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Although the incidence of low back pain is about 60 %, that of low back pain plus sciatica is only 1 %. Sciatica is most commonly due to herniation of a lumbar intervertebral disk. L4–L5 is the most frequently involved level, followed closely by L5-S1 and then L3–L4. Disk protrusions at other levels or at more than one level at any given time is rare. Other potential causes of sciatica include spondylosis, infection, neoplasm, and vascular disease. There is some controversy about the usefulness of surgery or nonoperative treatment in managing these patients. The majority of patients with lumbar disk herniations and sciatica will improve with conservative treatment and time. The natural history of lumbar disk herniations is very favorable. Today, there is a tendency to operate on these patients a few weeks after the onset of their initial symptoms, especially when minimally invasive surgical (MIS) techniques can be offered. Some surgical techniques have become so minimally invasive (micro-endoscopic discectomy), allowing their performance on an ambulatory basis [1]. It is our task, as consulted spine surgeons, to return a patient with sciatica in a prompt and effective manner to his or her previous level of function as soon as possible.

In this discussion we will cover symptomatology (sciatica), absolute and relative surgical indications, and risks and benefits of lumbar discectomy. In the following chapters, we will focus on the surgical technique of lumbar discectomy and on the surgical approach of extraforaminal lumbar disk herniations.

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27.1 Sciatica

Age-related factors affect the nucleus pulposus and secondarily the annulus fibrosus (see Chap. 3). These changes lead to the desiccation of the nucleus and a diminution of its property to act as semifluid. Morphologic findings are loss of elasticity, decrease in disk height, and a failure to distribute forces evenly [2, 3].

The initial symptoms of sciatica often follow no precipitating event or a seemingly trivial movement or maneuver and are typically not so incapacitating. Most of the time, they only consist of acute low back pain. At this moment, a fissure in the annular ring appears, which can be nicely demonstrated by magnetic resonance imaging (MRI) (see Chap. 21). As the inflammation (result of the annular fissure) progresses, the symptoms crescendo in a relentless fashion. Most patients experience paraspinal spasms directed at stabilizing the affected level. In some cases, the annular fissure gets bigger with a complete rupture of its ring as a result. At that time, part of the nucleus luxates through this annular defect and sciatica or cruralgia may occur. At that time the sciatica appears with radiating pain in the leg according to the dermatomal distribution of the affected nerve root. Through the annular fissure, the nucleus pulposus has protruded to a herniated fragment compressing the nerve root. The radiating pain is initially mainly the result of a mechanical compression of the nerve root. Not much later, the root becomes inflamed due to the mechanical trauma and the noxious substances that come free through the annular fissure. This inflammation can be dealt with during conservative treatment but is often responsible for a long-lasting, dull aching, burning limb pain, even when the nerve root is fully decompressed.

The initial goal of conservative therapy is to diminish the pain mainly due to inflammation. Standard conservative treatment consists of relative rest, nonsteroidal anti-inflammatory drugs, muscle relaxation, and, potentially, epidural steroids. There seems to be no significant difference in the outcome when conservative treatment is compared to the natural history of sciatica. However, in the acute phase, our patients will

appreciate all efforts to diminish their pain! After the acute onset of sciatica, more than 50 % of patients will improve significantly during conservative treatment after 2 months [4].

The diagnosis of a lumbar disk herniation can be confirmed by computerized tomographic (CT) scan or, preferentially, by MRI.

27.2 Surgical Treatment

27.2.1 Absolute Indications for Surgical Treatment

In my opinion there are three absolute indications for surgical treatment of acute sciatica/cruralgia due to a herniated lumbar disk:

- *The cauda equina syndrome.* In the presence of cauda equina compression with bladder and/or bowel incontinence (which is often not obvious at the time of admission) due to a lumbar disk herniation, urgent decompression of the cauda is mandatory. This is the only indication for urgent lumbar disk surgery. Every attempt to treat this disorder conservatively will end in court. A high degree of vigilance is required to diagnose this condition in an early stage. Although the evidence in support of early decompression is weak, we do advocate emergent intervention within 24 h after the onset of symptoms, when medically feasible [5]. Often, even after adequate surgical decompression with complete pain relief as result, bowel or bladder incontinence persists for months or even becomes permanent.
- *Weakness and sensory loss.* The presence of significant neurological deficits such as weakness and/or sensory loss, which affects 5–20 % of patients with acute sciatica/cruralgia, is a good indication for surgery without delay. It seems obvious that a neurological deficit due to mechanical compression of the nerve root will better resolve, the earlier the root can be liberated. Some authors have shown, however, that delays of up to 3 months have a minimal effect on the ultimate recovery of strength [6]. Moreover, no evidence exists that surgical

treatment yields better results than conservative ones, but no ethical committee will allow a randomized controlled trial (RCT) comparing these two treatment modalities in case of evident neurological deficit.

- *Severe persistent pain.* Clearly not all patients have the possibility to rest and undergo conservative treatment of their sciatica/cruralgia. Busy people with severe incapacitating leg pain due to a herniated disk fragment often urge us to find an immediate, yet elegant solution for their problem. The more surgery becomes minimally invasive due to microsurgical and endoscopic techniques and the more this surgery can be done on an ambulatory basis, the more it becomes an attractive alternative for relief of symptoms, even after the first week. As we will see later, the benefit of surgery consists mainly of the initial pain relief, rather than of the better long-term outcomes. The outcome after surgery at long term can be compared with conservative treatment and even with the natural evolution of a lumbar disk herniation.

27.2.2 Relative Indications

The American Association of Neurological Surgeons and the American Academy of Orthopedic Surgeons have listed, many years ago, seven criteria for patients undergoing surgical treatment for herniated lumbar disk disease:

- Failure of 2–4 weeks of appropriate conservative therapy
- Radicular pain in a dermatomal pattern
- Sensory loss in the same dermatome
- Weakness in the correct distribution
- Depressed tendon reflex appropriate to pain, weakness, and sensory loss
- Limited straight-leg raising with reproduction of radicular pain
- Abnormal neuroimaging (CT scan or MRI) consistent with the neurological deficits [7]

Today, these criteria are still valid. In those patients fulfilling these criteria, it's up to them-

selves whether they decide to get rid of pain by surgery or they prefer to wait for the results of conservative treatment. Weber reported a prospective RCT in which surgery was compared to conservative therapy. The study showed that, although surgery of lumbar disk herniations was superior to nonoperative treatment at 1 year, results at 4 and 10 years follow-up showed no statistical difference [8]. More recently, the SPORT trial concluded that patients in the surgical group yielded better postoperative results as compared to the non-operated group at 4 years follow up [9]. Although surgery may provide more rapid relief of pain, the ultimate result is approximately the same regardless of different treatment modalities, with long-term resolution of sciatica/cruralgia approaching 87 %.

Today, it is universally accepted that the majority of patients with sciatica/cruralgia due to a lumbar disk herniation will improve within 8 weeks of symptom onset with conservative management alone [10–13]. The issue currently under debate is what to do for the small percentage of patients who have unremitting symptoms after this time. Multiple, prospective RCTs have shown that patients with lumbar disk herniation and persistent radiculopathy who choose surgery, experience a substantial improvement in their symptoms in a shorter amount of time compared with patients undergoing nonsurgical treatment [10, 15]. It should be noted that similar improvements are seen in surgical patients regardless of whether a standard open discectomy or a microdiscectomy is performed [14–17].

27.3 Risks and Benefits

If, according to a 32-year-old study, but confirmed by well-performed more recently ones, there is no difference in outcome when surgery is compared to conservative therapy and if surgery always carries some operative risk, what then is its benefit? Clearly there is a benefit for the so-called absolute indications, especially the cauda equina syndrome. For the “relative indications” the benefit is early pain relief in comparison to conservative treatment. Therefore, it is better to

operate on a patient with acute sciatica lasting for 4 weeks than on one with chronic sciatica lasting for 6 months, since the latter may be close to the spontaneous resolution of the problems. The relative benefit of surgery will be rather small in this case. Additionally, recovery of the root might be problematic too, after mechanical compression lasting for 6 months.

Most patients are afraid of lumbar disk surgery, and they have always heard a story of someone who became paralyzed afterward. Although the theoretical risk of seriously damaging a nerve root exists, in practice it almost never occurs. The most serious risk of lumbar surgery, with an incidence of 0.04 %, is spondylodiscitis. It involves extreme low back pain occurring weeks to months after surgery and requires antibiotics for at least 6 weeks. Wound and superficial wound infection are minor risks (0.4 %).

Procedures for the removal of the herniated disk have two major goals: to relieve pain and symptoms immediately and to prevent recurrence. The first goal can be accomplished in more than 90 % of cases. The second is more difficult. The more the surgeon tries to prevent any recurrence, which implicates a near total disk removal, the more the intervertebral disk will collapse, resulting in instability and occasionally facet joint pain. The use of devices to prevent lumbar disk herniation recurrence, is still under investigation. Furthermore, recurrence of a herniated disk is not typically for operated patients: there is no difference in recurrence between operated and nonoperated patients [8]. The disk itself will degenerate once an annular fissure appears. Consequently, low back pain can occur due to disk degeneration in operated as well as in nonoperated patients. Therefore, for me, recurrence and persistent low back pain after conservative or surgical therapy is not a complication but is the logical consequence of the natural history of disk degeneration.

A major “complication” after surgery is the so-called failed back surgery syndrome, occurring in less than 1 % of all operated patients [18]. The origin is unknown, although intrinsic radiculopathy is the main problem. It can be caused by long-term nerve root compression, by surgical trauma to the root, or by postoperative arachnoiditis or a combination of these three. The syndrome

consists of a dull, burning pain in the limb, occurring weeks to months after surgery. Spinal cord stimulation may be of any benefit for about half of these patients [18] (see also Chap. 37).

27.4 Conclusions

Once a trial of conservative treatment has been attempted, it may be wise to proceed with operative intervention on a patient suffering from sciatica/cruralgia due to a herniated lumbar disk. With the exception of the absolute indications, we see that the relative indications become more popular because of minimally invasive surgery performed on an ambulatory basis. In these conditions the patient can benefit maximally from surgery because of the early relief of symptoms and his or her full recovery to previous functions. Nevertheless, the patient should be informed that the outcome over the long term is comparable to that after conservative therapy.

Editor's Note on Evidence

While our colleagues, the pain specialists, were able to do their job, we, almost 100 years after Mixter and Barr, are not able to demonstrate a high level of evidence that, in the case of a lumbar disk herniation, surgery is better than any other treatment modality. Surgical discectomy for carefully selected patients with sciatica due to lumbar disk herniation provides faster relief from the acute attack than conservative management, although any positive or negative effects on the lifetime natural history of the underlying disk disease are still unclear. According to the latest Cochrane review on this subject, there is now strong evidence on the relative effectiveness of surgical discectomy versus chemonucleolysis versus placebo and considerable evidence on the clinical effectiveness of discectomy for carefully selected patients with sciatica caused by lumbar disc herniation that fails to resolve with conservative management [19]. The evidence for other minimally

invasive techniques remains unclear except for chemonucleolysis using chymopapain, which is no longer widely available [19].

For interventional pain treatments, evidence does exist, although not one treatment modality reaches a level 1A evidence of efficiency. There is a level 2 B± that interlaminar steroid application (by infiltration) is beneficial when treating a lumbar disk herniation. When the herniation is a protrusion (contained), there is a level 2 B+ evidence that a transforaminal infiltration with steroids at the side and level of the herniation is beneficial. For extruded disk fragments, this technique has a level 2 B– evidence [20] (see Table 27.1).

Table 27.1 Evidence for interventional pain management of lumbosacral radicular pain [19]

Technique	Assessment
Interlaminar corticosteroid administration	2 B±
Transforaminal corticosteroid administration in “contained herniation”	2 B+
Transforaminal corticosteroid administration in “extruded herniation”	2 B–
Radio-frequency lesioning at the level of the spinal ganglion (DRG)	2 A–
Pulsed radio-frequency treatment at the level of the spinal ganglion	2 C+

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