Lumbar Diskogenic Pain, Provocation Diskography, and Imaging Correlates

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KEYWORDS

• Diskography • Provocation diskography • Diskogenic pain • Annular fissure
• High intensity zone (HIZ) • Modic end plate change

KEY POINTS

- Diskogenic pain is the most common cause of axial back pain.
- Provocation diskography is the reference standard for the diagnosis of diskogenic pain.
- There is ultimately no pathoanatomic gold standard for diskogenic pain against which to measure the accuracy of provocation diskography or imaging.
- Provocation diskography requires reproduction of concordant pain with disk pressurization as well as grade 3 or 4 annular disruption.
- Careful analysis of MR imaging features can provide a reasonable prediction of the likelihood of diskogenic pain.
- There is no well-validated minimally invasive or surgical therapy for diskogenic pain.

Diskogenic pain refers to pain mediated by the intrinsic innervation of the intervertebral disk. It is experienced as pain centered at the symptomatic spine segment (axial pain) without radicular features or radiculopathy. There is no pathoanatomic gold standard for diskogenic pain; histologic examination cannot identify a painful disk. The current reference standard test for diskogenic pain is disk stimulation or provocation diskography. Provocation diskography remains controversial, invasive, and potentially harmful to the disk. There is an understandable desire for an imaging diagnostic standard for diskogenic pain. This article reviews the history of provocation diskography and its current use in the diagnosis of lumbar diskogenic pain. Provocation diskography technique is beyond the scope of this imaging issue. Rather, the extensive literature on imaging correlates of diskogenic pain is examined.

DISKOGENIC (AXIAL) BACK PAIN

Historical and clinical perspectives are important for imaging professionals to understand the essence of diskogenic pain. Mixter and Barr[1] described the prolapsed disk as a cause of low back and leg pain in 1934. Although the historical impact of that work was immense, many misinterpreted the study and believed disk prolapse to be the primary cause of back pain. In the following decades, many patients with disk prolapse (protrusion) and predominantly axial back pain were treated with surgical decompression (laminectomy and partial discectomy). The poor outcomes propelled the search for a more accurate diagnosis.[2]

Internal disk disruption (IDD) was first described by Crock in 1970.[3] IDD is the pathoanatomic process underpinning back pain arising from an intervertebral disk. As described by Bogduk

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elsewhere in this issue, IDD is an entity distinct from normal age changes in the disk, even though imaging manifestations may overlap. The condition usually follows a memorable event, such as a sudden axial load while lifting or shear and torsion forces transmitted to the spine during rapid acceleration incidents. The affected disks are rendered painful by pathologic changes of the internal disk structure, regardless of disk contour.

The clinical features are protean. Patients affected with severe IDD present with a variety of symptoms, but back pain is primary.[4] The dominant pain is midline and immediate paraspinous in the lumbar region. Pain spreading to the lower flanks and buttocks is a common complaint and may be unilateral or bilateral. The discomfort is generally characterized as deep and aching and is typically aggravated by axial loading, whether sitting or standing. Sitting intolerance is a major feature of the syndrome. Patients often extend both arms while sitting on an examination table, seemingly unloading their low back. There may be episodic sharp pain associated with trunk movements, which are usually guarded and often limited, especially in flexion. Many patients have difficulty recovering from standing flexion. They often assist recovery by placing their hands on their thighs and slowly climbing up to full upright position.

Although diskogenic pain is predominantly axial, somatic referred pain to the lower extremities is common. Lower extremity pain is usually unilateral but occasionally bilateral. Lower extremity pain associated with IDD is widespread, ill defined, and described as an intolerable ache deep in the limb. This is different from the radicular pain associated with disk herniation. Primary radicular pain is sharp, lancinating, electric in character, and usually well defined in a band-like distribution. Physical examination features of dural tension are usually absent in diskogenic pain. Abnormal neurologic findings are uncommon. There are often complaints of altered sensation, such as nondermatomal paresthesias, vague weakness, and descriptions, such as “my leg just gives out,” but objective motor or reflex changes are rare.

IDD is associated with psychological distress. Crock and Bedbrook[4] described psychological responses to the condition, including acute psychotic reactions and reactions to prolonged disease. Superimposed chronic illness behavior has been studied more recently and a patient’s psychological status is relevant in establishing an accurate diagnosis.[5]

DISKOGRAPHY

Iophendylate (Myodil or Pantopaque), an oil-based contrast agent, became available in the 1940s and was the preferred agent for myelography in Great Britain and the United States for the successive 3 decades. This allowed visualization of the thecal sac and its contents; the imager remained blind to the epidural space and internal disk structure. In cadaveric studies, Knut Lindblom,[6] a radiologist, injected “red lead”, a radiopaque material, into disks and recognized radial disk ruptures on radiographs. Seeking to develop a technique for direct study of the disk in patients with clinical signs of neural compression but normal lumbar myelograms, diskography was introduced by Lindblom in 1948.[7]

The first report of diskography in the United States was in 1951.[8] Cloward and Buzaid[9] subsequently described a technique and indications for lumbar diskography. In his classic 1960 monograph, Fernstrom[10] noted that back and leg pain could occur whether or not there is nerve compression, introducing the concept of radicular (mechanical or compressive) and diskogenic (biochemical or irritative) pain sources. This prefigures biochemical studies to be discussed later. Diskography in these early descriptions was a purely morphologic test, and it ultimately fell prey to the specificity fault seen in all spine imaging based on structure alone. Structural alterations are common, are generally asymptomatic, and increase with age.

PROVOCATION DISKOGRAPHY

Although the disk at this time was thought devoid of intrinsic innervation, diskographers began to report associations between morphologic abnormality and pain production during injection of contrast into the disk; morphologically normal disks were seldom painful, whereas disks with contour abnormalities or leaks into the epidural space were frequently painful.[11,12] Massie and Stevens[13] reported on diskography in 52 normal subjects and 570 patients; they noted that structurally abnormal disks were more common with advancing age but also occurred more commonly in patients than asymptomatic subjects. Structurally abnormal disks in control subjects were seldom painful during contrast injection, whereas in back pain patients a painful disk was frequently encountered. This introduced the concept of pain provocation as critical to the diagnosis of the painful disk.

Provocation diskography was dealt a significant setback by the methodologically flawed 1968 study of Holt,[14] which reported a false-positive rate of 37% in diskography performed on a cohort of asymptomatic prisoners. This was subsequently refuted in the more rigorous study of Walsh and colleagues.[15] In this study of patients and normal subjects, with careful blinding, only structurally abnormal disks in back pain patients were painful