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Recurrent pain after lumbar discectomy: the diagnostic value of peridural scar on MRI

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Abstract The association between peridural scarring and recurrent pain after lumbar discectomy is much debated. A recently published study found that patients with extensive peridural fibrosis were 3.2 times more likely to experience recurrent radicular pain than those with less extensive scarring. This finding may lead to an overestimation of peridural fibrosis in clinical practice. In a retrospective study we analyzed the records of 53 patients who underwent a lumbar MRI because of recurrent pain after first unilateral microdiscectomy. Patients were classified as those with radicular or non-radicular pain according to history and clinical findings. The diagnosis was confirmed by spinal anesthetic block. The extension of scarring was compared between the two groups of patients. The amount of epidural fibrosis was examined on contrast-enhanced MRI in axial slices subdivided into four quadrants. The amount of fibrosis was divided into four stages in each affected quadrant. We found no differences regarding the amount of peridural fibrosis between patients with radicular pain and patients with non-radicular pain. We conclude that the extent of peridural scarring as defined by MRI is of minor value in the differential diagnosis of recurrent back and leg pain after lumbar microdiscectomy.

Key words Lumbar discectomy · MRI · Peridural scar · Failed back syndrome · Diagnostic injections

Introduction

While the results of surgery for herniated lumbar intervertebral discs are good in most cases [5, 8], persistent or recurrent lower back pain and sciatica are a considerable clinical problem with an incidence of 10–20% [3, 5, 8]. When recurrent disc herniation or bony stenosis are absent and if scar formation is visible on MRI the pain is often ascribed to the fibrosis.

Although it is suggested that postoperative peridural scarring may be causal in as much as 24% of cases of failed back surgery syndrome [3, 37], evidence of an association between peridural fibrosis and recurrent radicular symptoms is still tenuous. The few studies of the problem are ambiguous. While most previous reports have disproved a correlation between peridural scarring and recurrent pain [1, 4, 13, 29], a recently published randomized, double-blind, controlled multicenter study found that patients with extensive peridural fibrosis were 3.2 times more likely to experience recurrent radicular pain than those with less extensive scarring. However, 83% of patients with extensive peridural fibrosis did not experience any pain at all [31].

The purpose of our analysis was to assess the value of peridural scar formation as defined by contrast-enhanced MRI in the differential diagnosis of recurrent pain after lumbar disc surgery. We compared the amount of epidural fibrosis between two groups of patients with recurrent back and leg pain after microdiscectomy. According to clinical findings and the results of additionally performed spinal anesthetic injections, we identified one group with

radicular pain and one group with non-radicular pain. An established method for quantifying the fibrosis was used to make our results comparable.

Materials and methods

Out of a total of 208 patients who underwent an MRI investigation because of recurrent back and leg pain after lumbar disc surgery, 53 patients (mean age 46 years, 25 men, 28 women) met the following criteria and were included in this retrospective study:

1. First lumbar microsurgical unilateral discectomy at a single level
2. Recurrent symptoms after initial relief of symptoms
3. Absence of recurrent disc herniation, of bony nerve root compression or of significant degenerative changes of the lumbar spine
4. At least a 6-month period between operation and the MRI investigation
5. Significant, at least transient, pain relief after either periradicular infiltration or infiltration of the sacro-iliac (SI) joint or the lumbar facets with local anesthetic.

The patients were divided into two subgroups:

1. *Radicular pain:* Those with clinical evidence of radicular symptoms (segmental pain distribution, diminished straight leg raising, sensory deficits) plus significant pain relief after anesthetic periradicular infiltration.
2. *Non-radicular pain:* Those with either (a) clinical evidence of SI joint syndrome (local pain, diffuse pain distribution in the groin and/or buttock, positive Patrick's test) plus significant pain relief after anesthetic infiltration of the SI joint, or (b) clinical evidence of facet syndrome (diffuse pain distribution in the low back region, greater trochanter and posterior lateral thigh, pain exacerbation by hyperextension of lumbar spine, local tenderness) plus significant pain relief after anesthetic infiltration of the lumbar facet joints or their capsules.

Spinal infiltrations were performed using standard techniques under aseptic conditions after administering local anesthetic with lidocaine. The correct locations were demonstrated by fluoroscopy.

Anesthetic injections of the nerve roots were performed peridurally or paravertebrally. For peridural nerve root block, a 23-G teflon insulated pole needle was guided through the interlaminar space as far laterally and caudally as possible to reach the nerve root as it curves laterally to exit through the neuroforamen. Microvoltage neurostimulation (0.1–1.0 V, 50 pulses/s) was performed to verify the correct position of the needle. Finally, 1 ml of 0.5% bupivacaine was injected.

For paraspinal nerve root block, a 23-G teflon insulated pole needle was introduced lateral adjacent to the neuroforamen. We performed microvoltage neurostimulation (0.1–1.0 V, 50 pulses/s) to confirm the correct position of the needle tip, after which 2 ml of 0.5% bupivacaine was injected.

Anesthetic injection of the SI joint was done with a 20-G spinal needle. The joint was approached in a medial to lateral direction, starting from 2 cm lateral to the midline of the upper sacrum, allowing the needle to pass beneath the overhanging posterior margin of the iliac bone. Instillation of contrast medium ascertained that the joint had been reached. Two to five millilitres 0.5% bupivacaine were injected.

For infiltration of the facet joints, a 20-G spinal needle was guided to the joint capsule in an oblique direction. Once the needle position was confirmed, 1 ml of 0.5% bupivacaine was injected.

The MRI examinations were performed using a spinal surface coil (FOV 25 cm) at a field strength of 1.5 T (Philips ACS NT). Slice thickness was 4 mm, matrices applied were 256 × 256 or 256 × 512. In all patients, sagittal T1-weighted spin echo images (TR/TE 500/15), sagittal T2-weighted images (4000/120) and axial T1-weighted images (500/15) before and within 3 min after administration of i.v. Gd-DTPA (0.1 mmol/kg body weight) were obtained.

MR images were evaluated by a neuroradiologist (M.F.) unaware of clinical findings and treatment groups. The scar was identified by early Gd-DTPA enhancement surrounding the nerve root or thecal sac [30, 40].

The extent of epidural fibrosis was analyzed according to the method of Ross et al. [31]: five contiguous axial slices (centered on the intervertebral disc) were subdivided into four quadrants, defined by perpendicular lines through the center of the thecal sac. The size of epidural scarring was classified into four stages for each quadrant at each slice:

1 = 1–25% of a quadrant filled with scar at one or more slices
2 = 26–50% of a quadrant filled with scar at one or more slices
3 = 51–75% of a quadrant filled with scar at one or more slices
4 = 76–100% of a quadrant filled with scar at one or more slices.

We referred to these values as 'maximum scores'.

In contrast to the study of Ross et al., our patients were operated unilaterally at one level only, so we investigated only the quadrant of the affected nerve root.

To examine the longitudinal extent of the fibrosis we added the maximum scores of all five slices of each patient. For this analysis we determined three degrees (summed scores) of scar formation: 1 = values 1–4; 2 = values 5–8; 3 = values 9–20.

The association of scar formation (maximum scores as well as summed scores) with the different groups of patients (radicular vs non-radicular pain) was tested using the Mann-Whitney rank sum test. The data of the SLR were normally distributed so we used Student's t-test. Severity of neurological signs was analyzed by the Chi square test.

Results

The demographics and selected clinical data of the patients are summarized in Table 1. According to the above-mentioned criteria, 27 patients (mean age 45 years, 12 men, 15 women) were classified as having radicular pain, 26 patients (mean age 48 years, 13 men, 13 women) as having non-radicular pain.

We found no significant differences between the two groups concerning residual paresis (Chi-square test, P = 0.3326), residual sensory deficits (Chi-square test, P =

Table 1 Clinical data and demographics of 53 investigated patients (*SLR* straight leg raising)

Gender	
Male	25 (47.2%)
Female	28 (58.8%)
Age (mean)	46.13 years
Operative level	
L3/L4	5 (9.4%)
L4/L5	26 (49.1%)
L5/S1	22 (41.5%)
Residual paresis	18 (33.9%)
Residual dysesthesia	44 (83.0%)
Reflex differences	38 (71.7%)
SLR angle (mean)	41° (SD 20°)

Table 2 Distribution of cases of peridural scarring across the different groups of patients (maximum score)

Score	Radicular group	Non-radicular group	Total
1	8	6	14 (26.4%)
2	7	7	14 (26.4%)
3	5	8	13 (24.5%)
4	7	5	12 (22.6%)

Table 3 Distribution of cases of peridural scarring across the different groups of patients (summed score)

Score	Radicular group	Non-radicular group	Total
1	9	8	17 (32.1%)
2	12	12	24 (45.3%)
3	6	6	12 (22.6%)

0.9505), reflexes (Chi-square test, $P = 0.6005$) and the mean values for the SLR test (Student's t-Test, $P = 0.601$).

The distribution of the various degrees of fibrosis (maximum values) in the two groups is shown in Table 2. Using the Mann-Whitney rank sum test, no significant differences were found ($P = 0.8398$). Table 3 demonstrates the distribution of peridural scar formation assessed by the summed score. We found no significant differences between the two groups of patients using the Mann Whitney rank sum test ($P = 0.8631$).

The mean interval between operation and MRI investigation was 31.9 months (min 6, max 90) in the radicular pain group and 25.4 months (min 6, max 95) in the non-radicular pain group.

Discussion

Peridural fibrosis is a natural consequence of discectomy. Although it seems obvious that scarring may cause pain by influencing neural structures [2] and the adherence of the nerve root to chronically inflamed tissue [33], its role in failed back surgery syndrome and the recurrence of sciatic pain remains a subject of debate.

While fibrosis has been reported to be the etiology of the failed back syndrome in a certain number of cases [9, 10], various studies found no relationship between epidural fibrosis and recurrent sciatic pain comparing symptomatic with asymptomatic patients after lumbar disc operation [1, 4, 13]. However, some of the recent studies have certain limitations. The report of Annertz et al. [1] was hampered by a small study sample. Grane et al. [13] found that the size of the scar more than 1 year after operation was similar in symptomatic and asymptomatic patients, but a number of patients had disc herniation as a probable cause of recurrent sciatic pain. Cervellini et al. [4] examined 20 patients with recurrent sciatica and 20 asymptomatic patients after lumbar disc surgery by CT without contrast medium. Meanwhile, contrast-enhanced MRI is the more accurate diagnostic tool in postoperative spine investigations [38]. Nygaard et al. [29] evaluated the association between the amount or enhancement of peridural scar formation and clinical outcome, but without considering the radicular origin of recurrent symptoms.

The premise that peridural scarring may cause recurrent radicular symptoms led to numerous studies on the prevention of fibrosis. In the context of an examination of an anti-adhesion-barrier-gel (ADCON-L®), Ross et al. [31] found in a multicentered randomized trial that an increasing amount of scarring led to significantly increased likelihood of experiencing recurrent radicular pain. This association was found only in a small subgroup of 20 patients experiencing recurrent radicular pain after discectomy. Only 14 of 84 patients with excessive periradicular scarring had any pain at all.

Repeat operations performed because of peridural fibrosis show unfavorable long-term results [9, 11]. However, some patients experience a transient relief of pain. This leads to the conclusion that in a number of patients fibrosis may cause symptoms, and investigations into the prevention of epidural scarring are necessary. Nevertheless, the results of Ross et al. [31] may lead to an overestimation of the pathogenic role of peridural fibrosis in clinical practice.

Postcontrast MRI has been established as the modality of choice for imaging patients with recurrent symptoms after disc surgery [14, 15]. Nevertheless, caution may be advisible in the interpretation of gadolineum enhancement in early postoperative MRI, because of the normal sequence of changes [39]. The degree and enhancement of the scar formation is dependent on time since the operation, and decreases within the first 6 months [12, 40]. Grane et al. [13] found that patients examined less than 1 year after surgery had more epidural scarring than those investigated after the first 12 months. We avoided analyzing MRI investigations within the first 6 months after surgery because of the risk of misinterpretations [40]. Between 6- and 12-months examinations few patients demonstrate changes in the amount of peridural scar, so an interval of 6 months between surgery and MRI seems to be sufficient for the assessment of postoperative peridural scarring [20].

The distribution of scar scores in our trial is homogeneous in both groups. This is a remarkable difference to the results of Ross et al. [31], where 42% of all patients demonstrated extensive scarring. Since the amount of fibrosis depends primarily on the extent of the surgical procedure [2, 19] this difference may be due to the microsurgical technique performed in our patients compared to the non-standardized surgical procedures in the trial of Ross et al.

An unequivocal diagnosis of radicular origin of pain is indispensable for an investigation into the association of

periradicular fibrosis with radicular symptoms. Recent studies used only clinical findings for defining recurrent radicular pain. However, in some patients with back and leg pain the interpretation of clinical findings remain unclear. Unilateral or bilateral lumbago, often with radiation into posterior thighs or even the entire lower limb, may originate in the SI joints [7, 35]. Irritations of the lumbar facet joints can mimic radicular symptoms with radiating pain down to the dorsal thigh, a diminution of the SLR test and even loss of the ankle jerk [26, 27]. On the other hand, neurological findings such as sensory deficits or abnormal reflex findings persist after successful surgery. The number of patients with residual neurological deficits such as dysesthesia, paresis or reflex differences was similar in both our groups of patients, emphasizing that, in isolation, evaluation of these clinical signs for defining radicular pain may lead to misinterpretations.

We used paraspinal anesthetic infiltrations as an additional tool to verify our clinical diagnoses of radicular or non-radicular pain. The diagnostic value of these procedures remains a matter of debate. North et al. [28] and Schwarzer et al. [36] demonstrated some limitations concerning the specificity of local anesthetic blocks in general. In contradiction to that, it is widely accepted that lumbar anesthetic injections are a useful test to indicate whether certain structures are responsible for pain. Periradicular blocks are demonstrated to have a high accuracy and diagnostic ability in the diagnosis of radicular pain [16–18]. Lutze et al. [23] found that periradicular injections had no significant influence on low back pain or pseudoradicular syndromes. Concerning sacroiliac joint pain, intra-articular anesthetic blocks are the diagnostic standard, and are superior to any provocation test [7, 24, 25]. Percutaneous facet joint injection is known to be a useful diagnostic procedure [22, 25] and Dreyfuss et al. [6] conclude that the "absolute diagnosis of lumbar zygapophysial joint-mediated pain is based on selective analgesic injections of these joints or their nerve supply." We think that the results of spinal blocks alone should not lead to a diagnosis. However, we agree that they can be undertaken as a step towards confirming the diagnosis of low back and sciatica. Our method is superior concerning the classification of pain compared to previous studies that used clinical aspects only.

The results of our study confirm previous studies that found no correlation between peridural fibrosis and recurrent symptoms after lumbar disc surgery. The amount of scarring was similar in both our groups of patients. We found no association between the extent of epidural scarring and radicular pain. In cases of recurrent pain after lumbar discectomy, even extensive peridural fibrosis is of little diagnostic value concerning the origin of pain.

Although there are always some limitations to retrospective studies, the data we analyzed were not influenced by this design. Clinical data were documented in standard manner, we used no quantification of pain, and only records that were complete and unequivocal were evaluated. The MRI evaluation was not affected, as the investigator was unaware of the clinical findings. The retrospective design made it possible to examine a relatively large number of patients suffering from recurrent pain after initial relief of symptoms, which is probably a very small group [29, 31].

Conclusions

Information concerning the presence or extent of peridural scarring is of little value in the differential diagnosis of recurrent pain after lumbar disc surgery. The pathogenic role of peridural scarring as defined by MRI remains unclear. An overestimation of the effect of peridural scar in recurrent pain after lumbar discectomy should be avoided. The differential diagnosis of nonradicular pain should be kept in mind before recurrent symptoms are ascribed to peridural fibrosis on MRI.

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