INTRODUCTION

Lumbar disc herniation consists of displacement of the content of the intervertebral disc (the pulposus nucleus) through its external membrane (the fibrous ring), generally in its posterolateral region. Depending on the volume of herniated material, there may be compression and irritation of the lumber nerve roots and the dural sac, represented clinically by the pain known as sciatica. This pain has been known since ancient times, but its relationship with disc herniation was only discovered at the start of the twentieth century, when it was described by Mixter and Barr.

Today, disc herniation is the most common diagnosis among the degenerative abnormalities of the lumbar spine, and it is the principal cause of spinal surgery, especially among men around the age of 40 years.

This review had the aim of discussing the principal epidemiological, diagnostic and treatment aspects of lumbar disc herniation.

EPIDEMIOLOGY

Disc herniation occurs mainly between the fourth and fifth decades of life (mean age of 37 years), although it has been described in all age groups. It has been estimated that 2 to 3% of the population may be affected, with prevalence of 4.8% among men over 35 years of age and 2.5% among women over this age.

Because it is so common, it has become considered a worldwide health problem, because of the incapacity that it causes.

Although greater risk of disc herniation has been attributed to smoking and exposure to repetitive loads and prolonged vibration, studies have shown that the difference is small, when populations exposed to these factors are compared with control groups.
PATHOGENESIS OF SCIATICA

The origin of sciatic pain is probably multifactorial, involving mechanical stimulation of the nerve ends of the external portion of the fibrous ring, direct compression of the nerve roots (with or without ischemia) and a series of inflammatory phenomena induced by the extruded nucleus\(^\text{18}\).

The factor that triggers sciatic pain is the mechanical compression of the nerve root caused by the disc herniation. Consequently, the membrane is sensitized to pain through ischemia and other phenomena\(^\text{19,20}\). Studies have shown that the threshold of neuron sensitization for a compromised root is around half of what it is for non-compromised segments\(^\text{21,22}\).

There is a difference in the levels of inflammatory cell infiltration between extruded and non-extruded disc herniations, such that it is lower in the latter\(^\text{6,7}\). It is believed that rupture of the posterior longitudinal ligament caused by extruded herniation exposes the hernia to the vascular bed of the epidural space, and inflammatory cells originating from these vessels on the periphery of the herniated disc material may have an important role in irritating the nerve roots and inducing sciatic pain. This may explain why extruded herniations present greater clinical impairment and greater frequency of reabsorption\(^\text{7}\). Thus, it can be said that mechanical compression effects predominate in patients with contained herniation, while the inflammatory component predominates in patients with uncontained (extruded) herniation.

Clinical picture

The typical clinical picture of disc herniation includes initial lumbalgia that may evolve to lumbar sciatica (generally after one week) and may finally persist as pure sciatica. However, because of the large numbers of possible presentations of acute or chronic forms, a careful watch for atypical forms of presentation is needed, with readiness to conduct a differential diagnosis. Although disc herniation is the main cause of sciatic pain, other possibilities such as tumors, instability or infection need to be ruled out. Adequate physical examination is essential for this, and it may also include determining the vertebral space where the herniation is located, by means of careful evaluation of dermatomes and myotomes.

What is important to emphasize is that, in the natural history of sciatica due to disc herniation, the symptoms are greatly resolved after around four to six weeks. This is the reason why the initial treatment should always be conservative, and it needs to be explained to patients that the process has a favorable course.

Imaging diagnostics

Because radiography is routine and inexpensive, it should form part of the imaging evaluation. Although the clinical picture may be clear and suggestive of disc herniation, the possibility that other abnormalities detectable via radiography might coexist should not be forgotten. Orthostatic and dynamic examinations in flexion and extension are important complementary assessments for achieving an analysis of the spinal column that is more complete.

The first-choice examination method is magnetic resonance imaging (MRI). In Brazil, there is still an insistence on the use of axial computed tomography but, although this is capable of identifying disc herniation, it does not come close to the quality and even less so to the sensitivity of MRI. The detailed information on bone and soft tissue that MRI provides, which may help not only in achieving the correct diagnosis but also even in the therapeutic proposals, make this an indispensable examination for correctly assessing patients.

On MRI, hernias are classified according to their shape, as shown in the following summarized morphological description. The disc material, which comes mainly from the pulposus nucleus, is displaced beyond the intervertebral limits and may take on three different shapes: protrusion, extrusion or sequestration.

Protrusion is when the height of the hernia (in the axial slice) is less than the length of the base in any of the planes (Figure 1). Extrusion is when the length of the base is less than the height of the hernia (Figure 2), while sequestration is when there is no continuity between the herniated material and the intervertebral disc\(^\text{23}\) (Figure 3).

Protrusion may be focal, which is interpreted as focal protrusion, or broad and concentric, which is called concentric protrusion (the term bulging protrusion is also used in some reports) (Figure 4).
TREATMENT

Conservative treatment

Lumbar disc herniation is a condition that has a benign nature. The aim of the treatment is to relieve pain and stimulate neurological recovery, with early return to activities of daily living and to work. Young patients with sequestrated hernias and mild neurological deficits whose hernias are small, with little disc degeneration, are the ones who benefit most from conservative treatment\(^{(24)}\). Sciatic crises may be so severe that patients are incapacitated and, at such times, treatment should aim to gradually reduce the pain, while physical activity levels should be increased, avoiding absolute rest. NSAIDs are the medications that should be used most, since these exactly meet the physiopathological needs (which are basically problems of inflammation), while pure analgesics remain an additional therapeutic resource.

As mentioned earlier, the natural history of sciatica is characterized by rapid relief of symptoms over a mean period of four to six weeks, with recurrence in approximately 5 to 10% of the cases, regardless of the type of treatment administered\(^{(25)}\).

One alternative to help the conservative treatment is blockage of the affected root using anesthetics and corticoids. These act directly on the hernia, through reducing its volume, and on the root, through reducing its inflammatory response\(^{(26-28)}\). In a study carried out by the Spinal Surgery Group of Cajuru University Hospital, 70 patients with lumbar disc herniation and radiculopathy who had been presenting painful conditions for up to eight weeks were evaluated. After three months of blockage, 77% of the patients were asymptomatic. It could be concluded that transforaminal anesthetic blockage was an effective and safe alternative for treating sciatic pain secondary to lumbar disc herniation\(^{(29)}\).

In a systematic review of the literature on lumbar transforaminal blockage for treating sciatic pain, Buenaventura \textit{et al} found level II-1 evidence for short-term relief (six months or less) and level II-2 evidence for long-term relief (more than six months)\(^{(30)}\). Our preferred approach today is to start the treatment of acute pain using this type of blockage.

Conservative treatment includes support physiotherapy with analgesia and relaxation, particularly through exercises and stretching. There is no evidence to justify the use of electrical stimulation in its wide variety of forms (TENS); the published studies show that there are no significant grounds that establish any value for electrical stimulation\(^{(31)}\).
Surgical treatment

The aim of surgical treatment is to decompress nerve structures. The indications for surgical treatment are as follows:

- Absolute indications: cauda equina syndrome or significant paresis.
- Relative indications: sciatica that does not respond to conservative treatment for at least six weeks; motor deficit greater than grade 3; and sciatica for more than six weeks or nerve root pain associated with foraminal bone stenosis.

Over the last few years, there has been much discussion about the balance of advantages between early surgery and prolonged conservative treatment. There are published papers showing that the clinical results in the study groups were similar after two years of evolution, but that the recovery was faster in the group with early surgery. These authors have shown that surgical treatment is economically favorable, since it enables early return to work (32,33).

SURGICAL TECHNIQUES

Although traditional discectomy is still the technique used by some surgeons, minimally invasive operations have been gaining attention over recent years, while microdiscectomy may be a halfway position between the two endpoints (34).

Two surgical approaches have been proposed. There is no longer any place for the traditional surgery known as “laminectomy”. What is studied today is the relative advantage of minimally invasive or percutaneous procedures over microdiscectomy. The favorable results from microdiscectomy, both over the short term (length of the operation, bleeding, symptom relief and complication rate) and after 10 years of follow-up, still make this the preferred technique. Some studies comparing the two techniques have recently been published, but without being able to establish significant differences between them (35). In a randomized study that analyzed the two procedures over a two-year period, there was a result favoring microdiscectomy (36).

There has also been discussion about extensive removal of the disc fragments and curettage of the disc space, versus removal of the herniated fragments alone, with minimal invasion of the disc space (37,38).

Watters and McGirt (35) found evidence favoring removal of the herniated fragments alone, considering the duration of the operation and the return to work activities.

Comparing the two tactics, significantly greater incidence of lumbar pain was found when aggressive disc removal was performed than when the conservative technique was used (28% versus 11.5%). Biomechanical studies have demonstrated that larger lesions of the disc space accelerate the degenerative disease. Removal of greater amounts of the disc during the surgical procedure may be associated with worse long-term clinical results, with regard to the appearance of lumbalgia. However, there is greater recurrence of disc herniation, at a rate of around 7%, when the conservative technique is used (39-41).

This has an impact, especially in economic terms, when making a decision to perform additional, complementary surgery (arthrodesis or arthroplasty). There has been much discussion on whether this would only be applicable to young discs with a height that is still normal, in which instability could theoretically occur. Well selected cases with a history of significant previous lumbalgia and high discs could benefit from these procedures. However, it needs to be made clear that arthrodesis or arthroplasty do not have any place in the conventional treatment for disc herniation.

Preservation of the ligamentum flavum

After lumbar discectomy has been performed, there is a process of periradicular healing, with accumulation of fibrous material, in replacement for the peridural fat (42). This allows the roots and dural sac to be mobilized freely in the peridural space, without compression or adherences. Peridural fibrosis may attach the roots and dura mater to the surrounding tissue, thereby impairing nutrition and the dynamic activity of the segment. The changes to arterial and venous flow in structures sensitive to mechanical deformation, such as the ganglion of the dorsal root, has a considerable clinical impact that is manifested in the form of pain, paresis and paresthesia (43).

The ligamentum flavum forms an anatomical barrier for the roots, dura mater and epidural fat, through protecting these structures from the compression caused by the surrounding tissue. For this reason, its preservation may result in a better prognosis with regard to formation of epidural fibrosis following the discectomy (44).

An association between fibrosis and spinal operation failure syndrome (“failed back” syndrome) has been demonstrated in 24% of the cases (45).
Revision surgery to deal with this problem raises the risk of neurological lesions and has an unfavorable prognosis. Medical treatment of fibrosis is ineffective. Multiple surgical strategies and certain synthetic devices have been used to prevent fibrosis, but with unsatisfactory results. For this reason, prevention or inhibition of the formation of peridural fibrosis is considered to be one of the most important prognostic factors for success in the surgery.

Favorable assessments were made in a study conducted by the Spine Group of Cajuru University Hospital after a minimum of ten years of postoperative follow-up, and this was attributed to the microsurgical technique, among other factors. This technique included preservation of the ligamentum flavum (Figure 5). These results were similar to those published by Ozer et al. (46) and Askar et al. (47).

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**Figure 5 – Detail of suturing of the ligamentum flavum**

**CLINICAL RESULTS FROM DISCECTOMY**

The results from conventional discectomy have been variable. Over the short term, with two years of follow-up, 90% of the results have been found to be good. Conversely, in longer-term studies (six years), the proportion of unsatisfactory results has been found to be as high as 60% (41,47). However, in a methodologically important study for which the abbreviation is SPORT (48), it was demonstrated that patients with lumbar disc herniation and radiculopathy who underwent early surgery had better assessment results in relation to the parameters that were considered. This difference became significant after six weeks of follow-up, reached its maximum benefit after six months and was maintained for four years.

In the study carried out by the Spine Group of Cajuru University Hospital, an analogue pain scale and the Oswestry index were used to evaluate the results after ten years among patients who underwent discectomy. It was shown that 87.9% of the results were good, in relation to irradiated pain.

When only patients with more than 15 years of follow-up were included, the frequency of good results was lower. It was found that 21.9% of the cases presented moderate functional incapacity, which is related to progression of the underlying disease, i.e. degeneration of the intervertebral disc (34).

**OTHER METHODS**

Over the last few years, there has been a gradual trend towards treatments for disc herniation that are less invasive, including percutaneous decompression, laser decompression and, most recently, decompression using a bipolar radio frequency device, also known as nucleoplasty. Although these reduce the intradisc pressure, their real benefit is still a matter of controversy (49-51).

**CONCLUSION AND RECOMMENDATIONS**

Disc herniation is a pathological condition with an extremely benign course.

Conservative treatment is effective in 80% of the patients, within four to six weeks.

In cases in which pain is difficult to control, foraminal block is the best option.

Surgical indications should be proposed if conservative treatment fails, or if the neurological symptoms progress.

In such cases, microdiscectomy (under a magnifying glass or through a microscope) with preservation of the ligamentum flavum has been shown to be effective for preventing complications, avoiding peridural fibrosis and reducing symptomatic relapses.
REFERENCES

1. Mixter WJ, Barr JS. Rupture of intervertebral disc with involvement of the spinal canal. N Engl J Med. 1934;211:210-4.
2. Love JC. Removal of intervertebral disc without laminectomy. Proc Staff Meet Mayo Clinic. 1939;14:800.
3. Sammes RE. Diagnosis of ruptured intervertebral disc without contrast myelography and comment upon recent experience with modified hemilaminectomy for their removal. Yale J Biol Med. 1939;11(4):433-45.
4. Spangfort EV. The lumbar disc herniation. A computer-aided analysis of 2504 operations. Acta Orthop Scand Suppl. 1972;142:1-95.
5. Garrido E. Lumbar disc herniation in the pediatric patient. Neurosurg Clin N Am. 1996;7(4):149-52.
6. Mayer HM, Mellerowicz H, Dihlmann SW. Endoscopic discectomy in pediatrics and juvenile lumbar disc herniations. J Pediatr Orthop B. 1996;5(1):39-43.
7. Obukhov SK, Hankenson L, Manka M, Mawk JR. Multilevel lumbar disc herniation in 12-year old twins. Childs Nerv Syst. 1996;12(3):169-71.
8. Bortolotto A, Prata SD, Bonfim dos Santos G. Hernia discal em crianças e adolescentes: relato de cinco casos. Rev Bras Ortop. 1998;33(10):811-4.
9. Long DM, BenDebba M, Torgerson WS, Boyd RJ, Dawson EG. Hardy RW. Persistent back pain and sciatica in the United States: patient characteristics. J Spinal Disord. 1996;9(1):4-11.
10. Vroomen P, de Krom M, Wilmink J, Kester A, Knottnerus J. Diagnostic value of back pain in patients with sciatica from lumbar disc herniation: cost utility analysis alongside a randomised controlled trial. BMJ. 2008;336(7657):1351-4.
11. Battie MC, Videman T, Gibbons LE, Fisher LD, Manninen H, Gill K. Volvo Award for back pain and sciatica in the United States: patient characteristics. J Spinal Disord. 1996;9(1):40-58.
12. Urban JP, Roberts S. Development and degeneration of the inter-vertebral discs. Mol Med Today. 1995;1(7):329-35.
13. Battle MC, Videnem T, Gibbons LE, Fisher LD, Manninen H, Gill K. Volvo Award in Clinical Sciences. Determinants of lumbar disc degeneration. A study relating lifetime exposures and magnetic resonance findings in identical twins. Spine (Phila Pa 1976). 1995;20(24):2601-12.
14. Jones G, White C, Sambrook P, Elsman J. Alliette variation in the vitamin D receptor transmembrane domain affects response to cholecalciferol and lumbar spinal degenerative disease. Ann Rheum Dis. 1998;57(2):94-9.
15. Videnem T, Leppavuori J, Kaprio J, Battle MC, Gibbons LE, Pellonén L, et al. Intragenic polymorphisms of the vitamin D receptor gene associated with inter-vertebral disc degeneration. Spine (Phila Pa 1976). 1998;23(23):2477-85.
16. Annunen S, Paasitulsi P, Lohihiina J, Perala M, Pihlayamaa T, Karpinnen J, et al. An allele of C0L9A2 associated with intervertebral disc disease. Science. 1999;285(5426):409-12.
17. Deneer GH, Coulier SN, Meek LM, Maslen K, Wood J. A human-specific polymorphism in the coding region of the aggrecan gene. Variable number of tandem repeats produce a range of core protein sizes in the general population. J Biol Chem. 1997;272(21):13974-9.
18. Horton WE, Lethbridge-Cejku M, Hochberg MC, Precht P, Tobin JD, et al. An allele of COL9A2 associated with intervertebral disc disease. Spine (Phila Pa 1976). 2001;26(6):652-7.
19. Wolfram Gabel R, Beaussel R, Fabre M, Kehrl P, Dietemann J, Bouyjih P. Histologic characteristics of posterior lumbar epidural fatty tissue. J Neurosurg. 1996;3(1):2193-195.
20. Almmark K, Rydevik B. Pathophysiology of sciatica. Orthop Clin North Am. 1999;30(2):223-34.
21. Masopust V, Häller M, Netuka D, Brádác O, Rokyta R, Vrabec M. Postoperative epidural fibrosis. Clin J Pain. 2009;25(7):600-6.
22. Oyinlussi E, Chiba K, Toyama Y, Hirabayashi K. Long-term outcomes of standard discectomy for lumbar disc herniation: a follow-up study of more than 10 years. Spine (Phila Pa 1976). 2001;26(8):652-7.
23. Lupossav GA, Stamos K, Katonis PG, Sapkas G, Korres DS, Haritofalkis G. Seven- to 20-year outcome of lumbar disc herniation. Spine (Phila Pa 1976). 1994;24(22):2313-7.
24. Wolfram Gabel R, Beaussel R, Fabre M, Kehrl P, Dietemann J, Bouyjih P. Histologic characteristics of posterior lumbar epidural fatty tissue. J Neurosurg. 1996;3(1):2193-195.
25. Almmark K, Rydevik B. Pathophysiology of sciatica. Orthop Clin North Am. 1999;30(2):223-34.
26. Masopust V, Häcker M, Netuka D, Brádác O, Rokyta R, Vrabec M. Postoperative epidural fibrosis. Clin J Pain. 2009;25(7):600-6.
27. Ross JC, Robertson JT, Frederickson RC, Petrie JL, Obuchowski N, Modic MT, et al. Association between interlumbar scar and recurrent radicular pain after lumbar discectomy: magnetic resonance evaluation. ADCON-L European Study Group. Neurosurgery. 1996;38(4):855-61.
28. Ozer AF, Oktenoglu T, Sasani M, Bozkus H, Canbulat N, Karaarslan E, et al. Laser disc decompression: a systematic review of current evidence. Pain Physician. 2009;12(3):561-72.
29. Ashar Z, Wardlaw D, Choudhary S, Rege A. A ligamentum flavum in lumbar discectomy: a new technique that prevents scar tissue formation in the first 6 months post surgery. Neurosurgery. 2006;59(1 Suppl 1):ONS126-33.
30. Vialle LR, Vialle E, Martins Filho Filho DE. Seguimento de longo prazo após cirurgia de hérnia de disco lombar. Grupo de Cirurgia da Coluna, Hospital Universitário Cajuru, PUC-Pir. In: XII Anais do Congresso Brasileiro da Coluna, Foz do Iguaçu, PR, 2007.
31. Vialle LR, Vialle E, Martins Filho Filho DE. Follow-up of more than 5 years post lumbar discectomy vs. placebo for chronic low-back pain. Cochrane Database Syst Rev. 2008:CD003008.
32. Van den Hout WB, Peul WC, Koes BW, Brand R, Kivelj T, Thomeer RT; Leiden-The Hague Spine Intervention Prognostic Study Group. Prolonged conservative care versus early surgery in patients with sciatica from lumbar disc herniation: cost utility analysis alongside a randomised controlled trial. BMJ. 2008;336(7657):1351-4.
33. Peul WC, Van den Hout WB, Brand R, Thomeer RT, Koes BW; Leiden-The Hague Spine Intervention Prognostic Study Group. Prolonged conservative care versus early surgery in patients with sciatica caused by lumbar disc herniation: two years results of a randomized controlled trial. BMJ. 2008;336(7657):1355-8.
34. Vialle LR, Vialle E, Martins Filho Filho DE. Seguimento de longo prazo após cirurgia de hérnia de disco lombar. Jornal de Cirurgia da Coluna, Hospital Universitário Cajuru, PUC-Pir. In: XII Anais do Congresso Brasileiro da Coluna, Foz do Iguaçu, PR, 2007.
35. Watters WC 3rd, McGirt MJ. An evidence-based review of the literature on the consequences of conservative versus aggressive discectomy for the treatment of primary disc herniation with radiculopathy. Spine (Phila Pa 1976). 2009;34(3):931-9.
36. Vialle LR, Vialle E, Martins Filho Filho DE. Seguimento de longo prazo após cirurgia de hérnia de disco lombar. Grupo de Cirurgia da Coluna, Hospital Universitário Cajuru, PUC-Pir. In: XII Anais do Congresso Brasileiro da Coluna, Foz do Iguaçu, PR, 2007.
37. Vialle LR, Vialle E, Martins Filho Filho DE. Follow-up of more than 5 years post lumbar discectomy vs. placebo for chronic low-back pain. Cochrane Database Syst Rev. 2008:CD003008.
38. Van den Hout WB, Peul WC, Koes BW, Brand R, Kivelj T, Thomeer RT; Leiden-The Hague Spine Intervention Prognostic Study Group. Prolonged conservative care versus early surgery in patients with sciatica from lumbar disc herniation: cost utility analysis alongside a randomised controlled trial. BMJ. 2008;336(7657):1351-4.
39. Peul WC, Van den Hout WB, Brand R, Thomeer RT, Koes BW; Leiden-The Hague Spine Intervention Prognostic Study Group. Prolonged conservative care versus early surgery in patients with sciatica caused by lumbar disc herniation: two years results of a randomized controlled trial. BMJ. 2008;336(7657):1355-8.
40. Vialle LR, Vialle E, Martins Filho Filho DE. Follow-up of more than 5 years post lumbar discectomy vs. placebo for chronic low-back pain. Cochrane Database Syst Rev. 2008:CD003008.