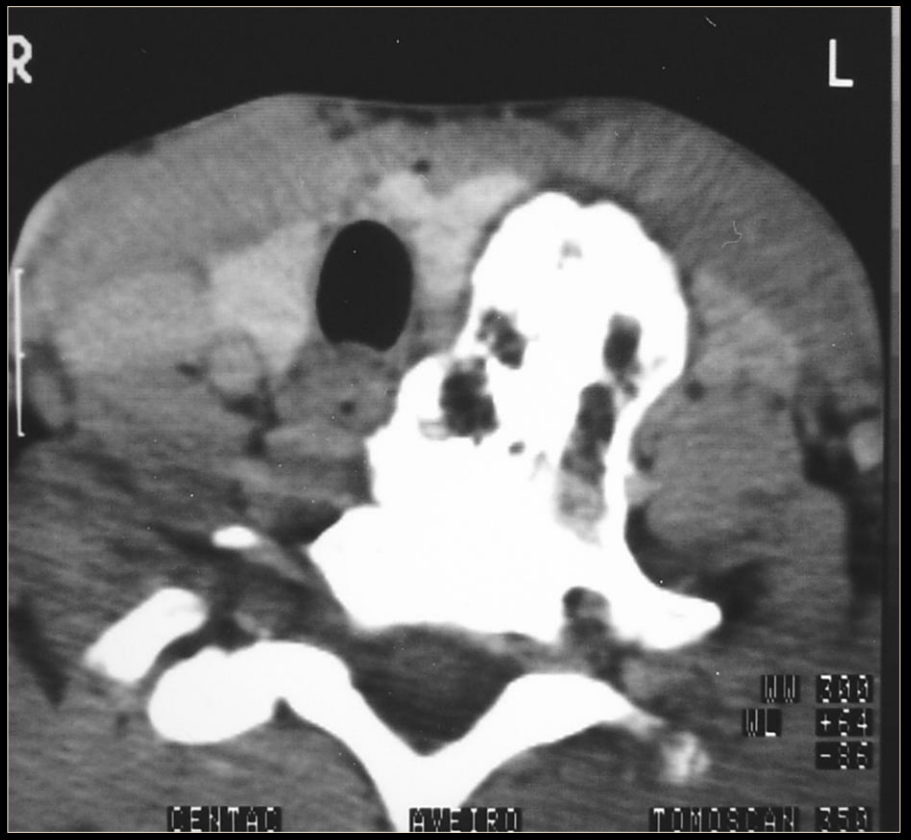




Cervical spine X-Ray – Volumous exostosis with the classic cauliflower appearance.

Osteochondroma of cervical spine





CT – We can see that the lesion has marrow and cortical continuity to the underlying bone, a finding that is pathognomonic.

ENOSTOSIS

- Enostosis = Bone Island = Endosteoma
- One of the two most common lesions to involve the spine (with hemangioma)
- Asymptomatic lesions that are discovered incidentally
- Propensity to occur in the axial skeleton
- Histologically – lamellar compact bone with a haversian system embedded within the medullary canal

ENOSTOSIS

- X-Ray and CT findings
  - Circular or oblong, osteoblastic lesion
  - Irregular, spiculated margin – “thorny radiations” or “brush border”
  - Surrounding trabecular bone is normal with an abrupt transition to the lesion

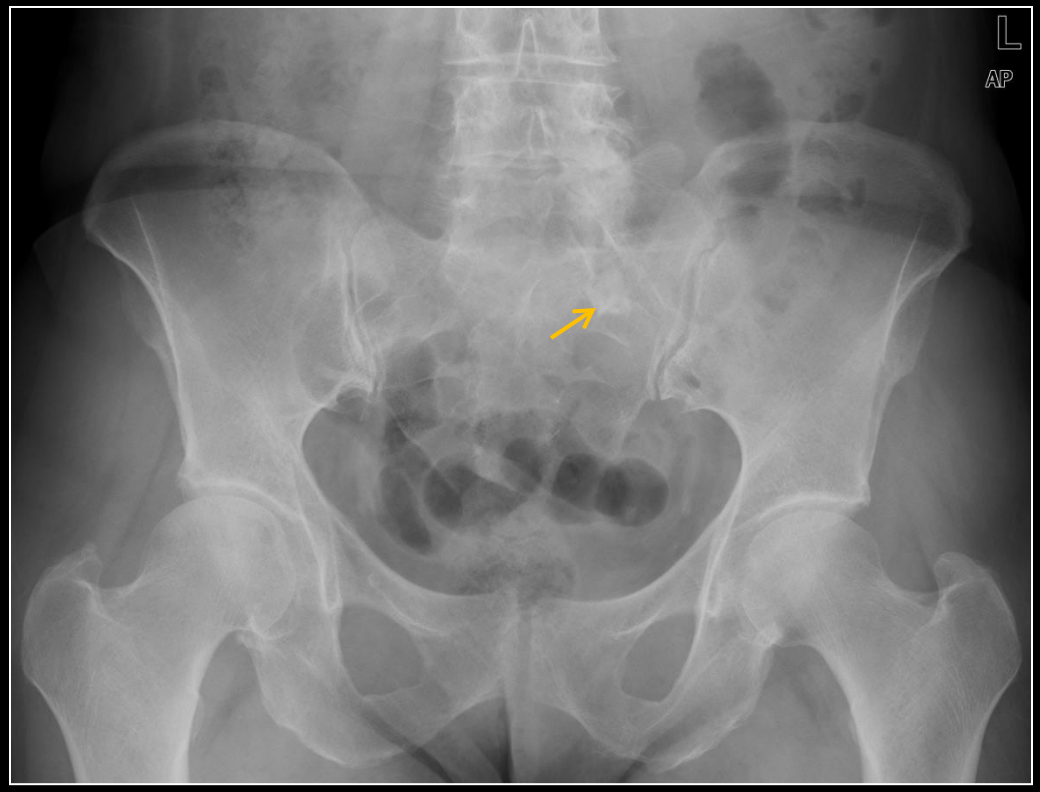
ENOSTOSIS

- Bone cintigraphic of most enostosis is normal, however uptake has been observed in some cases, most frequently in cases of giant bone islands (> 2 cm)
- RM:
  - low signal intensity, regardless of the pulse sequence used
  - spiculated margins may also be apparent
  - Signal intensity of the surrounding marrow is normal

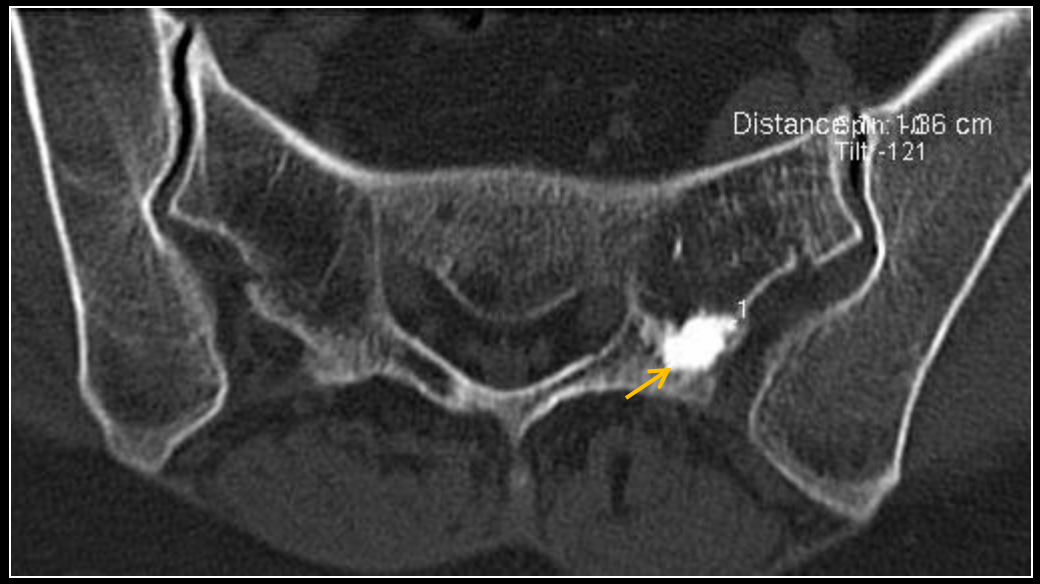
ENOSTOSIS

- The distinction between enostosis and osteoblastic metastatic disease can be particularly troublesome if lesion enlargement has occurred
- Consider vertebral biopsy if the lesion increases in diameter by more than 25% within 6 months or 50% within 1 year

Enostosis

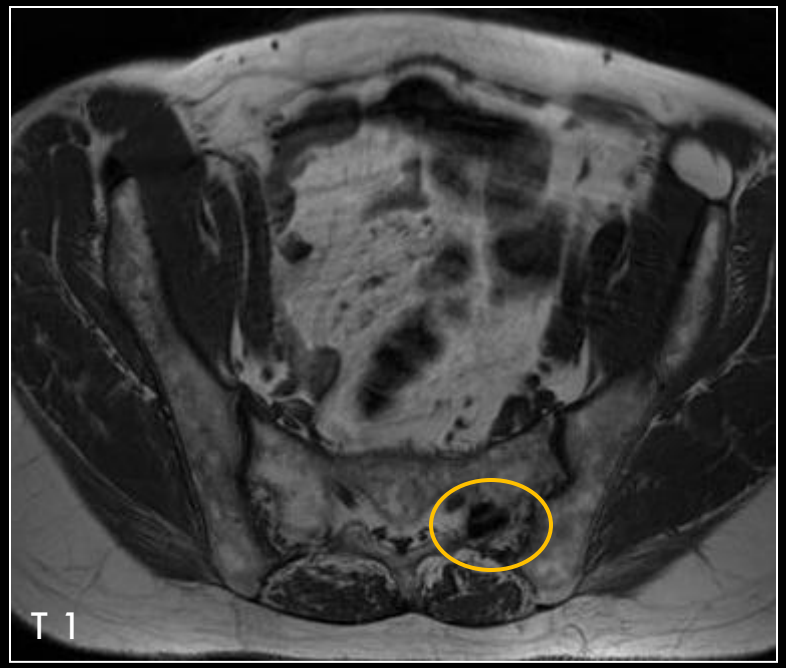


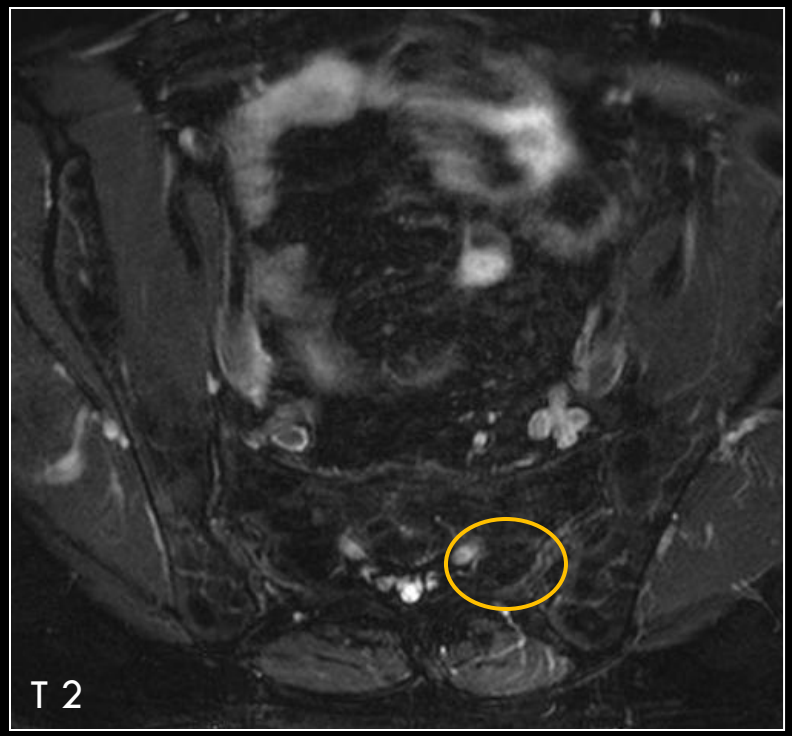
X – Ray – Sclerotic focus (arrow) located at left wing of sacrum.

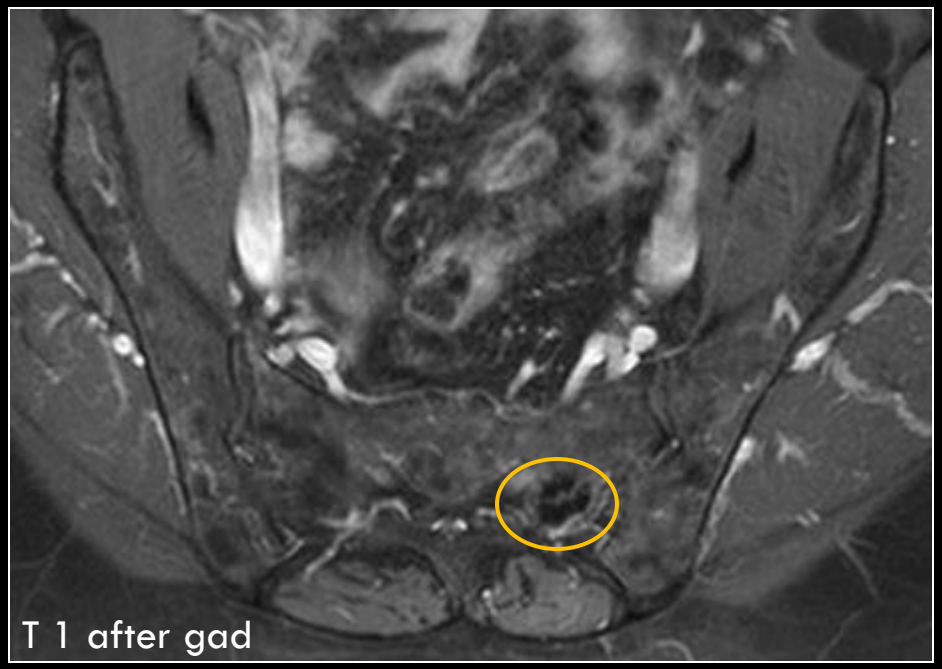


CT – Densely sclerotic lesion (1,4 cm) with an irregular spiculated border just beneath the posterior cortex of the sacrum's left wing

Enostosis







MR – The lesion is low signal on both T1 and T2. After gadolinium there is no lesion enhancement.

HEMANGIOMA

- Majority discovered incidentally in asymptomatic patients
- Occur predominantly in women
- +++ 4th-5th decades of life
- Vertebral hemangioma is extraordinarily common (10% of autopsies) and accounts for 28 % of all skeletal hemangiomas
- +++ Thoracic spine and can be multiple (33%)
- Histologicaly they are composed of low-pressure, thin-walled vessels with slow blood flow that are interspersed among thick bone trabeculae and fat

HEMANGIOMA

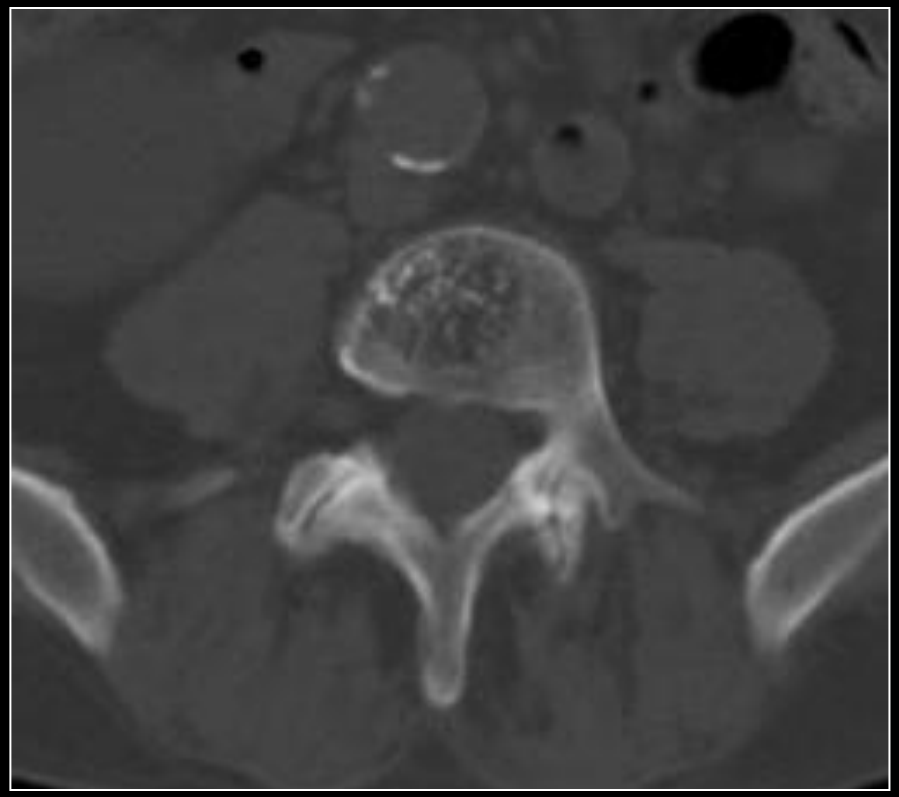
- At radiography, vertebral hemangiomas classically have a coarse, vertical, trabecular pattern with osseous reinforcement (trabecular thickening) adjacent to the vascular channels that have caused bone resorption
- At CT, hemangiomas are of low attenuation and contain coarse punctuate and striated areas of sclerosis – "polka-dot" appearance

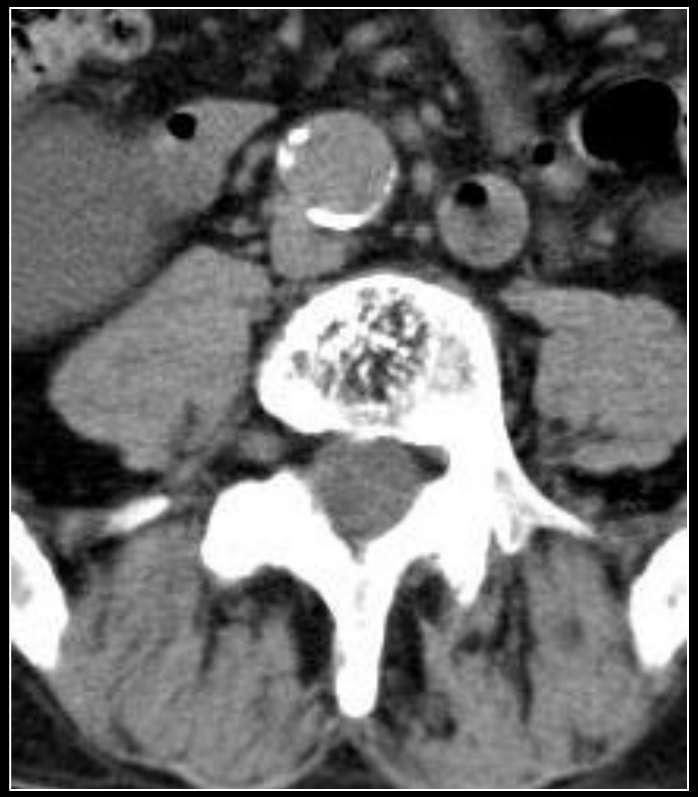
  Cortical bone destrution is almost never present

HEMANGIOMA

- At MR, areas of trabecular thickening have low signal intensity
- T1 – the signal intensity varies from low to high, depending on the degree of adipose tissue present
- T2 – usually show areas of very high intensity corresponding to the vascular components
- Less than 1% behave agressively and lead to compression fractures or soft tissue masses that may cause spinal cord compression

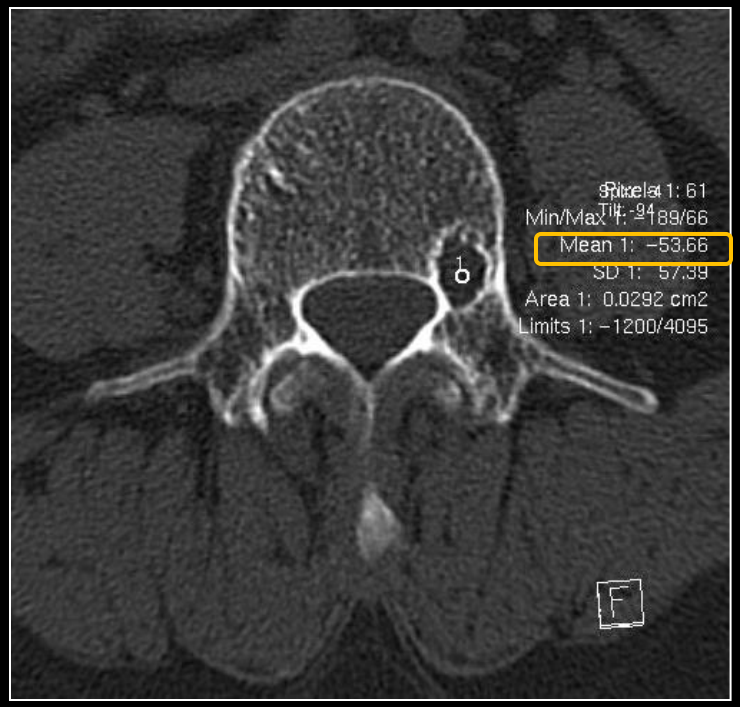
Hemangioma of lombar spine

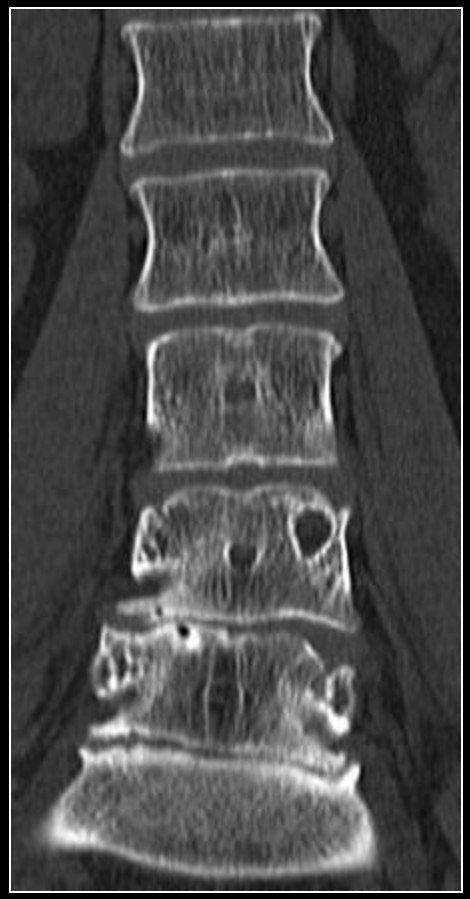


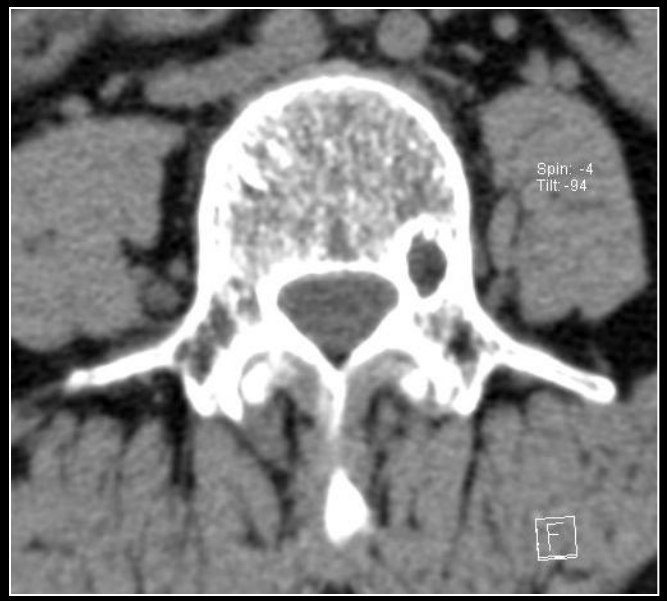


Lombar spine CT – This is the classic CT appearance of hemangioma. Lesion of low attenuation that contains coarse punctuate and striated areas of sclerosis, originating the “polka-dot sign”

Hemangioma of lombar spine

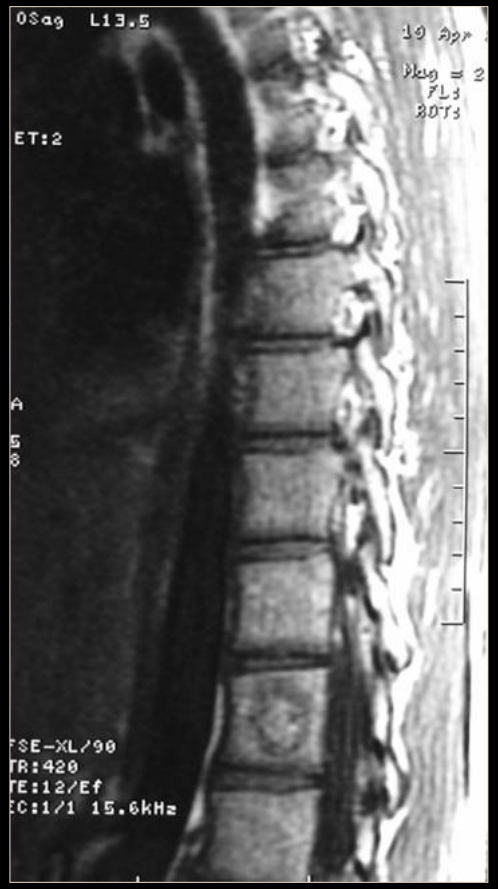




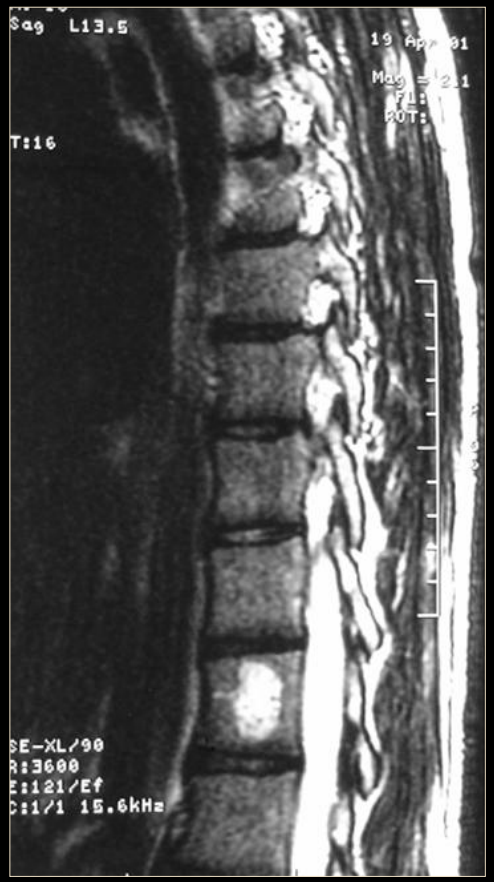


Lombar spine CT – Low attenuation lesion (ROI of minus 53 HU) in the left upper region of L4, with some extension into the ipsilateral pedicle, sclerotic margins and no cortical rupture. This was a hemangioma with a predominantly fat matrix.

Hemangioma of dorsal spine



T1



T2

T1 after gadolinium

MR – High signal on T1 and T2, with lesion enhancement after gadolinium.

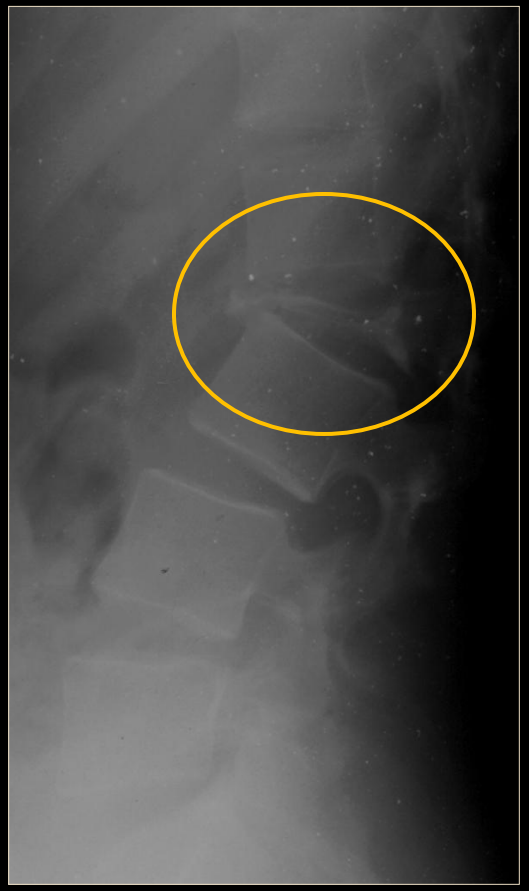
LANGERHANS CELL HISTIOCYTOSIS

- LCH = Histiocitosis X
- Disorder of imune regulation manifested by abnormal proliferation of histiocytes and granuloma formation
- Langerhans cell, a unique histiocyte, is the distinctive pathologic component
- Eosinophilic granuloma is limited to a single or few bones and typically occurs in children and young adults

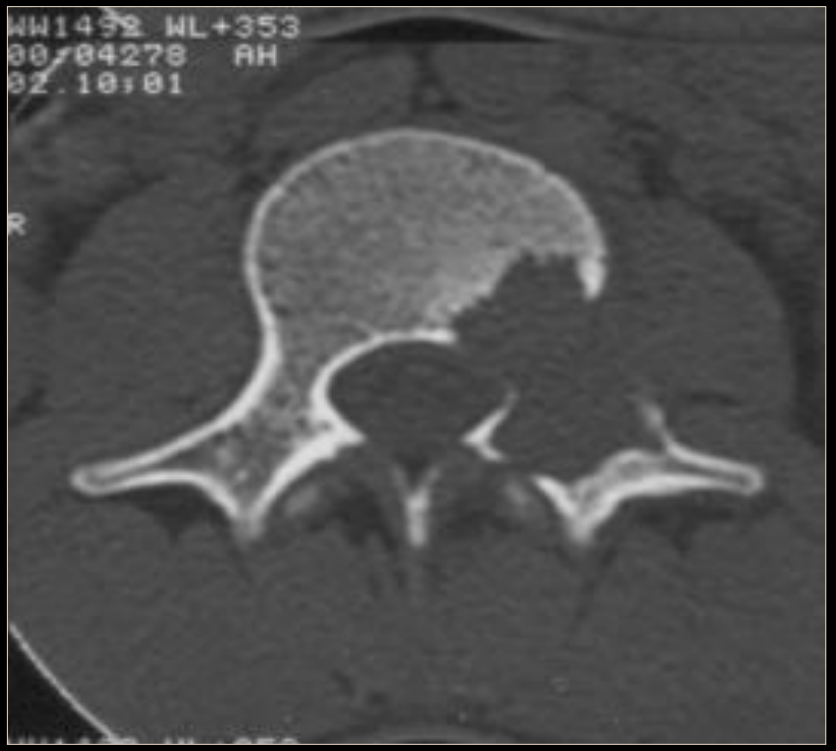
LANGERHANS CELL HISTIOCYTOSIS

- Early lesions appear lytic followed by uniform collapse of the vertebral body
- Extreme vertebral collapse produces de wafer or “coin-on-edge” appearance know as vertebra plana
- The intervertebral disk spaces are preserved or appear slightly widened
- Associated paraspinal mass may represent soft-tissue edema and hemorrhage related to the vertebral collapse or soft-tissue extension of LCH
- CT and MR are useful in outlining the extension of the lesion if surgery is considered

Langerhans cell histiocytosis



Lombar spine X-Ray - Extreme vertebral collapse of L2, the so called vertebra plana appearance.



CT – Lytic lesion of the left side of the neural arch and vertebral body, without sclerosis and without soft tissue masses.