

Lumbar Disc Herniation, Nucleo- and Sequesterectomy

9

Timing and Technique

N. A. van der Gaag and Wouter A. Moojen

9.1 Introduction

The objective of this case is to provide an update based on the current highest level of evidence on several aspects of one of the most commonly performed neurosurgical procedures, lumbar disc surgery for sciatica. Using a straightforward case we discuss the following issues: timing of surgery for sciatica, surgical approach of symptomatic disk herniation surgery (tube, transforaminal or microdiscectomy), and technique of removal (nucleo- and sequesterectomy).

9.2 Case Description

A 29-year-old female patient suffered from radiating leg pain for 6 months. The pain originated from the back to the lateral side of the

upper left leg, lower leg to the instep. Bending, coughing and sneezing led to aggravation of the complaints. She did not have back pain. Over the months the course of the disease was progressively worse. Her medical history consisted only of asthma. To reduce current complaints of pain she was prescribed paracetamol and opioids. The patient could not fulfill her job as a secretary due to the severeness of the pain. She did not try any other conservative therapy such as physiotherapy.

At examination the straight leg raise test was positive at an angle of 45°. A hypesthesia of dermatome L5 was present, but she had no muscle weakness. Deep-tendon reflexes were not different between left and right side.

Magnetic Resonance Imaging (MRI) demonstrated a hypointense signal intensity of the nucleus pulposus on T2 sagittal images at the level of L4-5 (Fig. 9.1). Disc height was nearly normal without the presence of upper and lower vertebral endplate changes. Within the disc level a clear herniated disc was present. On axial slices the disc protrusion obliterated the left sub-articular zone with clear compression of the left L5 root with flattening of the emerging root sheath (Fig. 9.2). All other disc levels had a normal disc contour and signal intensity.

For the duration of symptoms and progressive course surgery was proposed. The patient underwent removal of the symptomatic disk herniation through a minimal unilateral transflavial approach with magnification, with the patient under general anesthesia. An annular

N. A. van der Gaag (✉)
Haaglanden Medical Center, The Hague,
The Netherlands

Haga Teaching Hospital, The Hague, The Netherlands
e-mail: n.vandergaag@hagaziekenhuis.nl

W. A. Moojen
Haaglanden Medical Center, The Hague,
The Netherlands

Haga Teaching Hospital, The Hague, The Netherlands
Leiden University Medical Center, Leiden,
The Netherlands



Fig. 9.1 Sagittal T2 sequence of the lumbar spine showing a disc herniation at the level L4-5

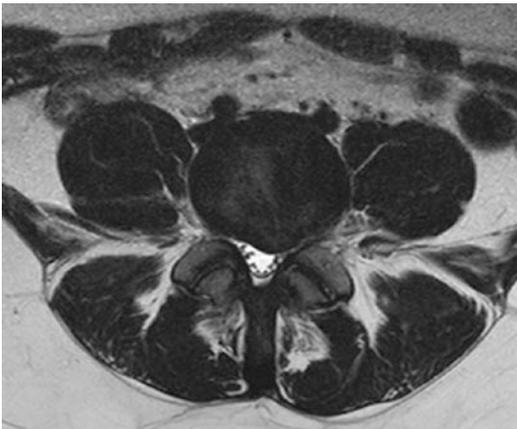


Fig. 9.2 Axial T2 sequence of a cross-section at the level L4-5 showing a paramedian herniated disc with compression of the left L5 root

fenestration was performed with curettage, and removal of loose degenerated disk material from the disk space with the use of a rongeur, without attempting to perform a (sub)total diskectomy.

She was discharged one day after the surgery in good condition. Complaints of pain had nearly completely resolved. At follow-up 2 months later the patient had a full recovery.

9.3 Discussion of the Case

Sciatica is defined as intense leg pain in an area served by one or more spinal nerve roots and can be accompanied by neurological deficit. The most common cause of sciatica is a herniated disc [1]. Lumbar-disk surgery is generally performed for patients with sciatica that does not resolve within 6–8 weeks. From the largest randomized controlled trial (RCT) on the subject it is demonstrated that surgery results in >80% improvement in pain and disability scores in the first weeks after surgery [1]. Early surgery provides relief of symptoms twice as fast compared to patients treated conservatively. However, compared to prolonged conservative care equal outcomes were observed at 1, 2 and even 5 years follow-up in this trial. It should be noted that, despite at least 6 months of conservative treatment, 46% of the conservatively allocated patients were treated surgically for persistent severe leg pain and disability [2]. Therefore, patients should be informed that prolonged conservative care gives them a good chance for resolution of pain and disability in the long run, without the need of a surgical intervention. This strategy carries a fair chance that waiting with pain still ends with surgery. Furthermore, an analysis of predictive factors demonstrated that, compared to patients with lower scores initially, those with more intense leg pain or higher disability scores were at higher risk to undergo delayed surgery.

Although it is generally presumed that late surgery is associated with less effectiveness and a higher chance of unsatisfactory outcome, due to more chronic changes around the disc protrusion or sequester, firm evidence is not (yet) available. From the RCT we found that early surgery resulted in a faster recovery of motor deficit accompanying sciatica compared with prolonged conservative treatment, but the difference was no longer significant during the final follow-up examination at 1 year [3]. Severe motor deficit at baseline (MRC grade 3) was a risk factor for persistent deficit at 1 year. A recent study suggest that immediate surgery resulted in higher recovery for severe paresis

(MRC gr 0–3) compared to delayed surgery [4]. In our presented case surgery was proposed for a 6-month period of pain without improvement without paresis, an example of an individual surgical decision process, complemented by patient preferences.

Magnetic resonance imaging (MRI) is considered the imaging procedure of choice for patients suspected of lumbar herniated discs. Both imaging and clinical findings determine the final decision of surgery. In a MRI study of the Sciatic cohort our group demonstrated that inter-observer agreement was excellent to predict the affected disc level (kappa range 0.81–0.86) and the nerve root (kappa range 0.86–0.89) [5]. However, generally moderate agreement was found regarding the characteristics of the impaired disc level and the herniated disc such as signal intensity of the nucleus pulposus, loss of disc height, absence of epidural fat adjacent to the dural sac or surrounding the nerve root sheath, flattening of the dural sac or the emerging root sheath, and nerve root thickness distal to the site of compression. Although the presented case is quite straightforward these study results prompt for a generally critical attitude towards this information normally enclosed in the radiology report. Therefore, to establish the indication for surgery requires clinical data and observation together with the necessary radiological information as only available to the clinician. Back pain, as discussed in the similar study mentioned above is not a prognostic indicator for good outcome after surgery neither did it correlate with the severeness of nerve root compression. No significant differences existed in prevalence of Vertebral Endplate Signal Changes (Modic) between sciatica patients with and without disabling back pain (41% vs. 43%, $P = 0.70$). No significant size differences were seen on preoperative MR images between patients with and without disabling back pain on there. Large disc herniations (size >50% of spinal canal) were observed in an equal percentage (18%) between patients with and without disabling back pain. Also, no significant difference existed in extrusions between patients with and without disabling back pain (64% vs. 67%, $P = 0.66$).

With the introduction of magnification, the original laminectomy for lumbar-disk surgery as introduced in 1934 was refined into open microdiscectomy, to date the most common procedure. The minimally invasive technique of intralaminar, transmuscular tubular discectomy was introduced in 1997 with the rationale of replacing the conventional subperiosteal muscle dissection by the muscle-splitting transmuscular approach of tubular discectomy. This should lead to less tissue damage, resulting in a faster rate of recovery but with similar long-term outcomes. Patients are expected to have reduced postoperative back pain, thus allowing quicker mobilization and contributing to shorter hospitalization and faster resumption of work and daily activities. In a large multicenter double-blinded (RCT) 167 patients were assigned to tubular discectomy versus 161 patients to conventional microdiscectomy [6]. The primary outcome was functional assessment on the Roland-Morris Disability Questionnaire (RDQ) for sciatica (higher scores indicating worse functional status) at 8 weeks and 1 year after randomization. Secondary outcomes were scores on the visual analog scale (VAS) for leg pain and back pain. At 1 year follow-up statistically significant differences for RDQ and VAS leg and back pain were observed in favor for the conventional microdiscectomy, but the differences did not reach published minimal clinically important differences. However, a 10% higher proportion of patients reported a perceived a good recovery at the final evaluation point of 52 weeks in the conventional microdiscectomy group [79%]. Therefore, the minimally invasive technique of tubular discectomy seems an attractive surgical method for treating sciatica, but these data do not support a higher rate of recovery when compared with conventional microdiscectomy. Furthermore, the conventional microdiscectomy had far lower recurrence rate (7%) compared with the tubular technique (11%).

The increase in minimally invasive techniques to access the disc or sequestered disc fragment have led to an alternative,

transforaminal route, the percutaneous transforaminal endoscopic discectomy (PTED). For this technique a lateral percutaneous technique is used to access the herniated disc through a small working channel that runs through the foramen. A systematic review comparing the conventional microdiscectomy technique with PTED included 3 RCT's and three retrospective studies [7]. With respect to the key outcomes of back pain, leg pain, function and general improvement there was moderate to low quality evidence of no differences PTED and conventional microdiscectomy. This finding was not affected by length of follow-up or inclusion of non-randomised studies. However, the authors concluded that studies comparing PTED with conventional surgery with sufficient sample size and methodological robustness are lacking. In The Netherlands a pragmatic, multicenter, non-inferiority, randomised controlled trial is currently running to determine the effectiveness and cost-effectiveness of PTED versus open microdiscectomy. Until these results become available we consider PTED as an experimental treatment option.

Another aspect of lumbar-disk surgery addresses the technique of removal of disc fragments only, sequestrectomy, or the removal of the disc fragments and disc materials in disc space, in this context called conventional microdiscectomy. Sequestrectomy may be particularly suitable for patients with a small annular defect. A potential disadvantage of sequestrectomy versus conventional discectomy is a higher presumed risk of recurrent disc herniation, potential advantages are more preserved architecture of the spine and less back pain after surgery. A recent systematic review identified 5 studies (746 participants) of sequestrectomy versus microdiscectomy of which one study was a RCT, the other 4 were nonrandomized prospective comparisons [8]. Sequestrectomy and standard microdiscectomy were associated with similar effects on leg and back pain after surgery, and functional outcome. Also complications and recurrence rate within 2 years after surgery were not different. Possibly the sequestrectomy was

associated with less postoperative analgesic consumption, with the reservation that all studies were assessed as being at a high risk of bias. The only RCT in this systematic review assessed health-related quality of life (QOL), which found sequestrectomy associated with higher (better) scores QOL scores. The authors suggest for this topic that well-designed randomized trials are needed to further clarify the effects of sequestrectomy versus microdiscectomy in patients in whom sequestrectomy is felt to be indicated. Studies with longer-term follow-up help to determine whether sequestrectomy is associated with an increased risk of recurrent herniation.

9.4 Conclusions and Take Home Message

To conclude, the abovementioned patient was treated with the (to-date) gold standard microdiscectomy technique with sequestrectomy only. PTED treatment is currently considered an experimental treatment option. Literature shows that prolonged conservative treatment is a valid option. Our patient was treated within six months because she initially preferred to treat her radicular pain conservatively. There is no clear scientific proof available which can help us physicians selecting the 'right' patient to go for surgery. Patients should therefore be closely involved to decide for the proper treatment.

Pearls

- early surgery provides relief of symptoms twice as fast compared to patients treated conservatively
- mild paresis (MRC grade 4) is not an indication for immediate surgery, for progressive and severe paresis (MRC grade 0–3) the option might be considered but amount of evidence is restricted
- back pain is not related to the severeness of the nerve root compression neither is

severe back pain prognostic for a good outcome after treatment

- sequestrectomy and standard microdiscectomy are associated with similar effects on leg and back pain after surgery, and functional outcome
- possibly sequestrectomy is associated with less postoperative analgesic consumption, with the reservation that available studies were considered high risk of bias
- tubular microdiscectomy is associated with a higher recurrence rate compared with conventional microdiscectomy and less treatment satisfaction
- PTED is an experimental option

Editorial Comment

This chapter summarizes in an excellent and sober fashion the state of the art knowledge regarding lumbar disc herniations in the year 2019. We strongly recommend to apply this knowledge outlined here in the counselling of patients with this common disease, especially because the level of evidence is extraordinarily high.

References

1. Peul WC, van Houwelingen HC, van den Hout WB, Brand R, Eekhof JA, Tans JT, Thomeer RT, Koes BW. Surgery versus prolonged conservative treatment for sciatica. *N Engl J Med.* 2007;356(22):2245–56.
2. Lequin MB, Verbaan D, Jacobs WC, Brand R, Bouma GJ, Vandertop WP, Peul WC, Leiden-The Hague Spine Intervention Prognostic Study Group, Peul WC, Koes BW, Thomeer RTWM, van den Hout WB, Brand R. Surgery versus prolonged conservative treatment for sciatica: 5-year results of a randomised controlled trial. *BMJ Open.* 2013;3(5):e002534.
3. Overvest GM, Vleggeert-Lankamp CL, Jacobs WC, Brand R, Koes BW, Peul WC. Recovery of motor deficit accompanying sciatica--subgroup analysis of a randomized controlled trial. *Spine J.* 2014;14(9):1817–24. <https://doi.org/10.1016/j.spinee.2013.07.456>. Epub 2013 Nov 5.
4. Petr O, Glodny B, Brawanski K, Kerschbaumer J, Freyschlag C, Pinggera D, Rehwald R, Hartmann S, Ortler M, Thomé C. Immediate versus delayed surgical treatment of lumbar disc herniation for acute motor deficits: the impact of surgical timing on functional outcome. *Spine (Phila Pa 1976).* 2017. (Publish ahead of print)
5. EL Barzouhi A, Vleggeert-Lankamp CL, Lycklama À Nijeholt GJ, Van der Kallen BF, van den Hout WB, Verwoerd AJ, Koes BW, Peul WC. Magnetic resonance imaging interpretation in patients with sciatica who are potential candidates for lumbar disc surgery. Paul F, editor. *PLoS One* 2013;8(7):e68411–11.
6. Arts MP, Brand R, van den Akker ME, Koes BW, Bartels RH, Peul WC. Tubular discectomy vs conventional microdiscectomy for sciatica: a randomized controlled trial. *JAMA.* 2009;302(2):149–58.
7. Kamper SJ, Ostelo RW, Rubinstein SM, Nellensteijn JM, Peul WC, Arts MP, van Tulder MW. Minimally invasive surgery for lumbar disc herniation: a systematic review and meta-analysis. *Eur Spine J.* 2014;23(5):1021–43.
8. Azarhomayoun A, Chou R, Shirdel S, Lakeh MM, Vaccaro AR, Rahimi-Movaghar V. Sequestrectomy versus conventional microdiscectomy for the treatment of a lumbar disc herniation: a systematic review. *Spine (Phila Pa 1976).* 2015;40(24):E1330–9.