SPINAL COLUMN TUMOURS

Prevalence and characteristics

- Of all primary benign bone tumors, 8% occur in the spine or sacrum
- Benign primary tumors most commonly occur during first 3 decades of life
- Spine metastasis most often occur in patients older than 40
- Benign tumors most frequently involve the posterior elements, but malignant tumors have a predilection for the vertebral bodies

Prevalence and characteristics

- Most common symptom is pain, which occurs in 76% of benign and 95% of malignant tumors.

- Ca breast, prostate, kidney, and thyroid gland account for 80% of all skeletal metastasis, with the spine as the most common site.

- Malignant tumors occur more frequently in the lower (lumbar > thoracic > cervical) spinal levels

Radiographic Diagnosis of Spine Tumors According to Age and Location

Diagnosis According to Age

10 to 30 Years Old

Aneurysmal bone cyst
Ewing sarcoma
Giant cell carcinoma
Histiocytosis X
Osteoblastoma
Osteoid osteoma
Osteochondroma
Osteosarcoma

30 to 50 Years Old

Chondrosarcoma
Chordoma
Hodgkin disease
Hemangioma

Older Than 50 Years

Metastatic
Myeloma

Diagnosis According to Location

Vertebral Body

Chordoma
Giant cell carcinoma
Hemangioma
Histiocytosis X
Metastatic disease
Multiple myeloma

Posterior Elements

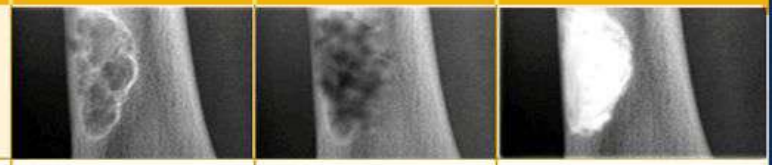
Aneurysmal bone cyst
Osteoblastoma
Osteoid osteoma
Osteochondroma

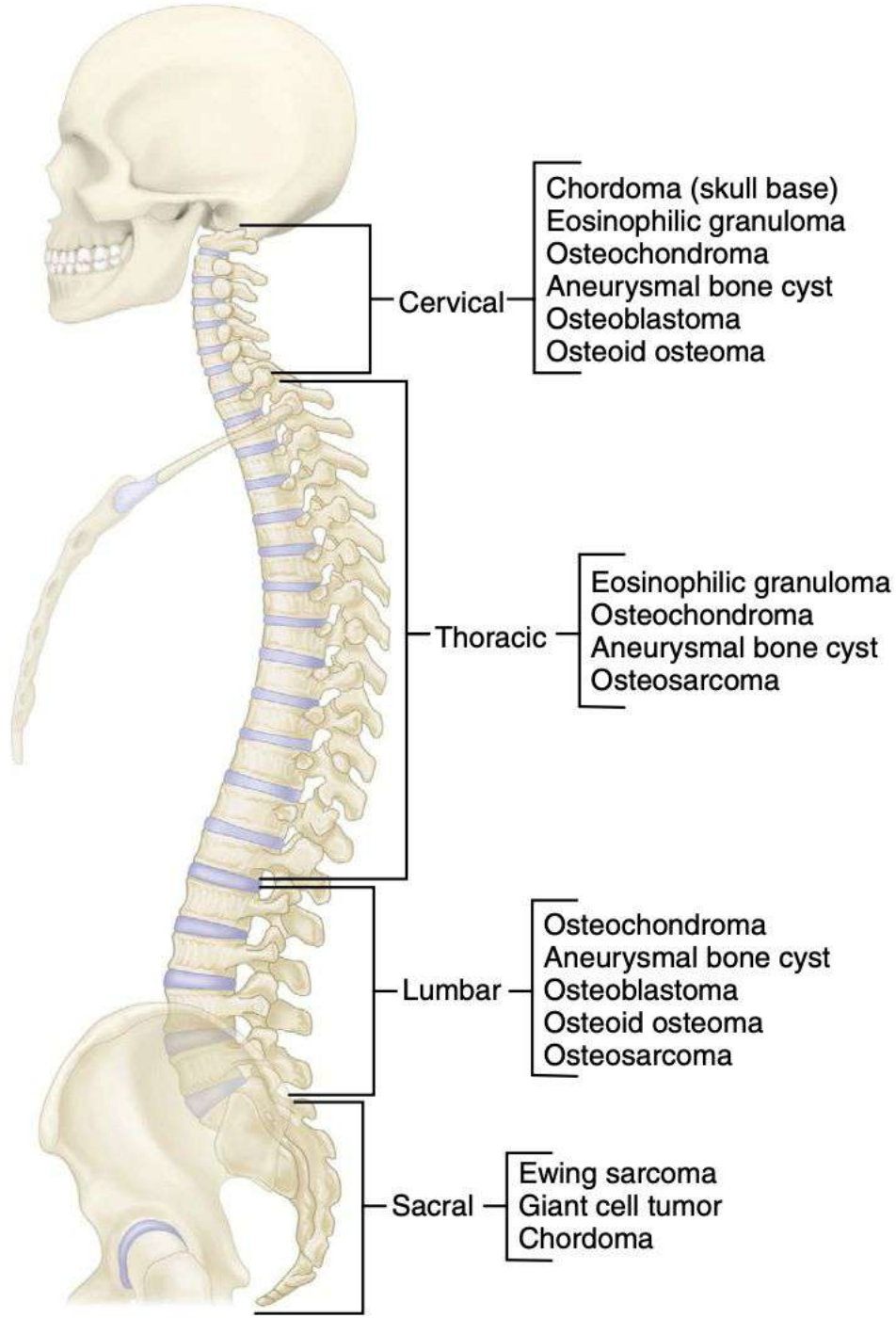
Adjacent Vertebrae

Aneurysmal bone cyst
Chondrosarcoma
Chordoma

Multiple Vertebrae

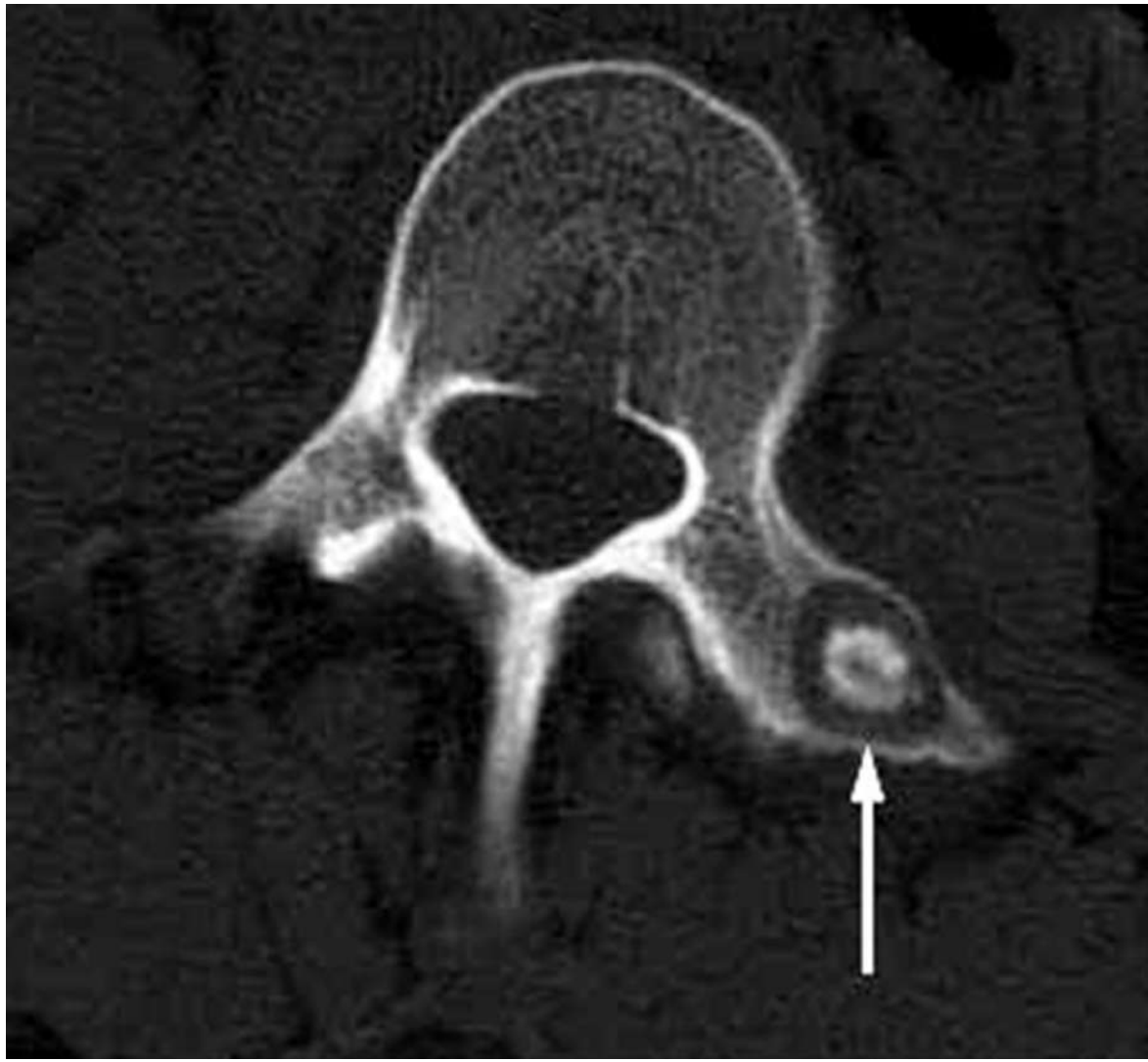
Histiocytosis X
Metastatic
Myeloma

Age	Well-defined	ill-defined	Sclerotic
			
0-10	EG SBC	EG -Ewing Osteosarcoma Leukemia	Osteosarcoma
10-20	NOF Osteoblastoma Fibrous dysplasia EG SBC ABC Chondroblasoma CMF	Ewing Eosinphilic Gran Osteosarcoma	Osteosarcoma Fibrous dysplasia Eosinphilic Gran Osteoid osteoma Osteoblastoma
20-40	Giant CT Enchondroma Chondrosarcoma (low grade) HPT - Brown tumor Osteoblastoma	Giant CT	Enchondroma Osteoma Bone island Parosteal Osteosarc Healed lesions: • NOF, EG • SBC, ABC • Chondroblastoma
40	Metastases Myeloma Geode	Metastases Myeloma Chondrosarcoma (high grade)	Metastases Bone island
All ages	Infection	Infection	Infection

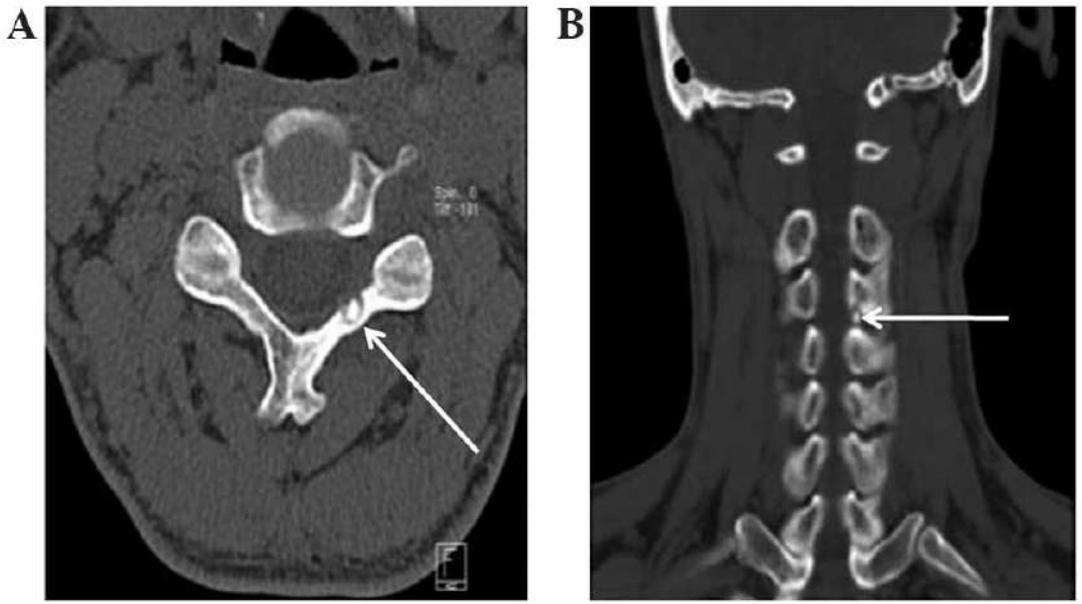


Osteoid Osteoma

- M>F
- 2nd Decade, Lumbar>cervical
- Posterior Elements
- Night pain/Awakenings
- Relieved with Aspirin
- Rx- Obs/Thermal ablation/Excision
- Scoliosis



OSTEOID OSTEOMA

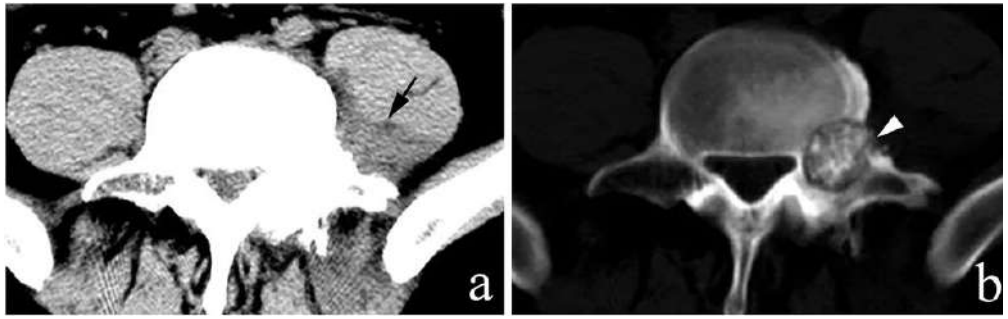


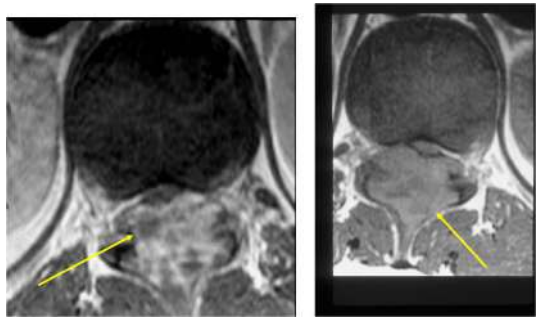
OSTEOID OSTEOMA SPECIMEN

Osteoblastoma

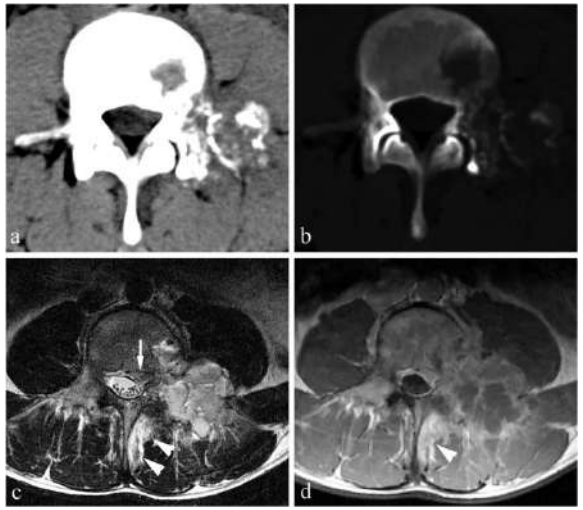
- M:F=2:1
- 2nd and 3rd Decade
- Always involves pedicles
- Cervical>Lumbar
- D/D- OSa, Ewings,ABCs
- Rx- Wide Excision

OSTEOBLASTOMA IMAGING





Osteoblastoma Of Posterior Spine Elements



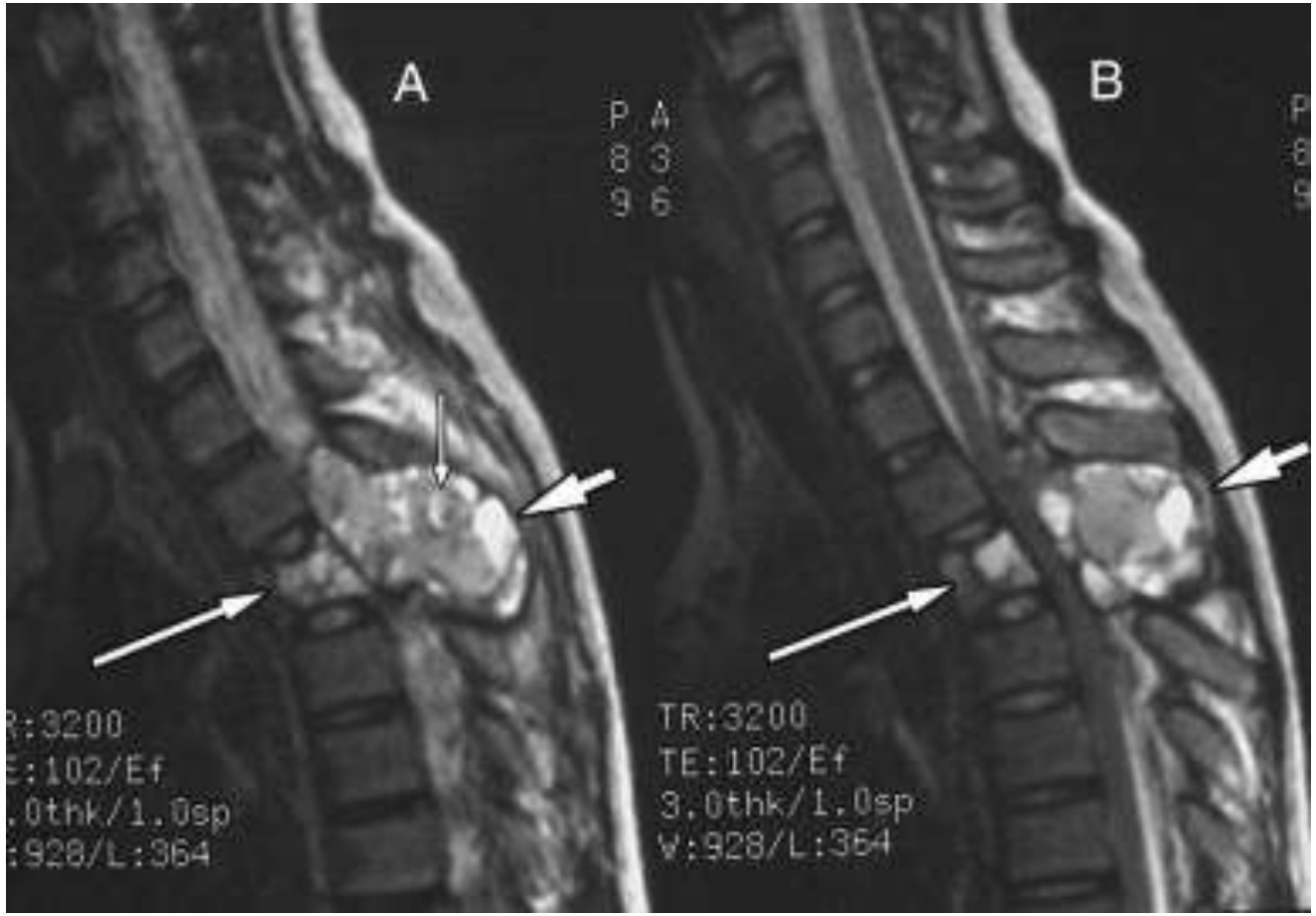
Aneurysmal Bone Cyst

- Approx. 11-30% of ABC are located in spine
- Age: <20 yrs

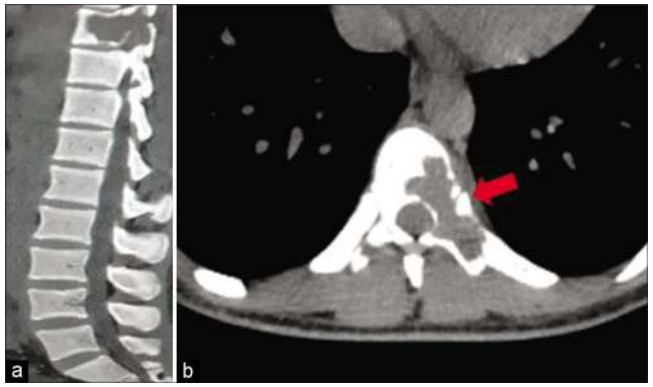
- Particularly in cervical and thoracic regions
- Posterior elements are typically involved.

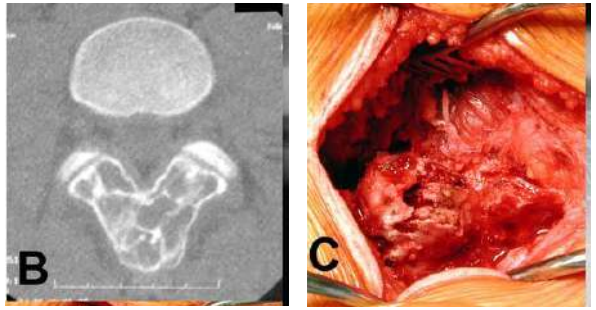
  - X-ray: Expansile lesion with a reactive rim of cortical bone

- Rx: 1. Surgery: Embolization, Curettage & bone grafting
  - ± Fusion
  - 2. Radiation : Successful in 50% cases

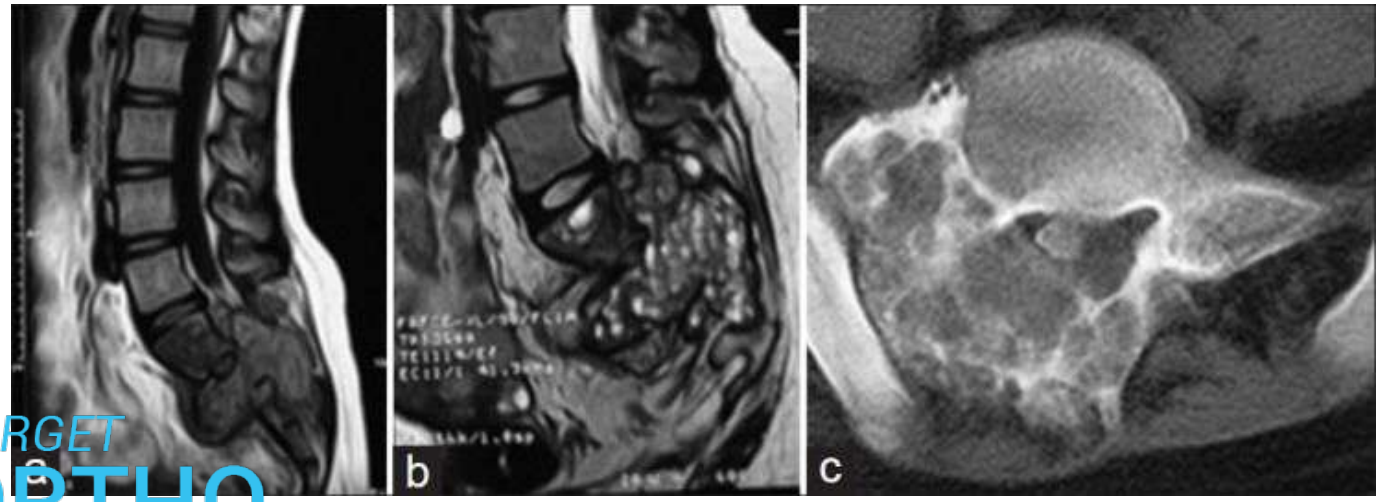


ANEURYSMAL BONE CYST





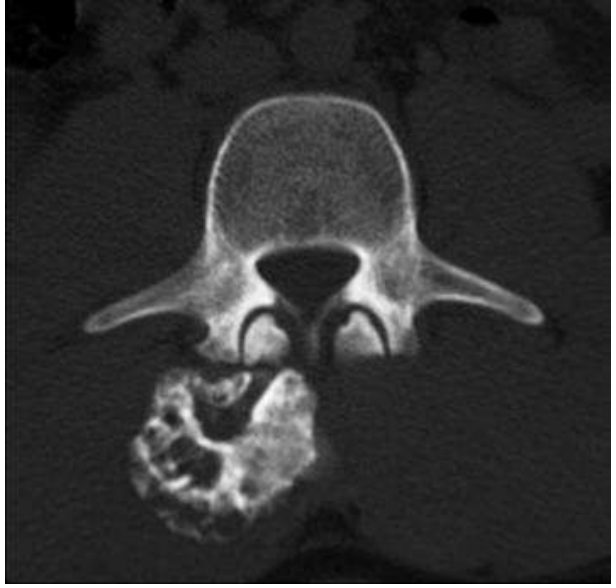
INTRA OP IMAGING



SACRAL ABC

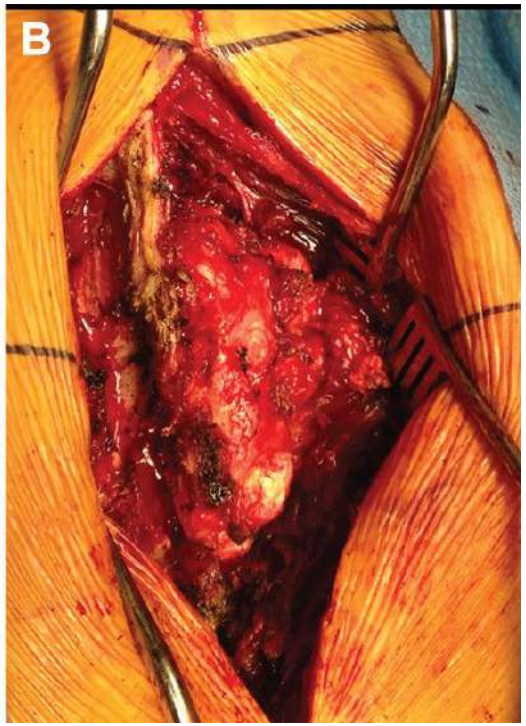
Osteochondroma

- MC Benign spinal tumour
- M:F=3:1
- Cervical and Upper Thoracic
- Radiologically- Cartilaginous cap
- Rx-En-Bloc Excision
- Recurrence- Rare
- Malignant transformation 10% cases

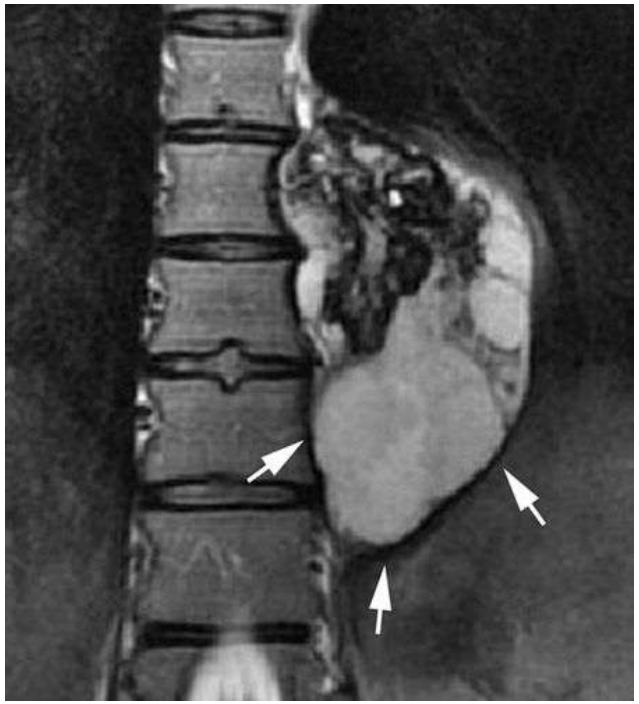


OSTEOCHODROMA

OSTEOCHONDROMA C SPINE



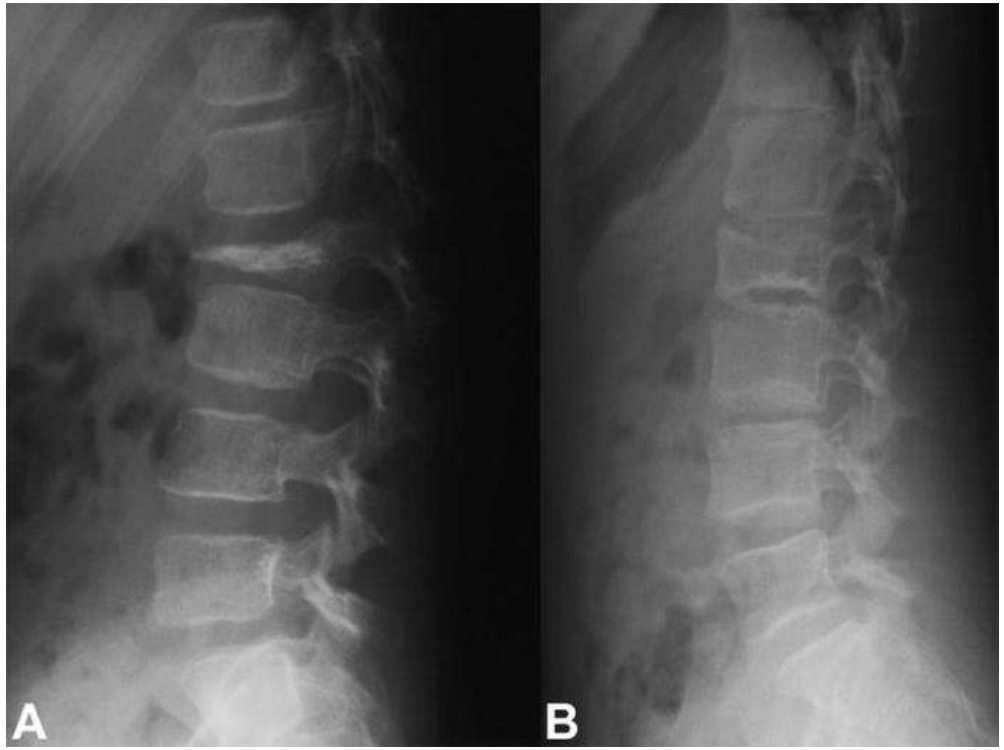
INTRAOP IMAGING OSTEOCHONDROMA T12 LEVEL



CARTILAGENOUS CAP ON CT

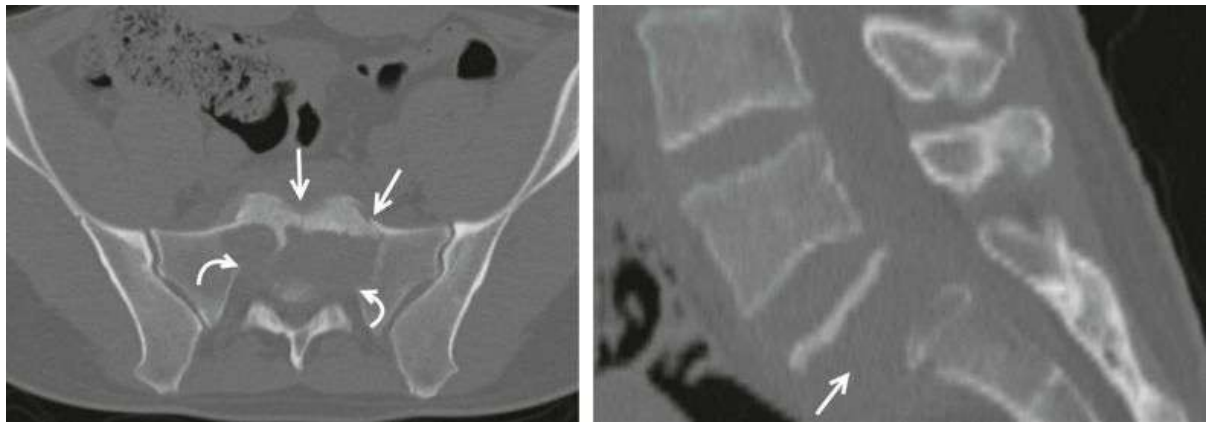
Eosinophilic Granuloma

- <10yrs age
- Cervical and thoracic
- Pain/Muscle rigidity/Neurological deficits
- Xray- Vertebra Plana
- Rx-
  - Immobilization
  - Most Regress spontaneously
  - Curettage and bone grafting



EOSINOPHILIC GRANULOMA

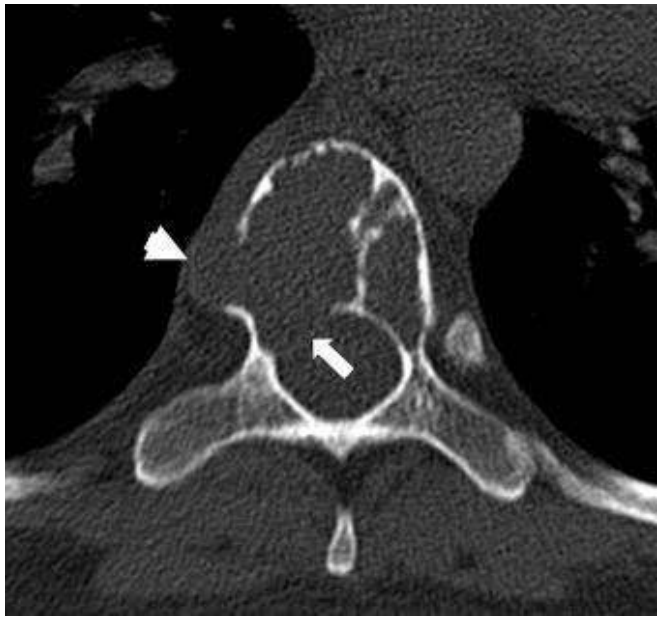
CERVICAL EOSINOPHILIC GRANULOMA

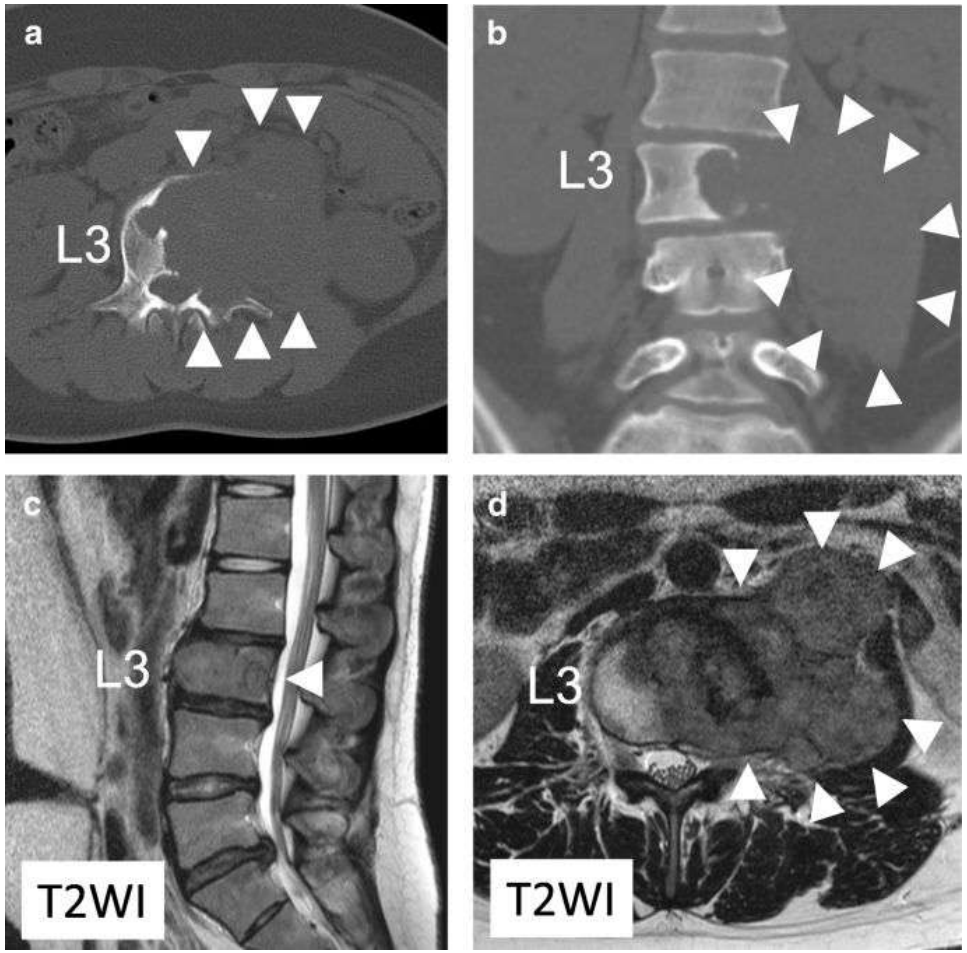


VERTEBRA PLANA

GCTs

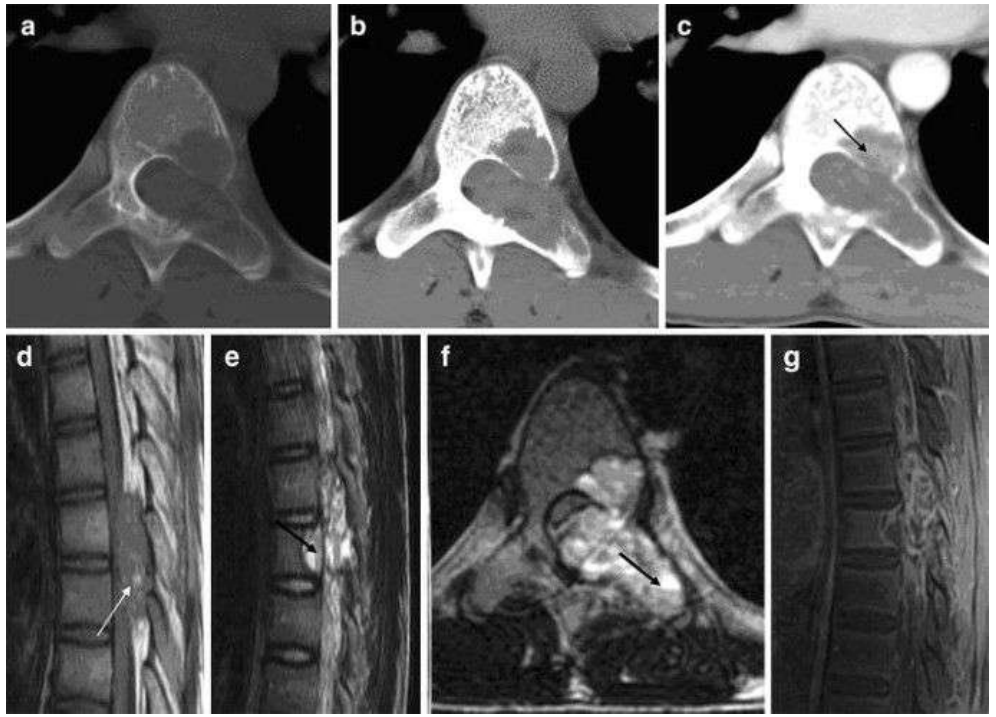
- MC: Sacrum
- Locally Aggressive
- M:F=1:2
- Pain-MC
- Neurological Deficits-20-80% cases
- Rx
  - En-bloc Resection
  - Denosumab
  - Pre-op Embolization





GIANT CELL TUMOR

GCT - right pedicle and lamina with marked perilesional soft tissue oedema

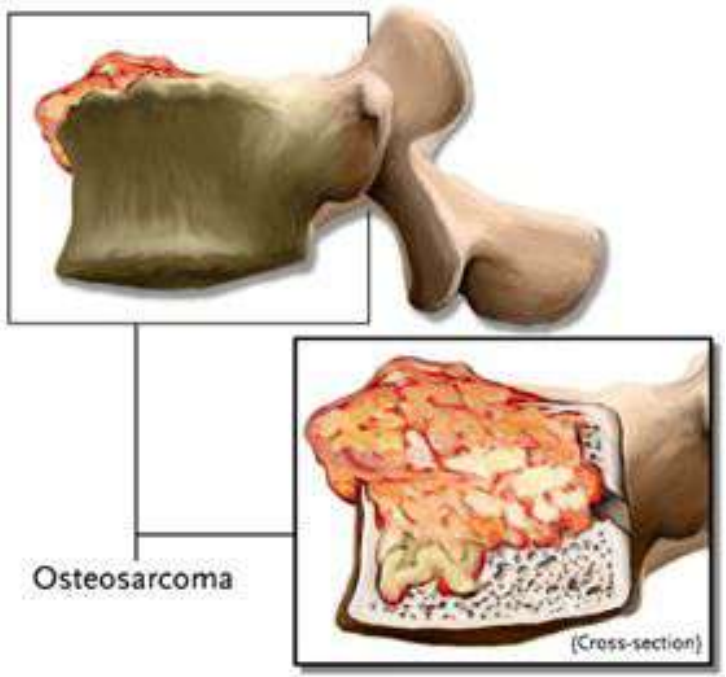


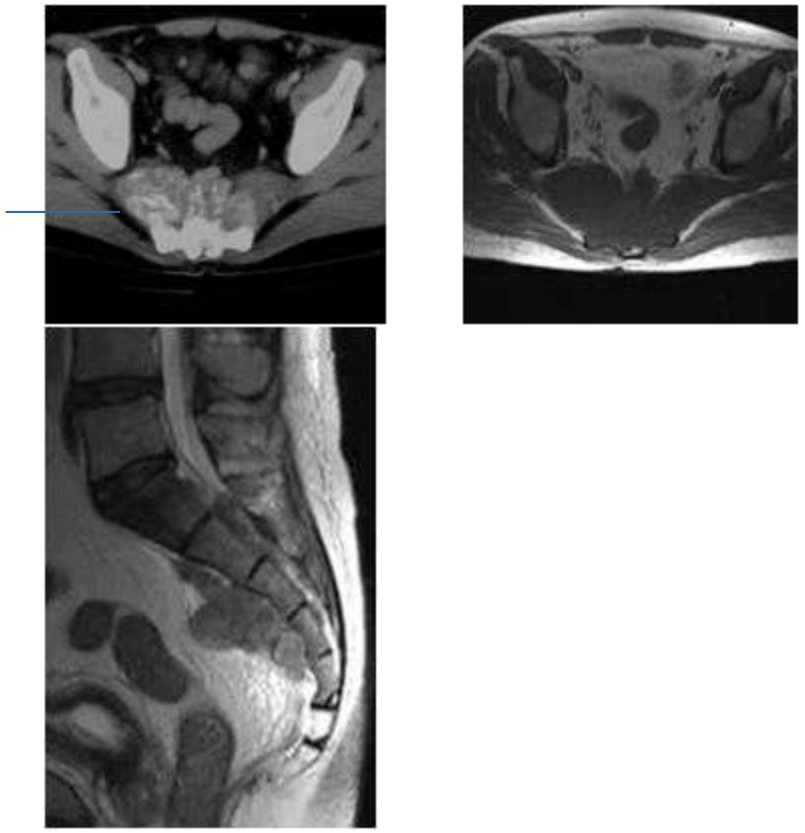
LOCALLY AGGRESSIVE GCT

Osteosarcoma

- Rare
- Pain-MC, Neurodeficit – 70%
- 95%- Vertebral body
- Secondary Osa- After radiation for pagets disease
- Xray- Lytic/Blastic/Mixed
- Bone Scanning- Multifocal
- Rx
  - Chemo/Radio
  - Surgery- Wide excision+Chemo

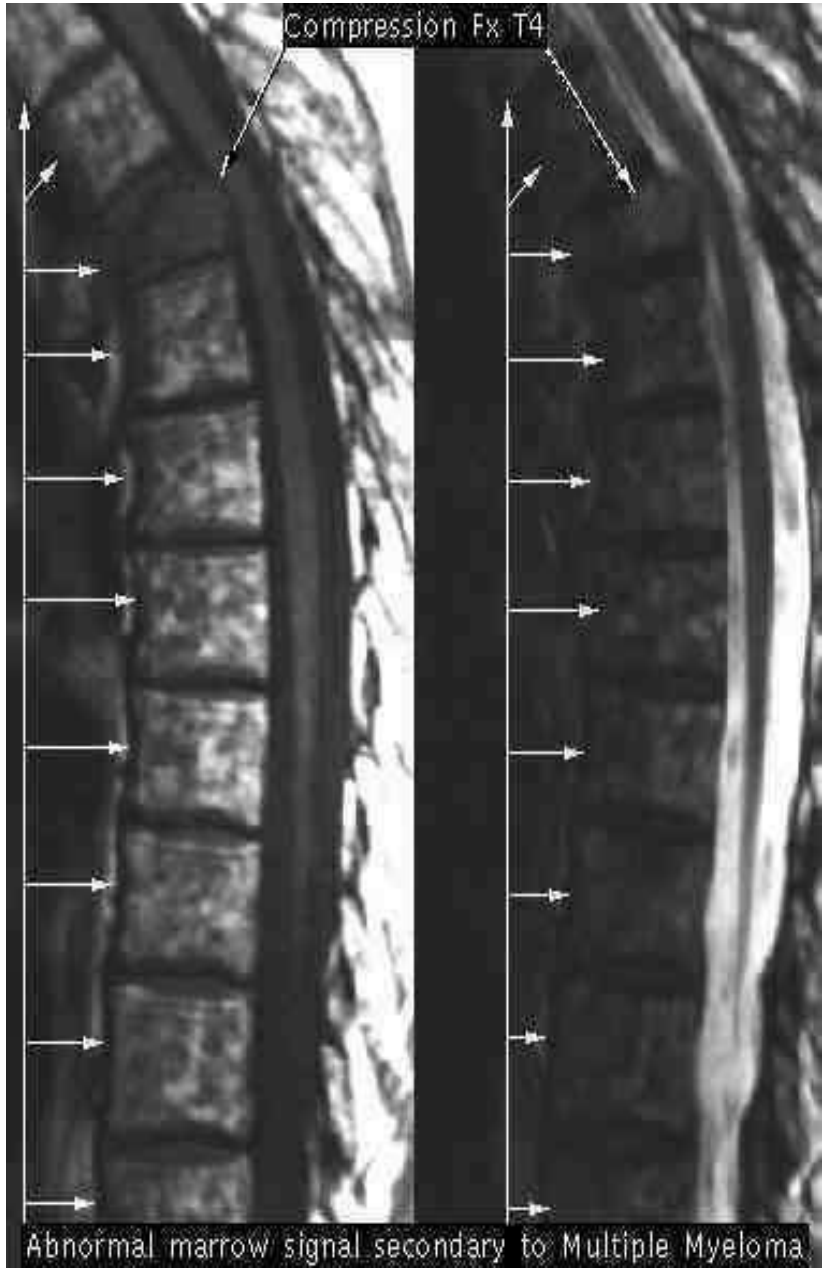
OSTEOSARCOMA





Multiple Myeloma

- It is a Malignancy characterized by monoclonal proliferation of malignant plasma cells.
- Nearly always systemic.
- MM is most common primary neoplasm of spine with the majority occurring in the thoracic and lumbar spine.
- Most patients are men, 60 years of age or Older.
- Fatal within 4 years of diagnosis.
- Single vertebrae may be involved i.e. plasmacytoma



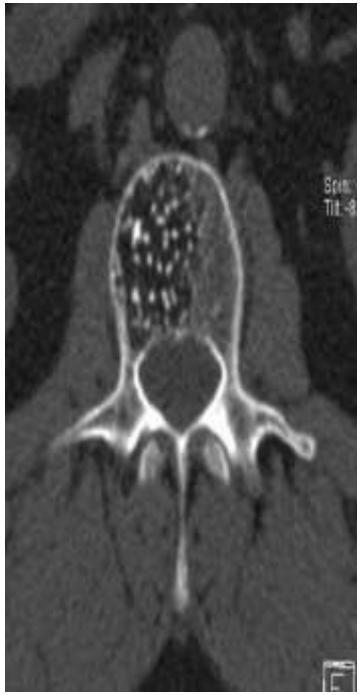
- Diagnosis confirmed by

1. At least 10% abnormal plasma cell
2. Lytic bone lesion
3. Monoclonal gammopathy (Protein electrophoresis, urinary Ben Zones protein)
4. Anaemia, High rise of ESR Treatment:
5. Irradiation
6. Chemotherapy
7. Surgery: Patients with neurologic Deficits & progressive deficit despite maximal chemo-radiation.

Hemangioma

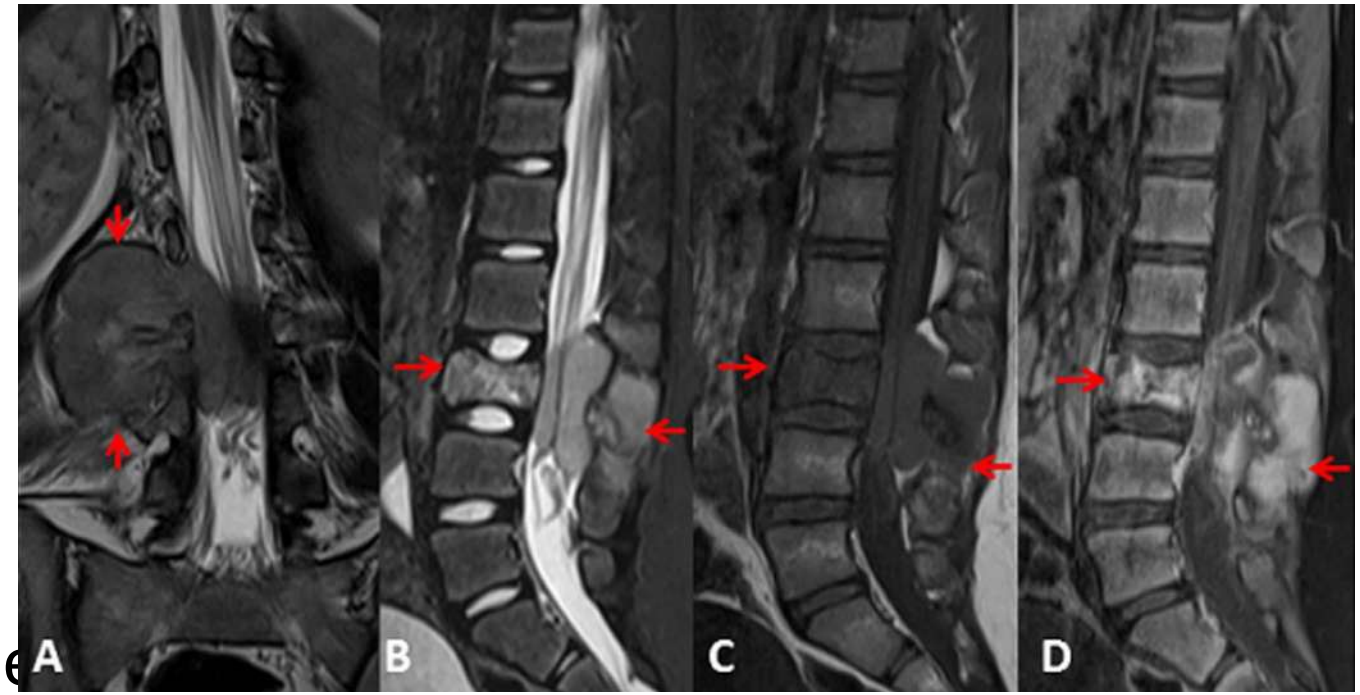
- Common primary bone tumor and are found in >10 % of population, mostly silent.
- Most commonly found in the 4th to 6th decades with female predominance.
- They may be solitary (70%) or multiple (30%) with contiguous level affected
- The most common locations are the thoracic
- Most of the hemangiomas arise in the body of the vertebra.
- Atypical & aggressive type may involve posterior elements

- At CT, the thickened trabeculae are seen in cross section as small punctate areas of sclerosis, often called the "polka-dot" appearance.
- X-ray: vertical striation with larger lesion & thickened trabeculae- Corduory vertebrae)

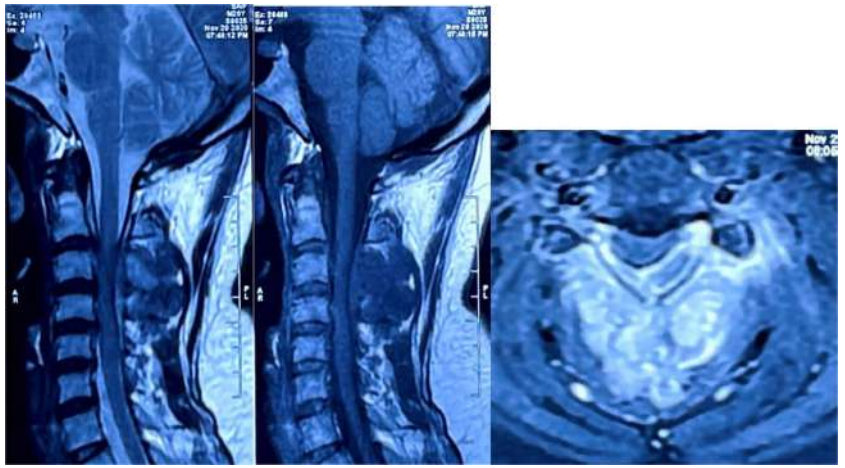



Ewings Sarcoma

- Sacrum MC
- Neurological involvement common
- Xray- Vertebra Plana(D/D-Eosino Gran)
- Rx- Surgical Resection+Reconstruction+De com
  - Radiation in sacral lesion



EWINGS SARCOMA



EWINGS SARCOMA OF C SPINE

CHORDOMA

- Most common non lymphoproliferative primary malignant tumor of the spine
- Originate from notochordal rests
- Almost always occur in a midline or paramedian location in relation to the spine.
- Nearly 50% originate in the sacrococcygeal region, particularly in the 4th & 5th sacral segments.
  - M:F= 2:1, mean age >50 years.
  - slow-growing tumors , relentless progression with high recurrence rate

- DRE: Palpable mass Anteriorly variable
- X-ray: Lytic lesion with calcification
  - The most suggestive manifestation is a destructive lesion of a vertebral body associated with a soft-tissue mass with a “collar button” or “mushroom” appearance

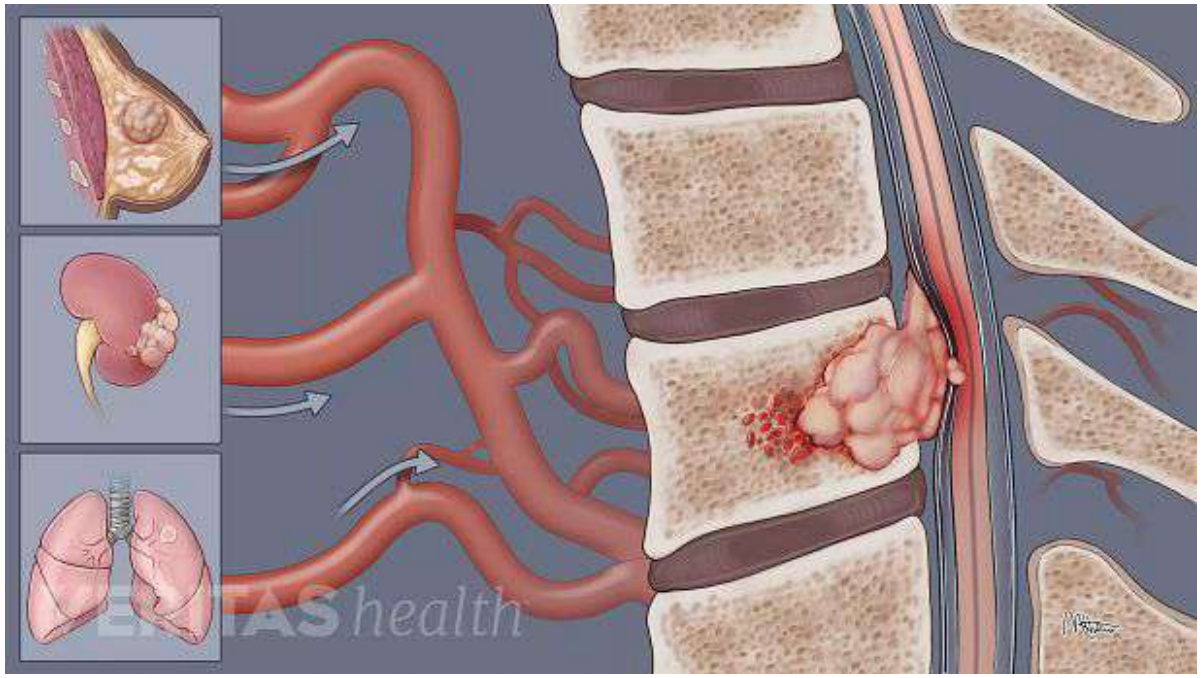
Rx: Wide En Bloc Excision

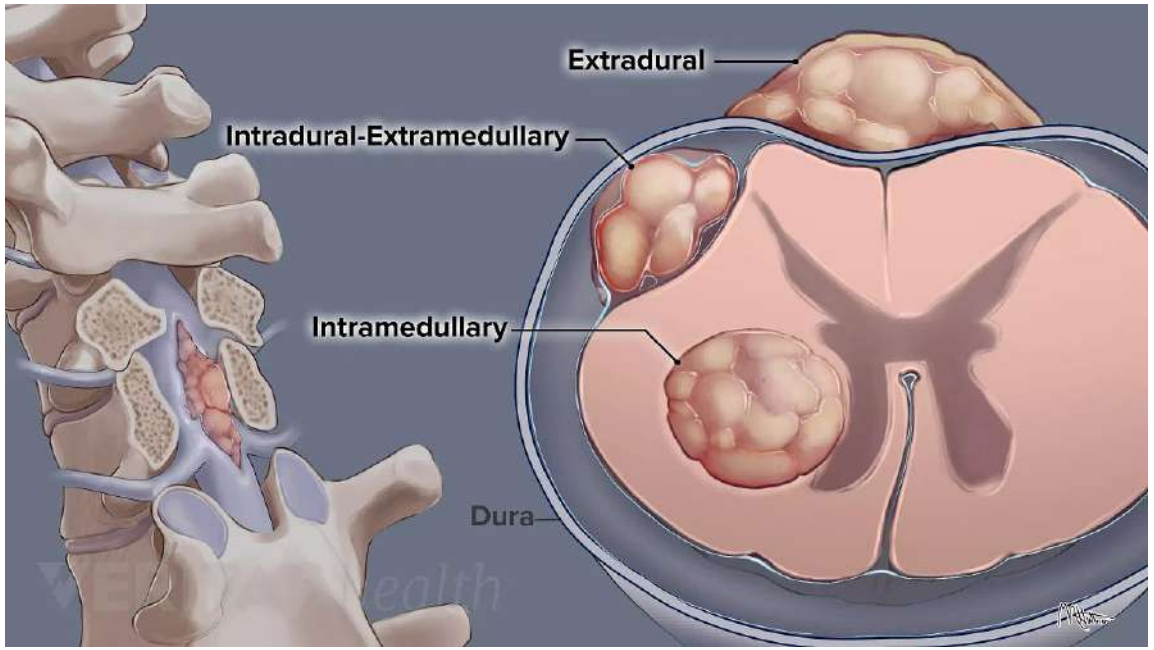
METASTASES

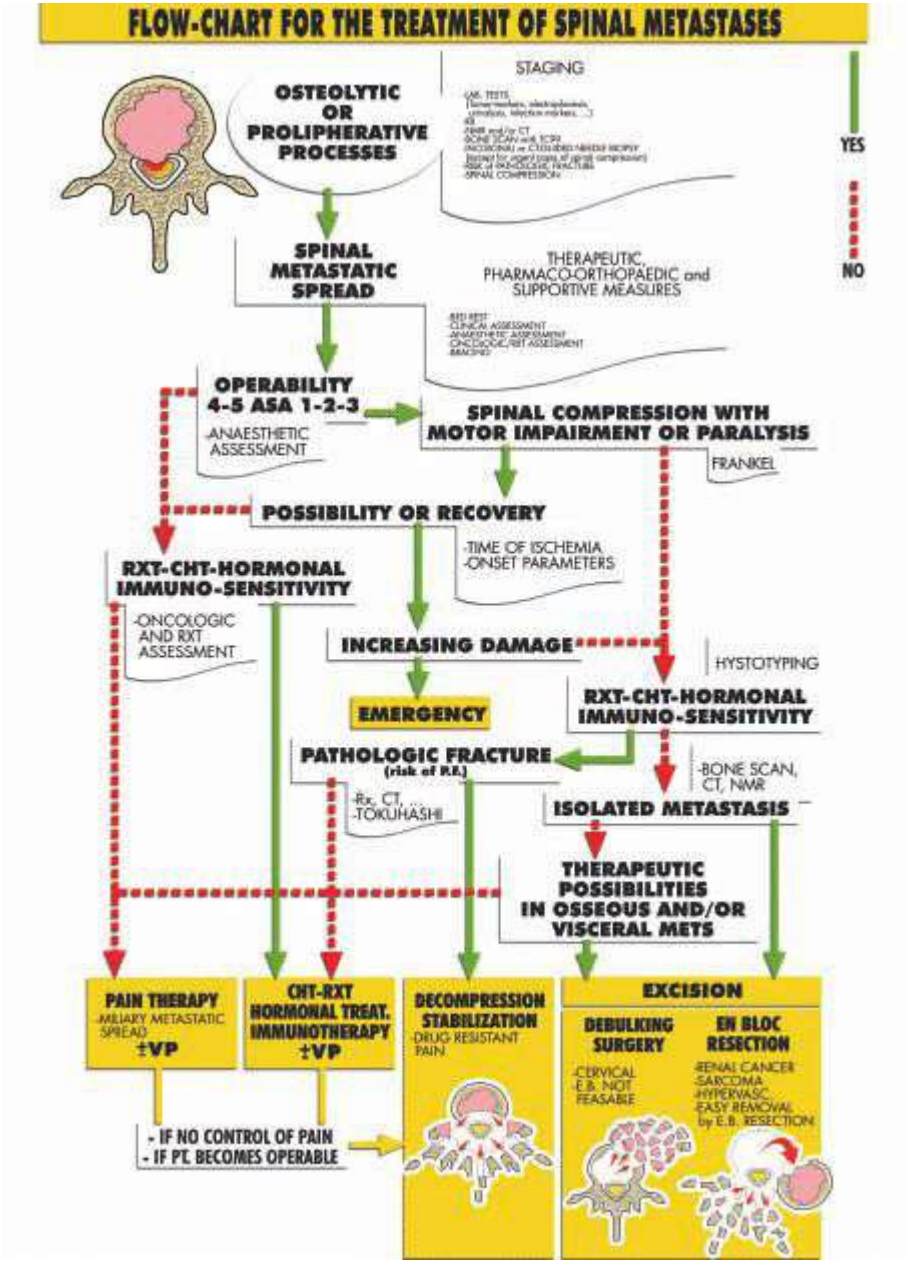
- Spinal metastasis is the most common tumor of the spine.
- Multiple in 90 % of cases.
- In adults, the most common primary tumors are adenocarcinomas of lung, prostate and breast.
- In children, most vertebral metastases arise from neuroblastoma and Ewing‟s sarcoma.
- Thoracic > lumbar > cervical spine.

The metastatic foci mostly involve the body. Most spinal metastases are lytic.

METASTASIS TO BONE







Classification of Malignant Bone Tumours

- Dewalds
- Weinstein Boriani Bignani
- Tomita
- NOMS
- ESCC Scale

Enneking

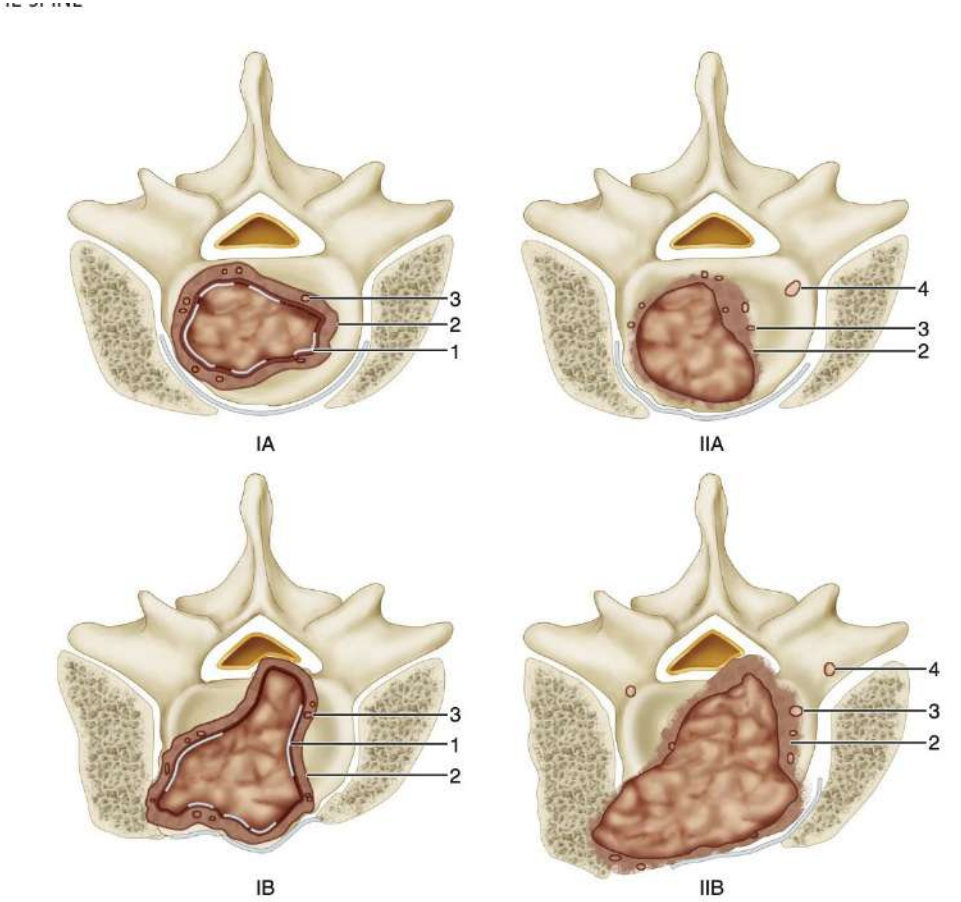


FIGURE 42.12 Enneking staging of malignant spinal tumors. Capsule of tumor is indicated by *1*, pseudocapsule is indicated by *2*, island of tumor within pseudocapsule (satellites) is indicated by *3* and at distance (skip metastases) is indicated by *4*. Types IB and IIB tumors can compress cord if expanding posteriorly. Pseudocapsule is more or less infiltrated by neoplastic tissue, which can have direct contact with dural sac.

Prognostic Scores

Table-1. Tomita Prognosis Scoring Table

	1 POINT	2 POINTS	4 POINTS
Primary tumor	Slowly growing	Intermediate growing	Rapidly growing
Internal organ met.	-	Can be treated	Can not be treated
Bone metastasis	Single	Multiple	-

Table-2. Renewed Tokuhashi prognosis scoring system

	0	1	2	3	4	5
Karnofsky Performance (%)	10-40	50-70	80-100	-	-	-
Mets outside of spine	3 or more	1-2	0	-	-	-
Mets in spine	3 or more	2	1	-	-	-
Internal organ met.	Not removable	Removable	None	-	-	-
Primary cancer	Lung	Liver	Others	Kidney	Rectum	Breast
Palsy	Frankel A,B	Frankel C,D	Frankel E	-	-	-

Table-3. Harrington Spinal Metastasis Score

1	No neurologic involvement
2	Bone involvement, no instability or collapse
3	Neurologic involvement without bone involvement
4	Pain at vertebra or instability with collapse, no neurologic involvement
5	Pain at vertebra or instability with collapse and neurologic involvement

Table-4. McLain and Weinstein spine metastasis anatomic classification

1. AREA	From spinous process to pars and inferior facet
2. AREA	From superior facet to transverse process and pedicle
3. AREA	¾ anterior of vertebral body
4. AREA	¼ posterior of vertebral body
LEVEL A	Intraosetal
LEVEL B	Extraosteal
LEVEL C	Tumor spreading to non-neighboring area

Weinstein Boriani Bignani

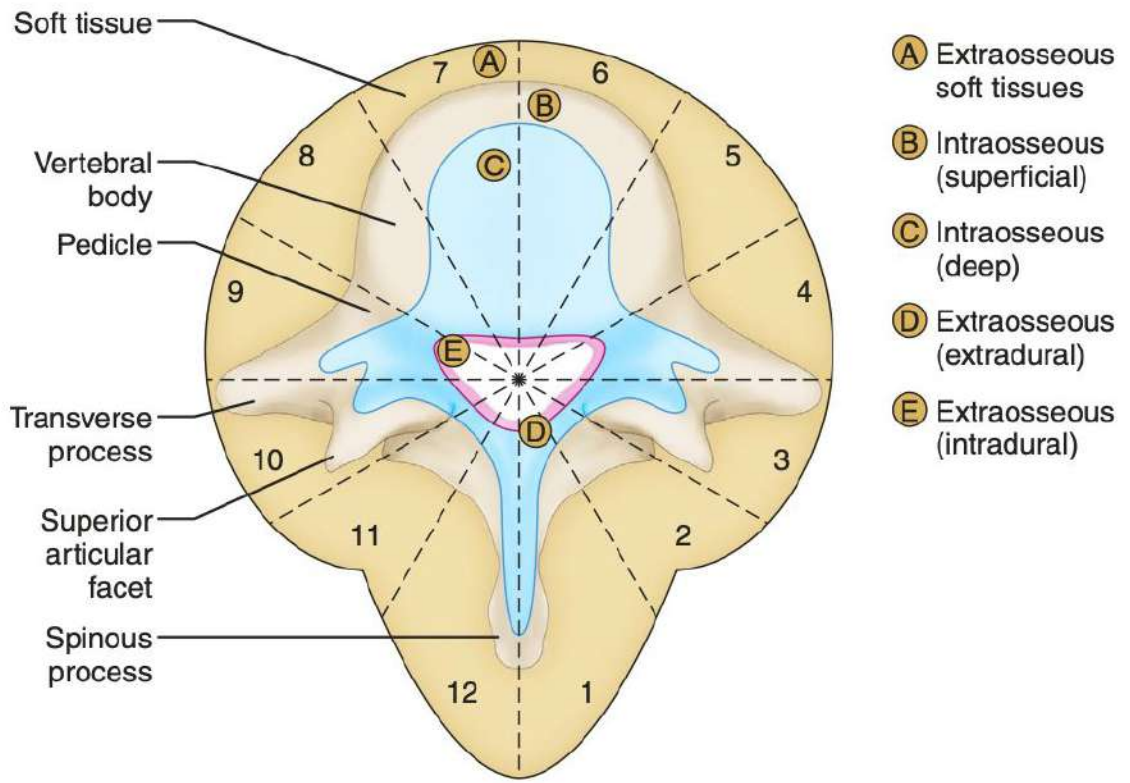


FIGURE 42.13 Weinstein-Boriani-Biagini surgical staging system. In this classification, the spine is divided radially into 12 equal segments (clock face) in the axial plane and examined in five layers from superficial to deep plane. (From Ciftdemir M, Kaya M, Selcuk E, et al: Tumors of the spine, *World J Orthop* 7:109, 2016.)

Tomita

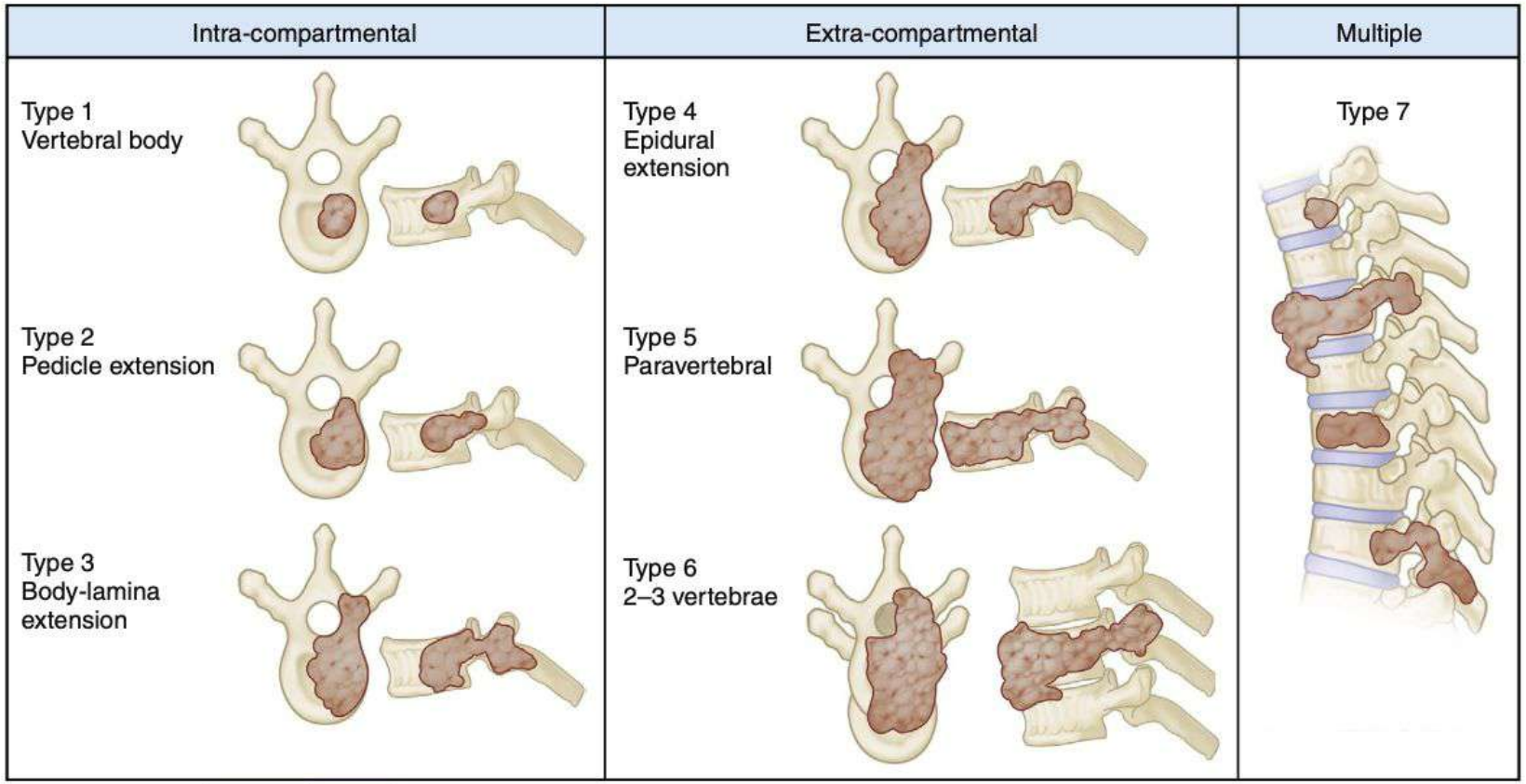


FIGURE 42.14 **Tomita et al. surgical classification of spinal tumors.** (From Ciftdemir M, Kaya M, Selcuk E, et al: Tumors of the spine, *World J Orthop* 7:109, 2016.)

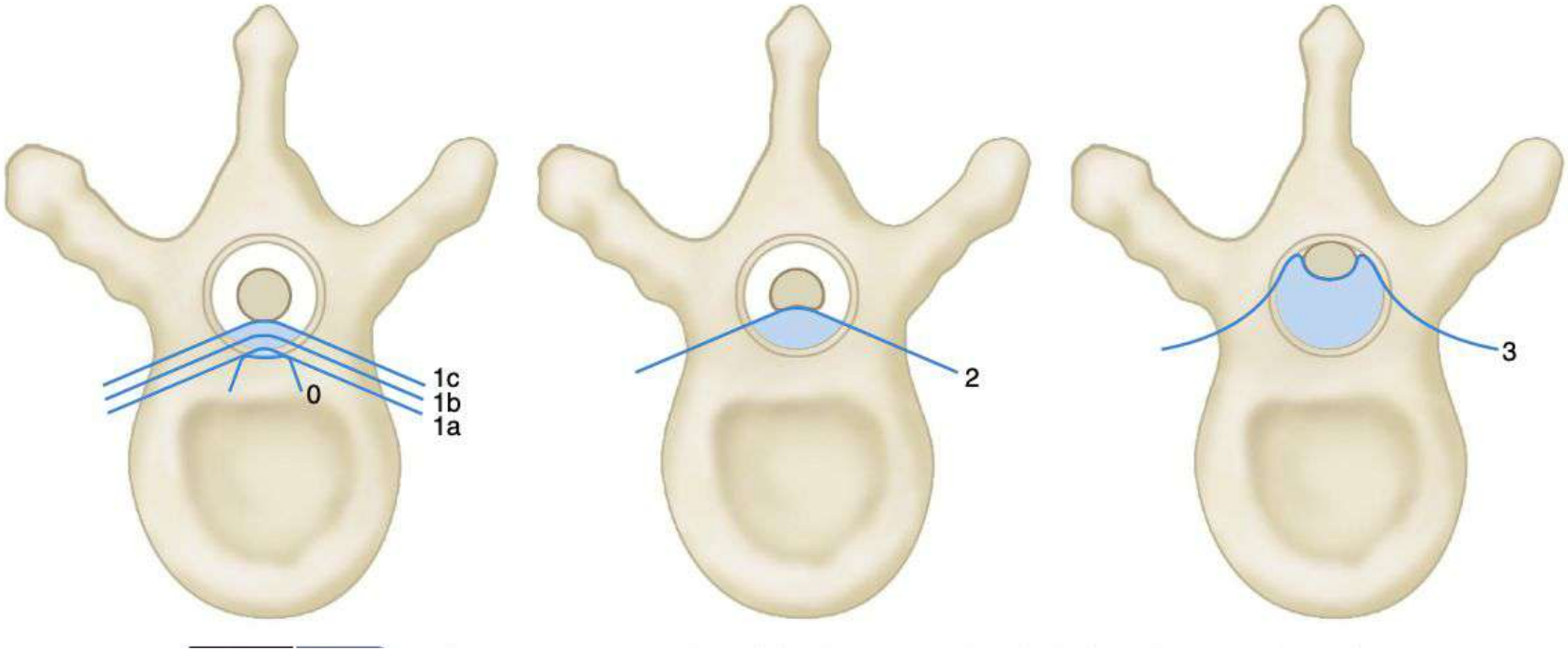
Surgical Strategy

Surgical Strategy for Spinal Metastases

POINT	SCORING SYSTEM			PROGNOSTIC SCORE	TREATMENT GOAL	SURGICAL STRATEGY
	PROGNOSTIC FACTORS					
	PRIMARY TUMOR	VISCERAL METASTASES	BONE METASTASES*			
1	Slow growth (breast, thyroid, etc.)		Solitary or isolated	2	Long-term local control	Wide or marginal excision
				3		
2	Moderate growth (kidney, uterus, etc.)	Treatable	Multiple	4	Middle-term local control	Marginal or intra-lesional excision
				5		
4	Rapid growth (lung, stomach, etc.)	Untreatable		6	Short-term palliation	Palliative surgery
				7		
				8	Terminal care	Supportive care
				9		
				10		

No visceral metastases = 0 points.
*Bone metastases: including spinal metastases.
From Ciftdemir M, Kaya M, Selcuk E, et al: Tumors of the spine, *World J Orthop* 7:109, 2016.

ESCC Stage



NOMS

Current Neurologic, Oncologic, Mechanical, and Systemic (NOMS) Decision Framework				
NEUROLOGIC	**ONCOLOGIC**	**MECHANICAL**	**SYSTEMIC**	**DECISION**
Low-grade ESCC + no myelopathy	Radiosensitive	Stable		cEBRT
	Radiosensitive	Unstable		Stabilization followed by cEBRT
	Radiosensitive	Stable		SRS
	Radiosensitive	Unstable		Stabilization followed by SRS
High-grade ESCC ± no myelopathy	Radiosensitive	Stable		cEBRT
	Radiosensitive	Unstable		Stabilization followed by cEBRT
	Radiosensitive	Stable	Able to tolerate surgery	Decompression/stabilization followed by SRS
	Radiosensitive	Stable	Able to tolerate surgery	cEBRT
	Radiosensitive	Unstable	Able to tolerate surgery	Decompression/stabilization followed by SRS
	Radiosensitive	Unstable	Able to tolerate surgery	Stabilization followed by cEBRT

PRESENTATION

- Persisting pain
- Weakness of both lower limb
- Incontinence
- Paraparesis/paralysis
- Bowel & Bladder involvement

DIAGNOSIS

- In early stages , diagnosis of primary tumors are very difficult. Symptoms are similar to degenerative spinal disease.
- Diagnosis based upon :
  - Biochemical
  - Radiology imaging
  - CTScan & CT Myelogram
  - MRI.
- CTor ultrasonic guided biopsy helps to confirm the diagnosis

Imaging studies

Plain radiographs:

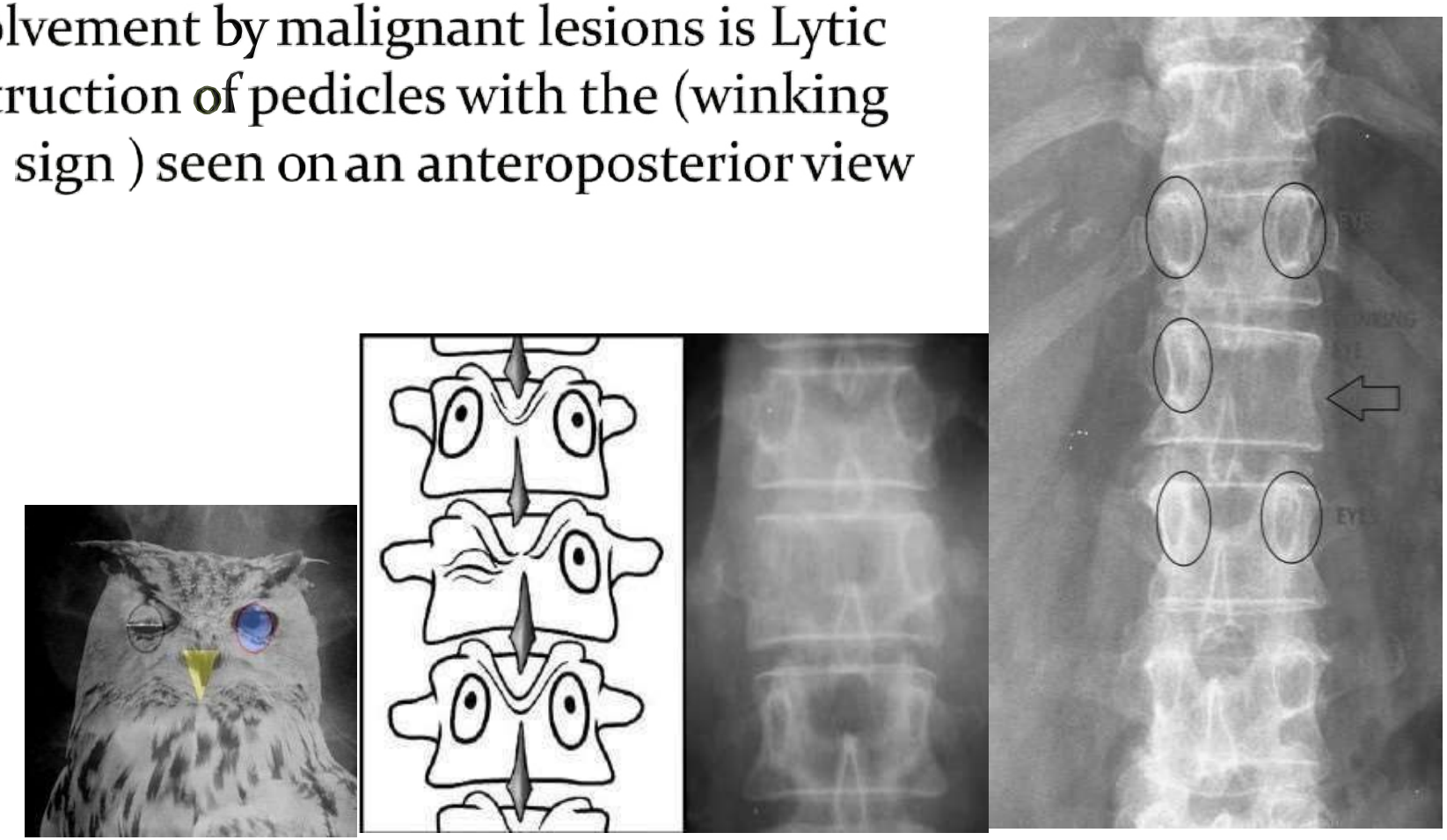
The first step imaging for a suspected spine tumor is plain radiographs

A tumor is detectable on plain radiographs only if

30 to 40% of vertebral body is involved

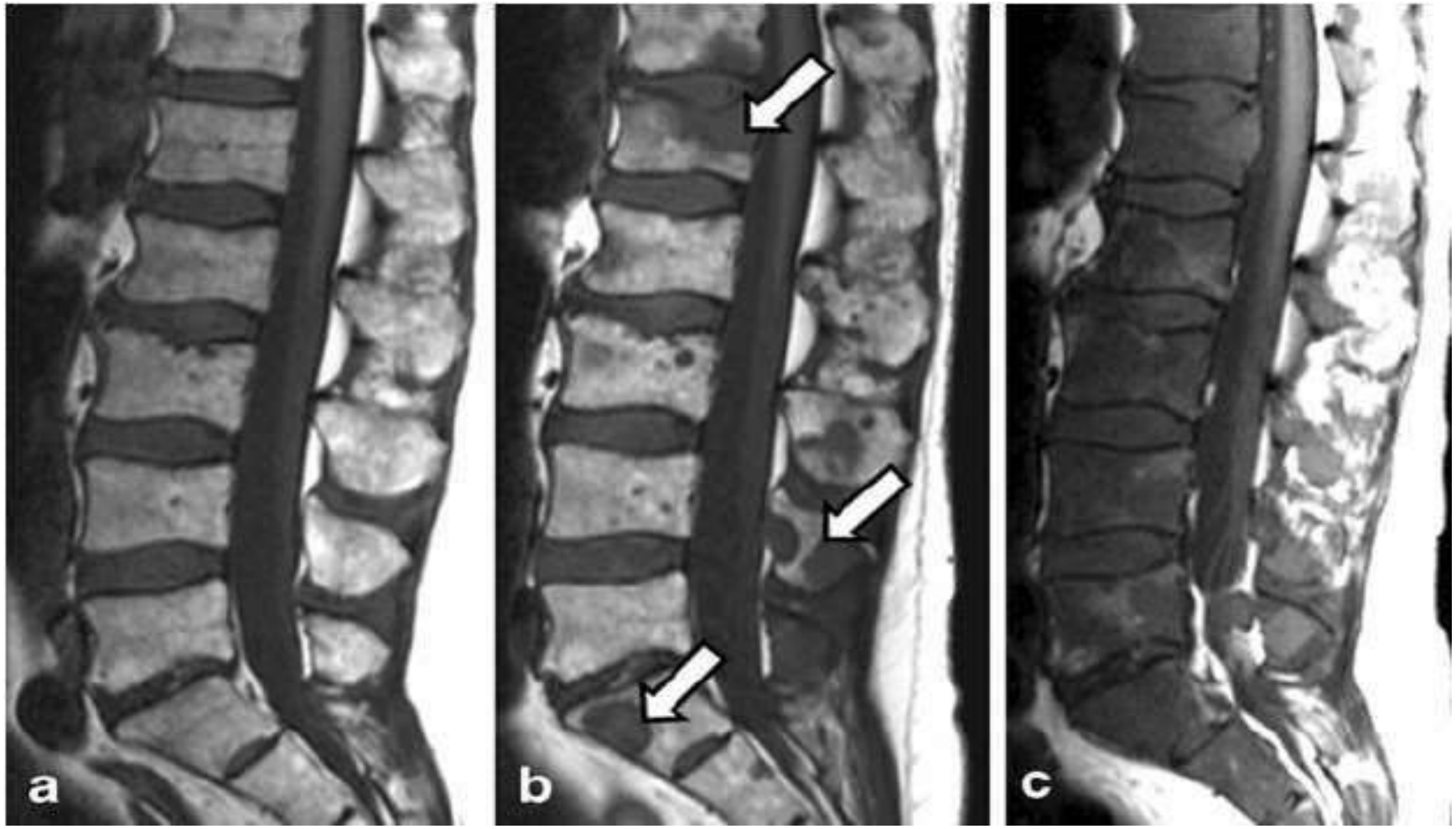
Neoplasms in the vertebrae can present as
osteolytic osteoblastic or mixed

The most classic early sign of vertebral involvement by malignant lesions is Lytic destruction of pedicles with the (winking owl sign) seen on an anteroposterior view



Magnetic resonance imaging

- Recommended for investigating the suspected lesions in terms of-
  - Level
  - Extent
  - Bone marrow infiltration
  - Infiltration to muscles, vessels
  - Infiltration to nerve roots, spinal cord & thecal sac

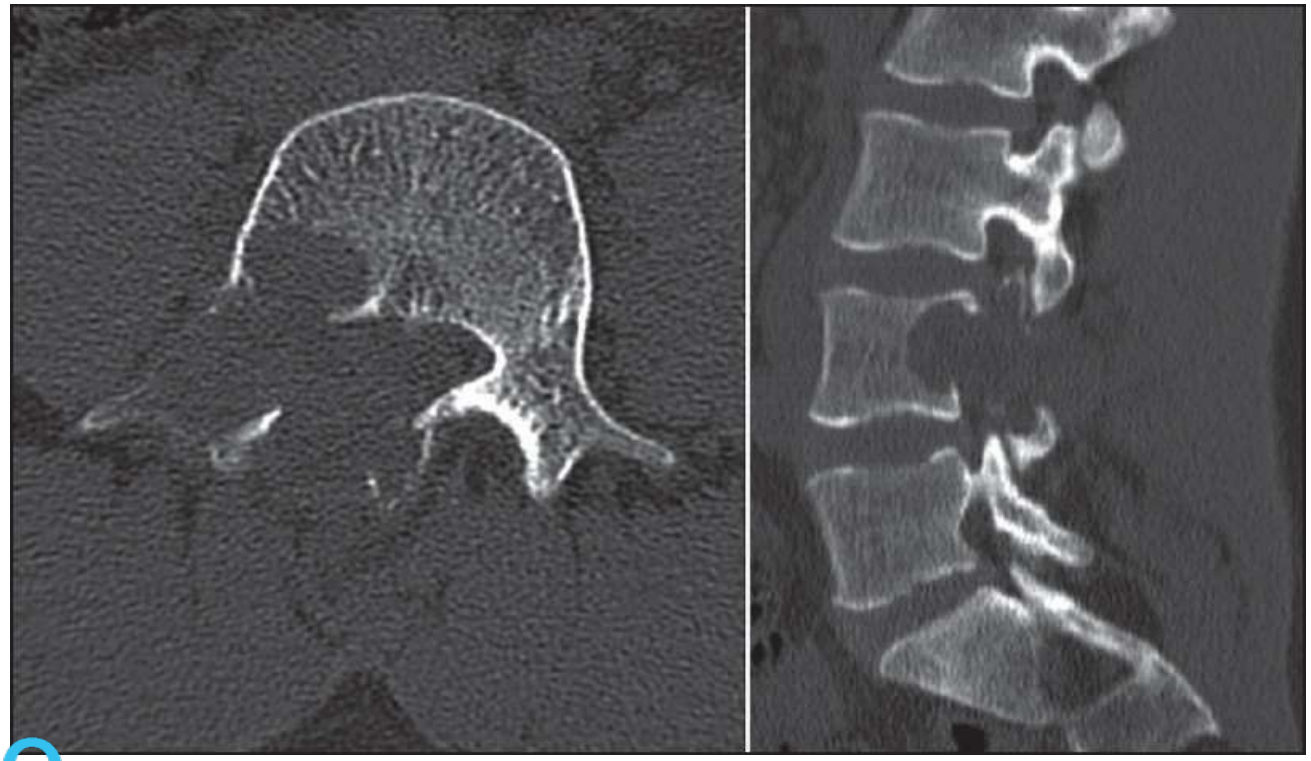


- M R I show Progressive metastatic disease to thespine

Computed Tomography:

In general, CT is more reliable in demonstrating the cortical outlines of bone and calcification in comparison to MRI.

It can better show the extent of the tumor destruction



CT scan of the lumbar spine showing destruction of the right pedicle, occur in aneurysmal bone cysts

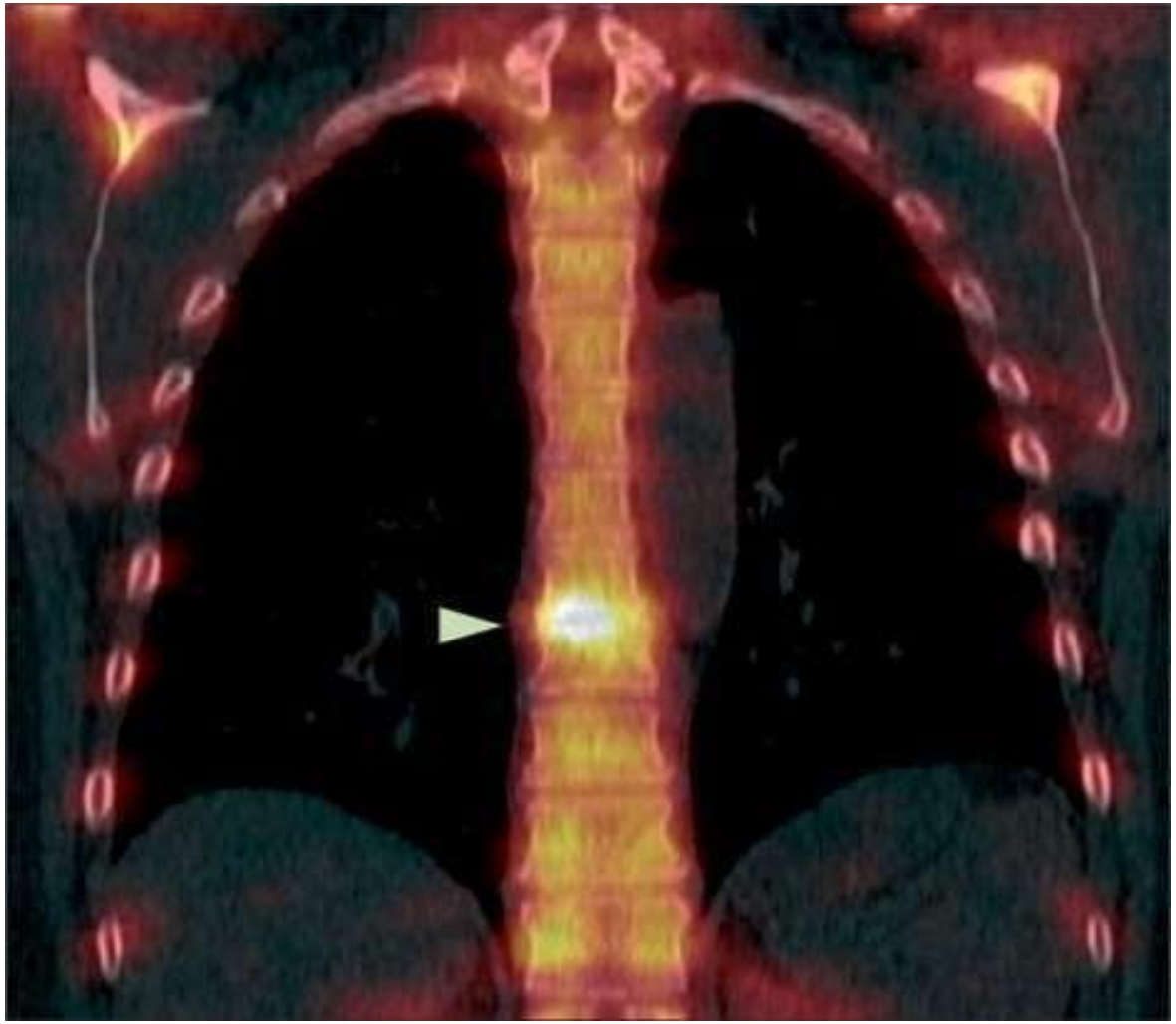
Radionuclide Studies:

- A technetium-99m bone scan is widely used in theinitial diagnosis and follow-up of bone tumors.

- Technetium scans are sensitive to any area of increased osteoid reaction to destructive processes in bones

- They can detect lesions as small as 2 mm, and as little as a 5–15% alteration in local bone turnover.

- They can identify changes 2–18 months earlier than x-ray.



Biopsy

- Diagnosis of a tumor is not considered definitive until a tissue sample obtained and histologically evaluated

Biopsy methods include percutaneous needle biopsy,open incisional biopsy, and open excisional biopsy

CT guided biopsy

Treatment

- Treatment of spinal tumor is a complex and it requires multidisciplinary approach .
- Contemporary treatment include surgery, radiation therapy and chemotherapy.
- Medical : Steroid , chemotherapy & radiotherapy
- Surgery : Minimal invasive surgery /Open surgery .

Operative Treatment:

The ultimate goal must be a “wide” and preferably an en bloc resection of the primary tumor in combination with a spinal reconstruction which allows for early mobilization.

The surgical techniques are classified by the tissue planes and approach as:

- curettage
- intralesional resection
- en bloc resection

Pre-requisite

Availability of

- Operating microscope
- Neuro-monitor
- Multi Disciplinary