DEGENERATIVE DISEASE AND INJURY OF THE BACK

Radiologic Examination of the Lumbosacral Spine

Louis Gilula, MD

RADIOGRAPHIC ANATOMY

Before showing you entities that may be seen on a routine radiographic lumbosacral spine examination, I would like to review briefly the radiographic anatomy of the normal spine. The vertebral body is normally concave on its anterior and lateral margins, and its superior and inferior surfaces, or end plates, are flat. Two pedicles arise posteriorly from the body and connect the vertebral body to the posterior elements. The pedicle unites the body to a posterior bone mass, of which the superior and inferior extensions are the superior and inferior articular facets. The bone between the superior and inferior articular facets is the pars interarticularis, or the isthmus. Two broad bony structures extending medially from the facets to join the spinous process are the laminae, and the transverse processes extend laterally from the superior articular facets at the level of the pedicles.

The lateral borders of the spinal canal are outlined by the pedicles on the anteroposterior view. On the lateral view, the posterior aspect of the body forms the anterior margin of the spinal canal, and the anterior surface of the laminae and the base of the spinous process form the posterior aspect of the spinal canal.

As is best seen in a lateral radiograph, the intervertebral disc spaces are the same width or become progressively wider between L_1 and L_4 and should not be narrower than the disc space above. The L_5 - S_1 disc space may be narrowed up to one-half the width of the above disc space without being abnormal. Our routine lumbosacral spine views include anteroposterior, lateral, both obliques, detailed lateral of the L_5 - S_1 disc space, and an anteroposterior up-angled view to profile the L_5 - S_1 space. Optionally stress views in lateral flexion and extension, and in anteroposterior lateral bending positions, may be obtained.

CONGENITAL ABNORMALITIES

Many congenital abnormalities and normal variants affect the lumbar spine, but I shall show you only three: spina bifida occulta, hemivertebra, and unfused inferior articular facet apophysis. Spina bifida refers to a defect in the vertebral arches, through which spinal membranes with or without dura and its contents may protrude. Patients with this type of defect may have neurologic symptoms. Spina bifida occulta (SBO) has a defect in the vertebral arch, but there is little or no protrusion of spinal membranes through this defect. Occasionally, the site of this defect may be identified on the overlying skin by the presence of a dimple or a hair. Radiographically, SBO is most common at L_5 - S_1, and less common at T_{12} - L_1 levels.

A hemivertebra is a bone comprised of part of a vertebral body and posterior elements, which may be separate or fused to an adjacent vertebra. This extra wedge of bone between two adjacent vertebra creates a scoliosis due to the additional bone on one side of the vertebral column.

ACQUIRED ABNORMALITIES

Of the numerous acquired lesions with radiographic findings, I shall present Schmorl's nodes, degenerative conditions of the spine, disc space infection, spondylolisthesis, isthmus defects ("spondylolysis"), diffuse idiopathic skeletal hyperostosis (DISH), and ankylosing spondylitis.

Schmorl's nodes are frequently seen throughout the thoracic and lumbar spine. These are defects in the cartilage end plates of vertebral bodies, through which disc material herniates. One idea about their development is that the cartilage end plates congenitally are weak in these individuals, and minor stress causes disc herniation through the weakened area, resulting in the typical radiographic appearance of a rounded defect in the end plate. The nodes may occur anywhere on the superior or inferior surfaces of the vertebral bodies. They are usually asymptomatic and without clinical significance, but some physicians feel that at the time the nodes formed, the patient had some discomfort. When vertebral end plate defects are sharp and at right angles to the disc, sickle cell anemia is a main consideration.

DEGENERATIVE SPUR FORMATION

As we walk erect, disc material normally compresses and bulges outward, and ligaments that are attached to the periphery of the vertebral bodies may be slightly elevated. Microhemorrhages may occur under these elevated ligaments, and bony spurs (spondylosis) may develop, even in the absence of a degenerative disc process. Weight bearing compression forces cause some of the fluid to be expressed from each intervertebral disc, so that daily we actually lose a small amount of height. In normal discs, the fluid is regained during sleep and rest.

Degenerative spur formation is found most commonly along concave portions of the spinal curves, as along the anterior thoracic spine seen on the lateral view of a routine chest examination, or along the concave side of a scoliotic curve. Degenerative spurs are usually not associated with clinical symptomatology, other than decreased range of motion.

DEGENERATIVE DISC DISEASE

Degenerative disc disease develops when the disc loses its structural integrity and begins to degenerate. As it degenerates, the patient may be asymptomatic; however, disc elements may herniate with or through a weakened annulus fibrosus, impinge on nerves, and produce neurologic symptoms. As the disc degenerates, it loses its cushioning effect, and the disc space may narrow with subsequent reactive changes of the opposing vertebral margins.

Reactive bone changes may be manifested as spurs larger than in an asymptomatic person, since the degenerating disc may bulge even more, elevating the adjacent ligamentous structures with more microhemorrhage and osteophyte formation. Bony sclerosis and thickening of the opposing vertebral margins may be present to a minimal or to a very extensive degree. An additional feature of degenerative disc disease is the presence of a vacuum phenomenon. With degenerated disc material there may be a potential space within fissures in the disc, which when distracted, for instance by hyperextension, fills with gas. This gas has been analyzed (1) and found to be 90%-92% nitrogen. Inert nitrogen readily goes into and out of solution at the tissue level, where it is more available than oxygen or carbon dioxide.

Reactive changes of degenerative disc disease involve both sides of a disc space. The cortical margins of the vertebral bodies are usually intact, although they can be very irregular. This can serve to differentiate degenerative disc disease from disc space infection. Disc space infection often has striking disc space narrowing, but usually there also is cortical destruction without hypertrophic spur formation.

DEGENERATIVE JOINT DISEASE (OSTEOARTHRITIS)

Degenerative joint disease is a condition where synovial joints undergo degeneration with hypertrophic bone formation and sclerosis of medullary bone. In the lumbar spine, the synovial joints are the apophyseal, or facetal joints. Occasionally, degenerative joint disease may be present without gross radiographic degenerative disc disease, and the opposite may also occur: degenerative disc disease may be present without gross radiographic degenerative joint disease. However, they generally occur together. Reactive bone formation may be very prolific, and indeed at times, hypertrophic bone formation along the apophyseal joints may simulate a fracture of the facet. With knowledge of this possibility laminograms may show that the facet in question is intact.

SPONDYLOLISTHESIS

Spondylolisthesis may develop from isthmus defects or from apophyseal degenerative joint disease in the absence of an isthmus defect. With increasing hypertrophic bone formation along the margins of the facet spaces, and with associated ligamentous laxity, the vertebral body above may move forward. An additional feature that appears to take place is alteration of the orientation of the facets. Over the years, the normal vertical orientation of the superior and inferior facets may become slightly more horizontal, helping spondylolisthesis develop. With spondylolisthesis and degenerative joint disease at the same level, degenerative disc disease is usually associated.

DIFFUSE IDIOPATHIC SKELETAL HYPEROSTOSIS (DISH)

A condition that probably is not familiar to most of you has been described recently in the radiologic literature (2,3) and in the Archives of Internal Medicine (4) by Doctor Resnick of the VA Hospital at San Diego. Historically, various features of this entity have been described as Forestier's disease, senile ankylosing

hyperostosis, and by several other names. In this condition, the disc spaces are normal, but there is extensive hypertrophic bone formation along the margins of the vertebral bodies, especially anteriorly and anterolaterally. In the past, huge bone formation in the cervical spine was described, which occasionally could cause dysphagia. In some cases, passing an esophagoscope tore the esophagus on these large spurs. Occasionally, surgical removal of spurs has been necessary.

Doctor Resnick examined many patients with this condition, found these patients to have an ossifying diathesis, and described them as "bone formers." DISH is felt to be present when (1) at least four vertebral segments are involved with "flowing calcification and ossification along their anterolateral aspects; (2) intervening disc spaces are relatively preserved; (3) apophyseal joints are not ankylosed; and (4) sacroiliac joints are not eroded, sclerotic, or fused."

These patients may have tremendous proliferation of ossification at ligamentous insertions practically anywhere in the body, but especially around the pelvis, hips, and calcaneus. Due to the large size of spurs and ankylosis, there can be limitation of motion. Other than occasional tendonitis, minor arthralgias and heel pain, the patients have little symptomatology. Potentially, it may be of value to recognize these patients as bone formers, so that if one of them has an operation near bone, one might expect more than the usual postoperative bone formation.

ANKYLOSING SPONDYLITIS

Typical, late stage, ankylosing spondylitis also fuses vertebral bodies, but without the prolific bony bridging of DISH. Ankylosing spondylitis may also fuse posterior elements and sacroiliac joints. Earlier stages of ankylosing spondylitis may present only with squaring of vertebral body corners, and may or may not have inflammatory changes of the sacroiliac joints.

MISCELLANEOUS

Old fractures may be recognized by vertebral deformities and and by smooth bony bridging of cortical fractures.

Neoplasms may be primary in the vertebral column. Osteoblastoma and osteoid osteoma are primary lesions common to the posterior

elements, especially in younger people. Osteosarcoma, the most common primary bone malignancy in young people, may also involve the spine. In persons over 40 years of age, metastases and myeloma are the most common malignant bone lesions, and they also affect the spine.

These are some of the common and uncommon lesions that may be seen upon roentgenographic examination of the lumbar spine.

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NIOSH Project Officer: Loren L. Hatch, DO, PhD
Principal Investigators: Theodore C. Doege, M.D.
Robert H. Wheater, M.S.

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