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Imaging of the Lumbar Spine Neoplasms

Kambiz Motamedi,* Hakan Ilaslan,[†] and Leanne L. Seeger*

The most common lumbar spine tumors are metastatic disease, myeloma, and hemangioma. Primary osseous lesions of the lumbar spine are unusual. When encountered, they often exhibit characteristic imaging properties, aiding the radiologist to provide a short list of differential diagnoses. We provide a discussion of imaging appearance of lumbar spine neoplasms. Emphasis of this review is on osseous lesions. Few common neurogenic intradural, extraaxial lesions are also discussed.

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In a busy radiology practice lumbosacral spine imaging is one of the more commonly performed studies. The majority of these studies are obtained to investigate lower back pain.¹ The most common studies of the lumbosacral spine are radiographs and magnetic resonance imaging (MRI). In some cases a nuclear bone scan with or without single-photon emission computed tomographic (SPECT) imaging may be helpful to localize pathology to the posterior elements. When specific questions arise, especially in cases of suspected trauma or tumor, a computed tomographic (CT) scan may be requested.^{2,3}

It is not unusual for a radiologist to encounter both symptomatic and incidental spinal neoplasms. The majority of lesions are hemangiomas. The most common malignant neoplasms affecting the lumbar spine are metastatic disease and myeloma.

Occasionally one may be confronted with a primary tumor of the spine. This article intends to review the tumors of the lumbosacral spine from hemangiomas and metastatic lesions to primary neoplasms of different cell origins, such as notochord remnants, cartilage, bone, and various other types. Our aim is to provide the radiologist with a tool to effectively recognize these lesions and produce a short list of differential diagnoses.

Common Incidental Benign Neoplasms

Hemangioma

Hemangiomas are benign vascular lesions. The majority of hemangiomas of the bony spine are small, asymptomatic,

and found incidentally. They become symptomatic when they are large enough to cause compression fractures. Hemangiomas have been reported in up to 27% of all individuals undergoing spinal imaging. They are most commonly found in the fourth to sixth decades with slight female predominance. Most spinal hemangiomas are in the lumbar spine (40%) and are usually confined to the vertebral bodies. Occasionally they may extend into the posterior elements. They may be at multiple levels throughout the spine. A single lesion will not transverse the disk space.^{4,5}

Hemangiomas exhibit characteristic imaging findings, usually posing no diagnostic dilemma to the radiologist. Due to vascular nature and relative nonaggressive behavior of these lesions, they tend to be well defined on radiographs, commonly with sclerotic borders and sometimes with channel-like structures. The most commonly described feature of a hemangioma on radiographs is that of striation or corduroy appearance. This translates into the polka dot appearance on axial CT scans (Fig 1). With the advent of multidetector row CT, these lesions exhibit a similar look as in radiographs when viewing reformatted longitudinal planes. The histopathology of hemangiomas with high vascularity and interspersed fat also dictates these lesions' MR appearance. They usually exhibit high signal on fluid sensitive sequences, such as inversion recovery and fat-saturated T2-weighted, and an intermediate signal on short time of echo (TE) sequences. The fatty tissue interspersed between the vascular channels may be best seen on the short TE sequences (e.g., T1-weighting) as foci of high signal.^{6,7}

Metastatic Disease and Myeloma

Metastatic Disease

The most common malignant neoplastic disease of the lumbar spine is metastatic disease. The metastatic foci may be in

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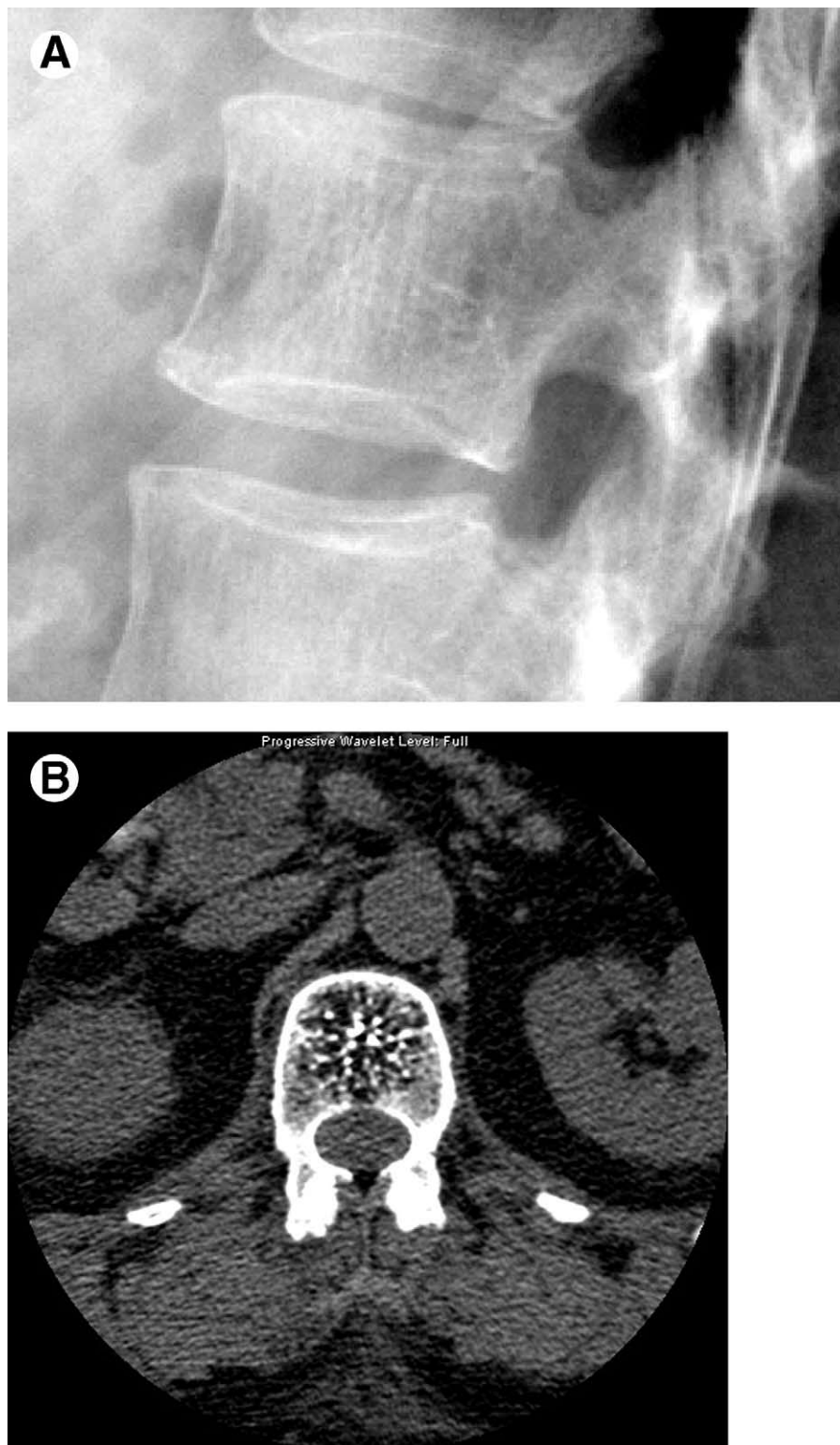


Figure 1 Vertebral Hemangioma. (A) A lateral radiograph demonstrates the striated appearance of the L1 vertebral body. (B) An axial CT section reveals the “polka dot” appearance of the hemangioma.

posterior elements or the vertebral bodies. The most common primary tumors are adenocarcinomas of lung, prostate, and breast. Because of the high red marrow content of lumbar spine and the affinity of metastatic implants for the reticuloendothelial system, other neoplasms with a tendency to

metastasize to bone may be seen in the lumbar spine as well. In a patient older than age 40, regardless of gender, metastatic disease should always be considered when a neoplasm of the spine is encountered.⁸⁻¹⁰

The recognition of metastatic disease is usually easy, as it

presents as multiple lesions. These lesions may be blastic or lytic. The blastic lesions present as so-called ivory vertebra on radiographs. The differential diagnosis for ivory vertebra is vast, and includes metastatic disease from prostate or breast cancer, Paget's disease, and rare conditions such as osteopetrosis or mastocytosis. The osteoclastic lesions cause lytic lesions of the bone. Examples include metastatic lung cancer and certain types of breast cancer.

The standard imaging management of metastatic disease starts with a technetium 99m nuclear bone scan. The bone scan is very sensitive for detection of foci of increased bone turnover; however, the specificity is low. Increased bone metabolism is present with other entities, such as fracture, infection, and degenerative disease. In the case of a known primary neoplasm, the diagnosis for a solitary focus of activity would be a metastatic deposit until proven otherwise. Radiographs should be obtained to further evaluate the area. Degenerative disease of the spine is quite common, deeming differentiation between tumor and degenerative changes necessary. Areas of increased activity that may correspond to the facet joints or disk spaces are likely due to degenerative changes.

If radiographs are unrevealing, CT scanning is usually indicated to characterize the bone lesion borders and possible mineralization. CT and MRI are able to evaluate for compression fracture and presence of a soft tissue mass, which may extend into the spinal canal (Fig 2). In some cases MRI may be helpful to differentiate between an osteoporotic and a neoplastic compression fracture. The latter tends to show complete replacement of the fatty marrow in the vertebral body and a possible soft tissue component that extends beyond the bone. Osteoporotic compression fractures may only demonstrate a band of marrow replacement representing edema. Obviously, the presence of multiple foci in the spine speaks for metastatic disease, whereas gradual return to the normal fatty marrow on follow-up studies indicates an osteoporotic fracture.¹¹⁻¹⁶

Lymphoma

Primary lymphoma of the bone is a rare disease, encompassing only about 1% to 3% of all lymphomas. Thus if a lesion of the bone proves to be lymphoma by histology, one should search for other systemic manifestations of lymphoma. The most common primary lymphoma of the bone is a non-Hodgkin lymphoma, with peak incidence in fifth to seventh decades and a strong male predominance (up to 8:1 male to female ratio). The spine is the fourth most common site for primary lymphoma following the femur, humerus, and tibia.^{17,18}

The imaging guidelines described above for metastatic disease are valid for lymphoma as well with one possible variation. Due to the infiltrative nature of lymphoma, one may see marrow invasion without a soft tissue mass. This may represent as intermediate signal on all MR pulse sequences. On CT subtle areas of disease may display patchy sclerosis.^{19,20}

Multiple Myeloma

Myeloma is a malignant plasma cell neoplasm of the bone marrow. Spinal lesions may be asymptomatic and detected

during myeloma work-up. When large enough they may cause compression fracture with pain and neurological symptoms. Generalized osteopenia is the most common osseous manifestation of myeloma. The male to female ratio is 3:2. The most common neoplasm of spine is myeloma with the majority occurring in the thoracic and lumbar spine.

The imaging characteristics of myeloma in lumbar spine are nonspecific. On radiographs and CT scanning one sees a lytic lesion with or without a soft tissue mass. On CT the appearance of the myeloma lesion has been described as a "mini brain." MRI is nonspecific and demonstrates replacement of the fatty marrow by a tissue with intermediate signal on short TE sequences and high signal on fluid-sensitive images.²¹⁻²⁴

There is one exception to this statement. In case of POEMS (polyneuropathy, organomegaly, endocrinopathy, myeloma, and skin changes) syndrome, the lesion may be sclerotic rather than lytic. This is best evaluated on CT (Fig 3). Treated myeloma, after chemotherapy and or radiation, may also exhibit sclerosis.^{19,25,26}

Chordomas and Cartilaginous Lesions

Chordoma

Chordomas are the most common primary malignant tumor of the spine. They arise from notochord remnants in the centers of the vertebral bodies. Recognizing a midline tumor in the vertebral segment would oblige one to include chordoma in the differential diagnosis. The clinical presentation depends on the location of the tumor. The tumors may present with nonspecific back pain, which may be accompanied with neurological symptoms. Chordomas commonly affect patients in the third to sixth decades, with equal gender distribution. They have been described to be more common at the cranial and caudal ends of the spine, that is, clivus and sacrum, respectively, but may occur at any level, with 35% arising in the lumbosacral spine.^{8-10,27-30}

The basic cell type of a chordoma appears soap bubbly under light microscopy (physaliphorous), thus dictating its imaging properties. It appears as a lytic lesion on radiography and CT scanning. On MR imaging this tumor exhibits intense high signal on fluid-sensitive images. This characteristic along with its midline location in an older patient aids in an accurate diagnosis for this lesion³¹⁻³⁵ (Fig 4).

Chondrosarcoma

Chondrosarcoma is a malignant cartilage-producing neoplasm. It is the second most common nonlymphoproliferative primary malignant tumor of the spine following chordoma. The patient may present with pain, neurological symptoms, and a palpable mass. The peak incidence is in the fifth decade, with men affected two to four times more frequently than women. The spine is affected in 3% to 12% of cases.^{8-10,36-38}

Radiographs may show destruction of the vertebral body,



Figure 2 Metastatic disease, adenocarcinomas of unknown primary. A sagittal T2-weighted fast-spin echo MR image shows a tumor of the L3 vertebral body with posterior extension.

posterior elements, or both. The characteristic chondroid matrix may be evident on radiographs, but better evaluated with CT. CT may also show a lower density of the cartilage lesion, when compared to muscle. CT and MR imaging both may demonstrate the osseous destruction, the soft tissue component, and the extent of the tumor in relation to the spinal canal and nerve roots. On MR imaging there may be intense high signal on fluid-sensitive images and lower signal intensity in comparison to muscle due to high water content of the hyaline cartilage matrix.^{39,40}

Chondroblastoma

Chondroblastoma is a benign cartilaginous neoplasm with a predilection for the growing skeleton. It usually presents with local pain. Chondroblastoma of the vertebral column presents in the third decade of life, a decade later than its appendicular counterpart. There is a male predominance (2-3:1, male-to-female ratio). The posterior elements of the spine belong to the rare sites of this lesion (1.4% of all chondroblastomas).¹⁰

This tumor often appears aggressive on imaging with a large soft tissue mass and significant spinal canal compro-



Figure 3 POEMS, multiple myeloma. An axial CT section demonstrates sclerotic lesions of the L2 vertebral body.



Figure 4 Chordoma. An axial T2-weighted MR image reveals a high-signal mass of the L2 vertebral body with compromise of the spinal canal.



Figure 5 Chondroblastoma. A sagittal contrast-enhanced T1-weighted MR image demonstrates an aggressive, enhancing lesion with posterior extension into the spinal canal.

mise. Radiographs are of limited value due to significant overlap of the osseous structures, even on the oblique views. A lytic lesion should be visible, prompting one to obtain a CT scan for further work-up (Fig 5). CT may demonstrate a geographic lesion with sclerotic borders and mineralized matrix with rings and arcs, typical of a chondroid lesion. This should suffice on imaging; however, since MR imaging is performed more often than CT for lower back pain, it is important to be familiar with MR imaging characteristic of chondroblastoma. As cartilage lesions they have a high water content, translating into very high signal on fluid-sensitive sequences, and tend to grow in lobules. The hallmark of chondroblastoma is its location in the posterior elements and surrounding marrow edema. The combination of an aggressive lesion makes chondroblastoma virtually indistinguishable from vertebral chondrosarcoma. In a younger patient with lower back pain, a chondroid lesion of the posterior elements, and surrounding marrow edema, chondroblastoma should be at the forefront of differential diagnosis.⁴¹

Osteoid Lesions

Osteoid Osteoma

Osteoid osteoma is a relatively common benign osseous lesion. The histological hallmark is a nidus, which is smaller than 2 cm. Clinically, the spinal osteoid osteoma presents with a painful scoliosis. The pain is worse at night, and is relieved with aspirin. It is a tumor of young patients in the first to third decades, with a male-to-female distribution of 1.5:2.⁸⁻¹⁰

The lumbar spine series may show a scoliosis, concave to the side of the lesion. CT scanning should then be performed for a careful search of a nidus. The nidus is usually a subcentimeter lytic area with a sclerotic center surrounded by periosteal thickening (Fig 6). Occasionally, vascular channels leading to this lesion may be seen adjacent to the nidus. As with other nonaggressive osteoid lesions, there is no need to obtain an MRI. In fact, MR may be misleading, as the nidus is commonly not evident. If visible, it appears as a low signal focus with extensive adjacent marrow and soft tissue edema.⁴²⁻⁴⁵

For pain relief the nidus usually has to be removed. This may be performed with image-guided transcutaneous radiofrequency ablation or with a surgical approach. In the latter case the radiologist may aide the orthopedic tumor surgeon by image-guided marking of the lesion with methylene blue, as the lesion may not be visible under a thickened cortex at time of operation. The distance of the lesion from a palpable landmark should be included in the CT report as well. There are data published on adequate conservative and symptomatic therapy of these lesions with aspirin, as they may have a natural history of involuting after an average of 2 years following first manifestation.⁴⁶

Osteoblastoma

Osteoblastoma is histologically similar to osteoid osteoma, however usually larger than 2 cm. It causes focal dull pain, at times with some neurological symptoms. Osteoblastoma is seen in patients in the first to third decades with a slight male predominance. Up to 40% of osteoblastomas are in the spine with equal distribution in the cervical, thoracic, and lumbar spine. They are centered in the posterior elements and may extend into the vertebral body.⁸⁻¹⁰

As with chondroblastoma, radiographs may show a lytic lesion of the posterior elements. CT then should be obtained to evaluate for an expansile lesion with a sclerotic border, which may have foci of calcifications representing an osteoid matrix (Fig 7). MR imaging would not add any valuable details. If done, MR would show the extent of the lesion and its relationship with the nerve roots and spinal cord. On MRI, they commonly exhibit edema of the surrounding marrow and soft tissues.^{43,47,48}

Osteosarcoma

Osteosarcoma is the most common nonhematological primary malignancy of bone and has been extensively documented in the appendicular skeleton. The mean age of inci-

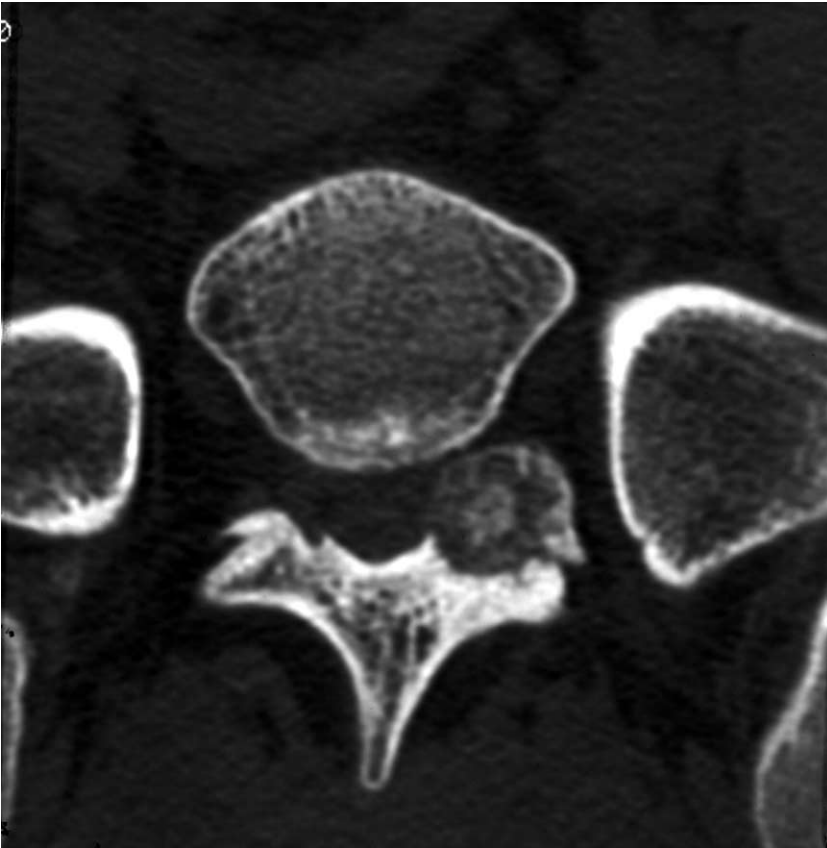


Figure 6 Osteoid osteoma. An axial CT section shows a lytic lesion of the left L5 lamina with a nidus.

Figure 7 Osteblastoma. An axial CT scan demonstrates an expansile tumor of the right T12 pedicle with an osteoid matrix.

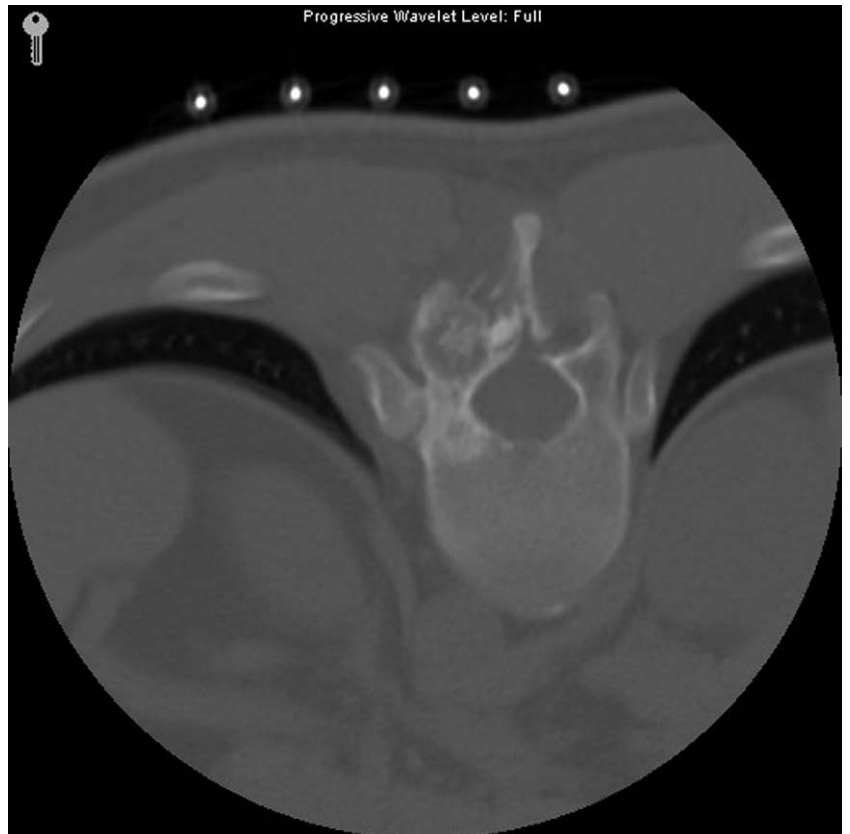


Figure 8 Osteosarcoma. An AP radiograph shows a lesion of the L5 vertebral body and transverse process with an osteoid matrix.



dence in the fourth decade, which is two decades later than the mean age of its appendicular counterpart. Radiation and Paget's disease are usually implicated in cases of vertebral osteosarcoma in elderly patients. The frequency of primary osteosarcoma in the spine was 4% in a recent study. The thoracolumbar spine is the most common site of origin, which comprises approximately two-thirds of cases. Involvement of the posterior elements with extension into the spinal canal is the most common pattern.⁸⁻¹⁰

On radiographs the tumors originating from the vertebral body may present as an "ivory vertebra." Most cases show some degree of osteoid mineralization (Fig 8); however, purely lytic tumors were also seen in the various subtypes such as telangiectatic. CT may demonstrate an osteoid matrix. CT and MR reveal the extent of the lesion. MR signal characteristics are frequently nonspecific.⁴⁹

Blue Round Cell Tumors

This group of lesions includes lymphoma, Ewing sarcoma (ES), Langerhans cell granulomatosis (LCG), osteomyelitis, and neuroblastoma. Lymphoma is also included and has been discussed elsewhere in this article. Neuroblastoma is a tumor of pediatric age and should not be included in a differential diagnosis list of lumbar spinal tumors for the adult patient. These lesions present histologically as uniform small blue cells. In long bones they have a tendency to affect the diaphysis and exhibit a similar radiographic appearance. In the region of the spine they may have distinct appearances.

Ewing Sarcoma

Ewing sarcoma was originally described as a tumor of the diaphysis of long bones that, in contrast to osteosarcoma, was sensitive to radiation. In some patients, initial symptoms may simulate disk herniation. Ewing sarcoma is most commonly seen in children and young adults with a peak incidence in the second decade of life. There is a male predominance similar to its appendicular counterpart. The lumbosacral

spine is the most common site of origin. Although vertebra is usually involved in metastatic disease, primary vertebral Ewing sarcoma is uncommon, with a reported incidence of 3.5% to 15% of all cases.^{8-10,50,51}

Radiography shows a typically lytic and aggressive tumor. Vertebra plana simulating Langerhans cell granulomatosis is a rare presentation. Cross-sectional imaging with CT and MR is most helpful to demonstrate the extent of osseous disease, soft tissue mass, and spinal canal invasion⁵²⁻⁵⁸ (Fig 9).



Figure 9 Ewing sarcoma. An AP radiograph demonstrates a lytic mass of the L2 vertebral body with destruction of the right pedicle.



Figure 10 Langerhans cell granulomatosis. (A) A lateral radiograph shows vertebra plana of the L2 vertebral body. (B) A sagittal T2-weighted fast-spin echo MR image demonstrates the posterior extension of the tumor. (Courtesy of Mark D. Murphy, MD, Armed Forces Institute of Pathology, Washington, DC.)

Langerhans Cell Granulomatosis

Langerhans cell granulomatosis (LCG), formally known as eosinophilic granuloma, is a benign bone lesion. The histological hallmark is the Langerhans granulocyte interspersed with lymphocytes, polymorphonuclear cells, and eosinophils. Clinically these lesions may be silent or present with a dull pain and rarely neurological symptoms. They are found in the first through third decades of life and are more common in male patients. LCG has classically been described in the skeletally immature patient before closure of the physis. Up to 20% of LCG cases are in the spine, more commonly in the thoracic and lumbar region. It is localized to the vertebral bodies with rare extension to the posterior elements.⁵⁹⁻⁶¹

On radiographs LCG presents as an ill-defined lytic lesion with a wide zone of transition. However, in the spine this entity may cause a flattened vertebral body, the so-called vertebra plana. Occasionally, the lesion heals on its own, with restoration of the normal height of the vertebral segment. CT scanning may show a lytic lesion with smooth periosteal reaction, absence of a soft tissue mass, or mineralization. MRI plays a limited role with the exception of demonstrating marrow and soft tissue edema⁶²⁻⁶⁵ (Fig 10).

Osteomyelitis and Infections

Osteomyelitis (OM) of the spine usually begins in the disk space with extension into the adjacent vertebral body. The spondylodiscitis may occur at any age, particularly in immune compromised patients. The hallmark of spine infection is destruction of the intervertebral disk with lytic ill-defined lesions of the adjacent vertebral bodies. While periosteal reaction is common in long bones, it may be absent in the spine. CT, especially with coronal and sagittal reconstructions, would further confirm these findings. MRI with contrast material is useful to demonstrate the marrow edema, disk destruction with enhancement, or abscess formation. It also shows the extent of inflammation in the surrounding tissues. In case of contiguous extension of the infection, an epidural abscess may be evident.⁶⁶⁻⁶⁸

Attention should be paid to the atypical infections. Spinal tuberculosis usually represents a secondary focus. Due to its insidious nature tuberculosis causes no or very little disk space changes (Fig 11). It tends to extend over several levels along the perivertebral tissues and ligaments, and may cause a perispinal abscess, usually in the psoas muscles (Pott's disease).⁶⁹⁻⁷¹ In the southwest region of the United States, coccidioidomycosis is a common cause of atypical spinal infections. Again the disk space

may be spared. Due to its nonaggressive behavior the bone reacts with sclerosis in an attempt to wall off the process.^{72,73}

Both radiographs and CT may show the relative sparing of the disk space with sclerosis of the adjacent vertebral bodies. CT along with MR imaging demonstrate mild changes of the disk space with foci of marrow replacement in the vertebral bodies. Cross-sectional imaging readily shows the perispinal and multilevel involvement of the disease.⁷⁴⁻⁷⁶

Tumors of Unknown Cell Origin

Giant Cell Tumor

Giant cell tumor (GCT) is an aggressive but benign lesion of bone composed of osteoclastic giant cells in a stroma of spindle cells. It presents with pain and possibly neurological symptoms. GCT may show dramatic growth in pregnancy. This tumor occurs in skeletally mature patients in the second to fourth decades. It is more frequent in females. Despite benign pathology, they may rarely metastasize, and they recur without complete resection. Up to 7% of GCTs occur in the spine, the fourth most common location for this lesion. The majority of spinal GCTs are in the sacrum. If lumbar, it is usually located in the vertebral body without significant extension to the posterior elements.^{8-10,77}

Radiographs show an ill-defined lesion with a narrow zone of transition, typically without a sclerotic border. CT demonstrates absence of mineralization and can further show areas of cortical destruction (Fig 12). MRI imaging usually shows a vertebral lesion of low signal on short TE sequences. The fluid-sensitive sequences may reveal an intermediate to low signal due to high cellularity of these lesions and internal hemorrhage. There is usually no marrow edema in the absence of a pathologic fracture.⁷⁸⁻⁸¹

Aneurysmal Bone Cyst

Aneurysmal bone cysts (ABC) are benign lesions with blood-filled cavities. There are many theories regarding the etiology of the ABCs. Some believe the ABCs are posttraumatic phenomena. Approximately 30% of ABCs are secondary lesions arising within other primary osseous lesions, such as osteoblastoma, chondroblastoma, and GCT. These lesions commonly occur in patients of younger age, within the first two decades of life with slight female predominance. The spine is a common location for ABC, with the lumbar spine ranking second in location after the thoracic spine.^{8-10,82}

The most striking radiographic feature of this lesion is an expansile remodeling of the posterior elements with an ill-defined lytic lesion, wide zone of transition, and no mineralization. CT further evaluates these features, confirming the absence of mineralization. As the lesion contains multiple fluid-filled cystic septations, CT and MRI may show the presence of such structures within the lesion (Fig 13). Of note is the appearance of ABC on bone scan, as the fluid-filled cystic lesion may show a photopenic center aiding in diagnosing this entity. This is of utmost importance in directing an image-guided biopsy toward a possible soft tissue component.⁸³⁻⁸⁵



Figure 11 Tuberculous spondylodiscitis. A sagittal T2-weighted fast-spin echo MR image reveals the high signal irregular disk space with paraspinal fluid. (Courtesy of Mark D. Murphey, MD, Armed Forces Institute of Pathology, Washington, DC.)

Degenerative Facet Disease

Usual degenerative facet disease does not impose a dilemma for the radiologist. The facet joint is a synovial joint, and as such, it may be affected with an array of arthritic changes. A synovial cyst may arise from the facet joint and encroach the thecal sac causing neurological symptoms. On radiographs the only finding is usually facet joint hypertrophy. CT shows the narrowed facet joints with osteophytes with an adjacent cystic structure. However, unless the cyst contains proteinaceous material, it would be isointense with the contents of the spinal canal and may not be as easily perceptible. Upon administration of intravenous contrast there may be enhancement of the cyst wall. MR imaging also reveals the cystic structure. The contents commonly follow the signal intensity of simple fluid⁸⁶⁻⁹⁰ (Fig 14).

Inflammatory and noninflammatory arthritides may affect the facet joints. Examples are rheumatoid arthritis, ankylosing spondylitis, amyloidosis, and nodular synovitis (pig-

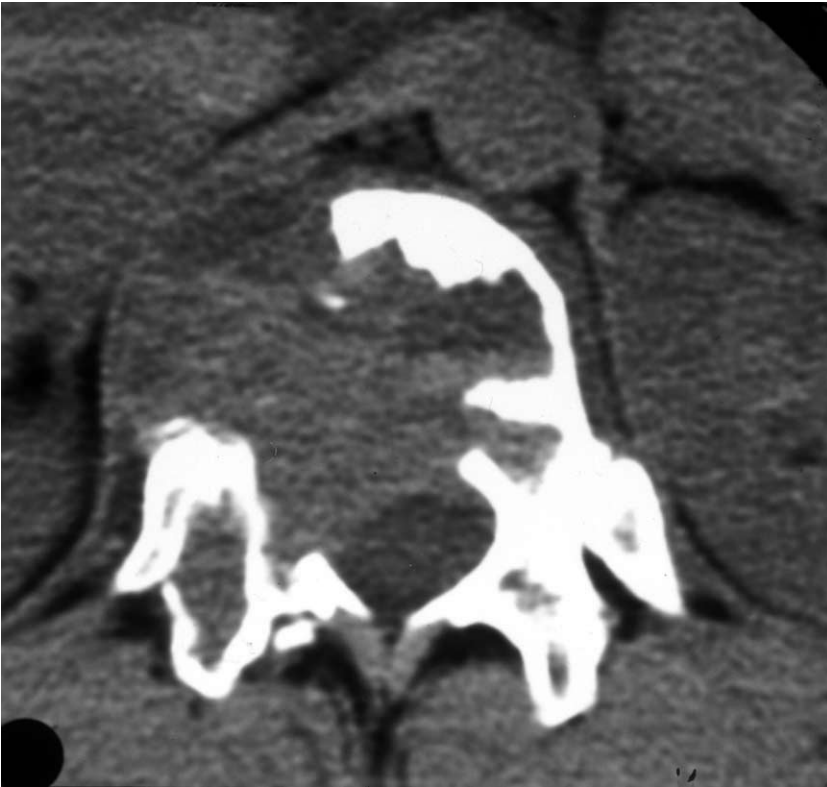


Figure 12 Giant cell tumor of bone. An axial CT section shows the lytic lesion of the T12 vertebral body with anterior and posterior extension.

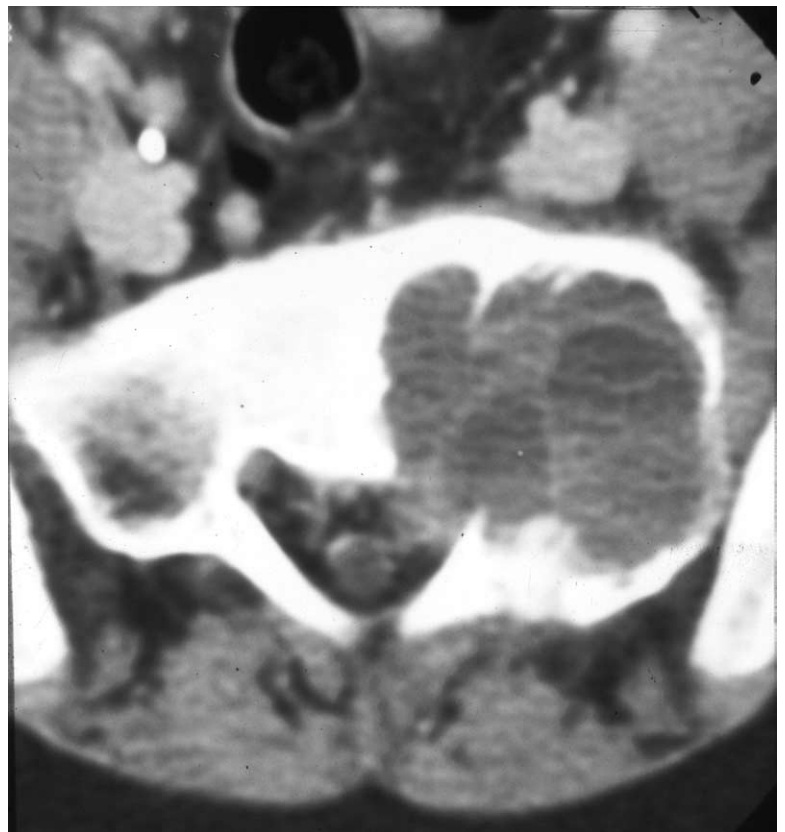


Figure 13 Aneurysmal bone cyst. An axial CT section demonstrates the lytic expansile lesion of the sacrum with fluid levels.

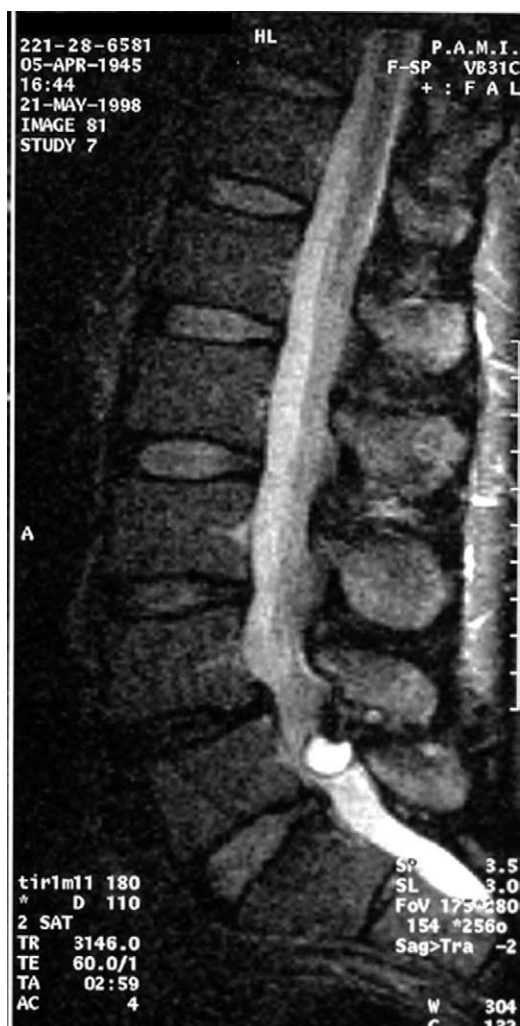


Figure 14 Synovial cyst. A sagittal T2-weighted fast-spin echo MR image shows the round cyst extending into the spinal canal. (Courtesy of Mark D. Murphey, MD, Armed Forces Institute of Pathology, Washington, DC.)

mented villonodular synovitis). With the exception of rheumatoid arthritis these entities are rare, and the patient's history usually directs the radiologist to a short list of differential diagnoses. The patient may present with pain and neurological symptoms, depending on the degree of synovial hypertrophy and osseous erosions.⁹¹⁻⁹⁶

Radiographs may show erosions along the facets. CT may be further helpful to localize the lesion to the facet joint. That is true especially in cases with less extensive synovial hypertrophy and joint destruction. MR imaging may reveal the hypertrophied synovium, and the extent of disease in relationship to the nerve roots and spinal canal.

Neurogenic

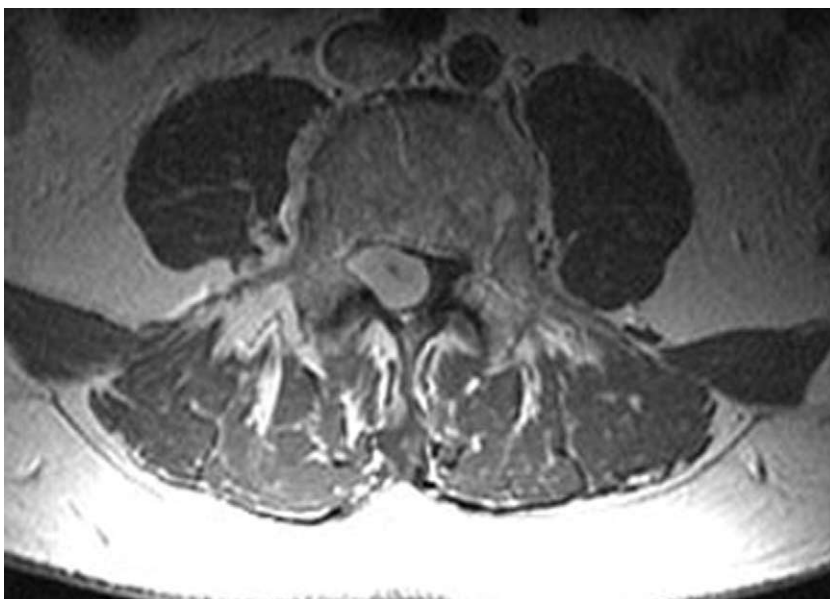
There is full array of neurological neoplastic disease that can affect the central nervous structures of the spine. The most common are schwannoma and meningioma.

Schwannoma and Meningioma

Schwannomas arise from the cells lining the nerve cells. Multiple schwannomas are associated with neurofibromatosis type II. Meningiomas of the spine are rare. They arise from the arachnoid cap cells. Patients may present with pain and neurological symptoms, depending on the size of the lesion. Meningiomas are a disease of the fourth through sixth decades and are more common in women.

When these tumors are located at the neural foramen, radiographs may show widening of the affected foramen. CT reveals an enhancing mass. Meningiomas may calcify. MR imaging reveals an enhancing mass with a nonspecific signal characteristic along the course of the nerve roots with a characteristic dumbbell shape, where the handle of the dumbbell corresponds to the neural foramen. They both show intense enhancement with administration of intravenous contrast⁹⁷⁻¹⁰² (Fig 15).

Figure 15 Schwannoma. An axial contrast-enhanced T1-weighted MR image reveals a soft tissue mass in the right L4 lateral recess. (Courtesy of Noriko Salamon, MD, David Geffen School of Medicine at UCLA, Los Angeles, CA.)



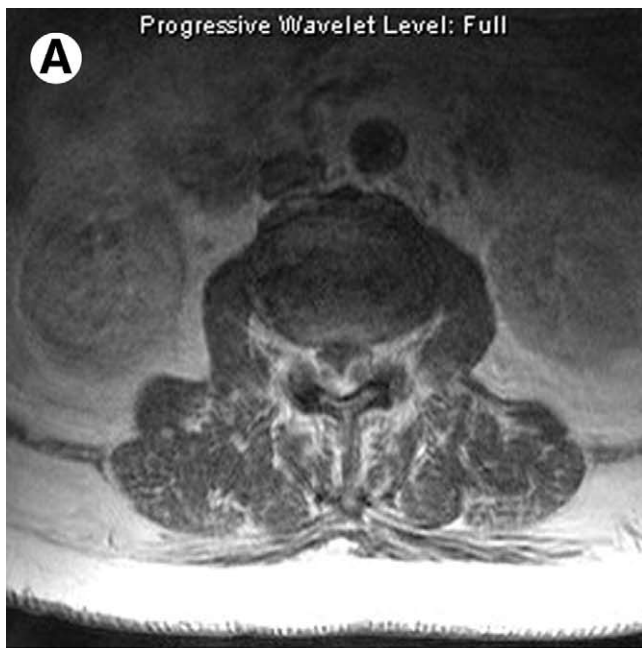


Figure 16 Epidural abscess. (A) An axial contrast-enhanced T1-weighted MR image shows a bilobed posterior epidural fluid collection. (B) A sagittal contrast-enhanced T1-weighted MR image demonstrates the longitudinal extension of this fluid collection from T12-L5.

Epidural Hematoma and Abscess

These entities are most often seen in postoperative patients of any age. The patients present with pain and a variety of neurological symptoms.

Radiographs are usually not helpful, and may only show the prior back surgery, such as laminectomy or spinal fusion. CT with its intrinsic poor soft tissue contrast has limited utility. MR imaging with intravenous contrast readily shows the epidural fluid collection with peripheral enhancement (Fig 16). Blood products may show blooming on gradient echo images. A differentiation between abscess and hematoma in a postoperative patient is usually not possible.¹⁰³

Lipoma

Lipomas of the filum terminale are common and are usually an incidental finding. Neurological symptoms are uncommon. They are a subtype of closed spinal dysraphism.

Radiographs are unremarkable. In cases of larger lesions, CT may show the low-density lipomatous lesion in the spinal canal. MR imaging also demonstrates a soft tissue mass, which strictly follows signal characteristics of fat. At the same time the MR imaging is helpful to evaluate for a tethered cord, which is commonly associated with a lipoma of the filum terminale.¹⁰⁴⁻¹⁰⁶

Tarlov Cysts

These are solitary herniations of the thecal sac into the sacral neural foramen. They are incidental findings and do not cause any neurological symptoms.

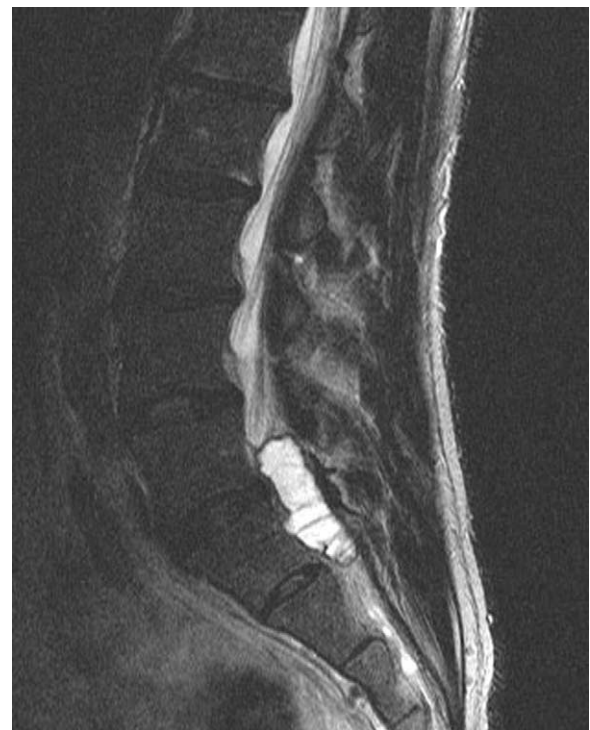


Figure 17 Tarlov cyst. A sagittal T2-weighted MR image reveals an arachnoid cyst extending into the spinal canal. (Courtesy of Noriko Salamon, MD, David Geffen School of Medicine at UCLA, Los Angeles, CA.)

Cross-sectional imaging may show widening of a sacral foramen containing a cyst-like lesion. MR imaging is specific, as these lesions are limited to the sacral region and contain cerebrospinal fluid^{107,108} (Fig 17).

Conclusion

The most common neoplastic diseases of the spine are metastatic disease, multiple myeloma, and hemangioma. They commonly affect multiple levels. In the case of metastasis, the patients present with a pertinent clinical history suggestive of the accurate diagnosis.

It is the primary osseous lesion of the spine that needs a special attention by the radiologist. These patients present often with nonspecific symptoms. Many of these lesions exhibit characteristic imaging findings. The information provided by the radiologist is invaluable. Cross-sectional imaging aids in planning a biopsy, staging of the tumor, and surgical planning.

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